

The economics of peace and war: a simulation

JOHN BALDWIN

*Department of Social Relations, Johns Hopkins University*¹

Introduction

In a social system, there are three ways in which an individual can go about obtaining a given object that he wants that belongs to another. He can offer to the other person goods, services, gratitude, status, etc., in exchange for the desired object; he can attempt to take it from the other person by force; or he can threaten to use force. Since in the following study it was not possible to keep accurate records of the use of threats, this paper will focus primarily on the economics that underlies peaceful trade and war.

Both means of obtaining goods from others are very common on all social levels from the interpersonal to the international, and vastly different value judgments are made about the relative rightness and wrongness of the two methods by different people in the different situations. Some individual psyches, social groups, and nations advocate theft, whenever feasible, as a proper strategy for acquiring goods from outsiders; whereas other psyches, groups, and nations argue against theft in general as

wrong. It is of both great theoretical and great practical importance for sociologists to understand what circumstances lead an actor to choose one of these two basic strategies for obtaining a desired object.

The purpose of this paper is to pose and examine the question, "What are the factors that operate in determining which strategy, theft or exchange—war or trade—an actor will use in his attempt to obtain a desired good from another?"

This question has much in common with other important questions in social theory. Both Thomas Hobbes' question of why there isn't a war of every man against every man, and the questions of why there are behavioral norms and how those norms came into existence can be analyzed by isolating the "factors that operate in determining which strategy, theft or exchange, war or trade, an actor will use." The present analysis will be based on the assumption that the actor is rational and operates to maximize his self-interest, and the paper will attempt to cope with those aspects of social theory relevant to the main question at hand.

Part I of the paper describes a game used in studying the theft-exchange question. Each player in the game represents a nation that wishes to obtain goods from other nations and can do so by either war or trade. Part II is an economic analysis

¹ Now with the sociology department at the University of California (Santa Barbara). This investigation was supported in part by a Public Health Service Fellowship (1-F1-MH-29, 131-1) from the National Institute of Mental Health, and in part by a grant from the Carnegie Corporation, New York.

of the various strategies that actually developed as the game was played by a group of undergraduates. Several factors that operate in determining the various game strategies will be isolated and examined. And in Part III, those factors isolated in Part II will be drawn together in the context of the major question of the paper.

I. The Peace and War Game

In an article, "Collective Decisions," Coleman (1964) presents an analysis of the process of bargaining among wholly free men; that is, among men who are "unsocialized, entirely self-interested, not constrained by norms of a system, but only rationally calculating to further [their] own self interest." Coleman attempts to show that, through collective bargaining, it is possible for completely unsocialized, totally self-interested actors to develop stable and mutually beneficial interactions. Part of the analysis is based on the study of a game, the legislative game, in which the players, each rationally attempting to maximize his own interests, reach collective decisions through bargaining procedures. In the game, as in real life, it is not always possible for every actor to make those bargains and exchanges that maximize his interests; and since the rules of the game make it impossible for such unfortunate individuals to take recourse to coercion or war in attaining their ends, they have no choice except to accept their misfortune.

Thus Coleman's game and logic of collective bargaining demonstrate that when there are rules limiting interaction to peaceful bargaining on an open market, it is possible for the participating individuals, but not necessarily for *all* the participating individuals, to maximize their self-interests. It is a very important observation that many

of an individual's needs and desires can be fulfilled through bargaining; but Coleman's analysis bypasses the problem of the origin of those rules that limit interaction to peaceful bargaining. If those individuals who cannot achieve their self-interest through bargaining had other means at their disposal for maximizing their self-interest, perhaps the collective bargaining would progress differently.

In order to study how an individual will attempt to maximize his self-interest when he can either bargain for or take by force the goods he desires, I developed a game in which both options are open to the player. In the present section I will describe the game; and in Part II I will discuss the strategies individuals employ to win the game.

In the peace and war game there are initially five to 15 players, each representing a nation in an international community. The game is divided into interaction periods with seven to 14 periods in an average game. During each period, each nation produces a national product that varies from nation to nation. Some nations are basically agricultural, some are industrial, and some are both; some nations have a large national product while others are less fortunate. Every nation has basic needs for certain amounts of both agricultural and industrial products, and those nations which do not produce everything they need can either enter the international market, trading their unwanted products for needed goods, or attempt to acquire those needed goods by fighting and conquering other nations.

Let us consider as an example a simplified version of a national production profile that might be used in a game. The nation A whose national product is shown in Figure 1 is an industrial nation with a

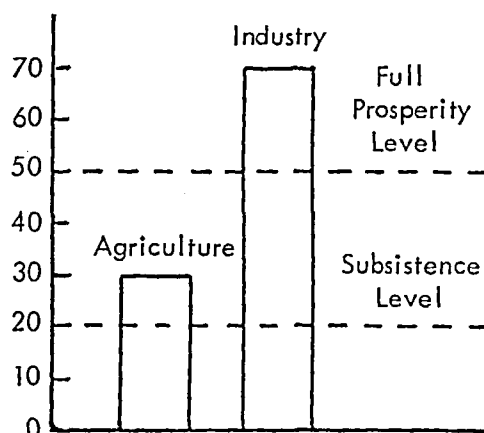


FIG. 1. Simplified national production profile for nation A.

low agricultural production. In each period of the game, nation A produces 30 units of agricultural and 70 units of industrial product. And in every period it must allow its populace to consume a basic subsistence level of goods, represented as 20 units of agriculture and 20 units of industry on the profile, in order for the populace to continue producing the agriculture and industry shown on the graph. Every unit of agriculture and every unit of industry in excess of the subsistence level that the populace consumes per period is counted as a unit of prosperity for that nation; and the nation that accumulates the greatest number of prosperity units in a game wins. But since any nation can consume only so much agriculture and industry before the people are satiated, there is an upper bound 30 units above the subsistence level on the amount of goods that can be consumed and counted as prosperity. Turning to Figure 1, we can see that if nation A were isolated from all external sources of goods it could provide its people with a subsistence level economy and 40 units of prosperity consumption too. The nation could consume 10 units of agriculture and 30 units of

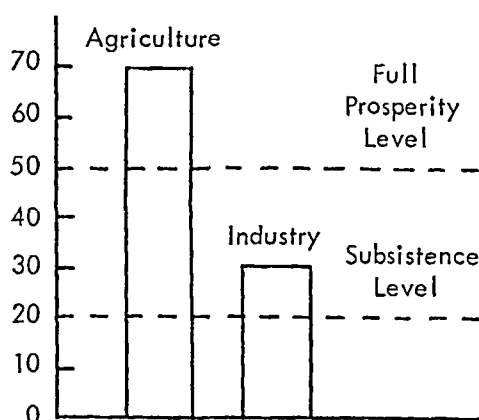


FIG. 2. Simplified national production profile for nation B.

industry as prosperity; but being satiated with industrial products after 30 units per period were consumed, it would have an excess of 20 units of industry that would go unused.

If nation A could find another nation, like nation B, which had a national product high in agriculture and low in industry, nations A and B could possibly arrange a trade. If nation B's national production were like that in Figure 2, the two nations could trade 20 units of agriculture for 20 units of industry and each end up with 50 units of agriculture and 50 units of industry. Thus, two nations, each of which if isolated could provide only 40 units of prosperity consumption for its people, by trading can become fully prosperous, at 60 units of prosperity per period.

But nation A *can* obtain the 20 units of agriculture that it needs from nation B by nonpeaceful means. A nation in the game can convert N units of industry to N units of military power at any time and accumulate its military power until it wants to or is forced to go to war. Nation A might choose to convert the 20 units of industry it has in excess of full prosperity into mil-

itary power instead of trading it to B, and thus, without sacrificing any industrial prosperity, build its military power by 20 units per period. Or it could make 50 units of military power per period, forgoing the 30 units of prosperity it got from industrial consumption while it quickly built a powerful military force. But nation B, which has little industry in excess of the subsistence level, can only make a maximum of 10 units of military power per period, and that is of necessity at the cost of 10 prosperity units per period. The industrial nation clearly has the military advantage over the agricultural.

The rules of the game permit nations to go to war with each other, define the battle losses of warring nations (in units of military power destroyed), and define when one nation is defeated by another.² Nation A, with its relatively strong military potential, may decide to attack nation B; and, if no other nations came to B's aid, A would probably win its war in two or three periods. A conquering nation can exploit a defeated nation in any way it chooses, so long as it leaves the defeated nation with a subsistence level economy so that the defeated nation can continue to produce those quantities of goods shown on its production profile. Thus nation A could take up to 50 units of

agriculture and 10 units of industry from B, leaving only 20 units of each for B's subsistence. Nation A would then be fully prosperous, with 60 units of prosperity consumption per period and with large excesses of goods, while nation B would be defeated and without prosperity.

Part II will consider the factors that would enter into nation A's decision about trading with or going to war with B, and the defense strategies B might adopt.

The game is actually much more complex than the two-nation, two-product example given above indicates. In the game the players are usually numerous enough so that competition for goods puts market prices beyond the control of any one player; so that weak nations can ally themselves in mutual defense pacts against potentially aggressive nations; so that inaccurate information about all the other eight or ten players can complicate matters, create uncertainties, and necessitate complex strategies, etc. Furthermore, in addition to agriculture, industry, and military power, three more products can be traded or fought about: industrial raw materials—fuels, metals, and chemicals—that must be consumed in order to produce the industrial product discussed in the simplified example above. Figure 3 shows a production profile like those used in the game, with the production levels of agriculture, fuels, metals, and chemicals. A nation's industrial product is limited by its least plentiful raw material. Thus a nation like A' in Figure 3, if isolated, could only produce 40 units of industry per period, even though it would have excesses of fuels and chemicals on hand; and it could only receive a maximum of 30 prosperity units per period (10 from agriculture and 20 from industry). If nation A' could trade 30 units of chemicals for 30 units of metals with some other nation, it could have 70

²The war rules are: Any nation can attack any other nation during any period, with wars being fought at a given part of the period. When two nations fight, each side loses 25 percent of the amount of the stronger nation's power as battle losses for that period. Thus, if nation A had 100 units of military power and B had 40, in a war both would lose $.25 \times 100$ or 25 units, leaving A with 75 and B with 15 units. When a nation suffers greater battle losses than it has military power, it loses its war. Thus, if nation A attacked B again (and neither had increased its military), both would lose $.25 \times 75$ or 18.75 units, which would be more than B had, and A would win the war.

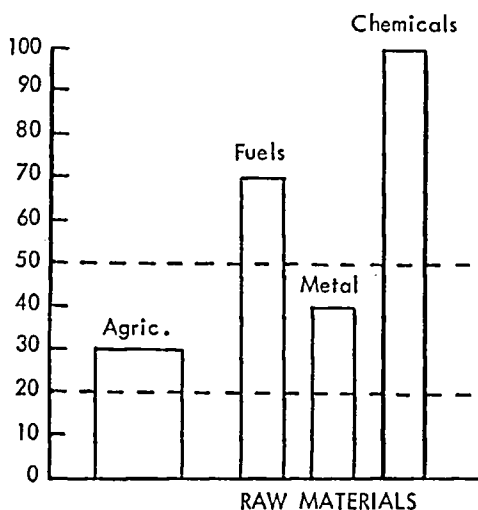


FIG. 3. Production profile for Nation A'. Subsistence level and full prosperity level as in Figures 1 and 2.

units of each raw material and thus be in the same situation as nation A, described above: it could either trade industry for agriculture or go to war. Since the game rules place no restrictions on what can be traded (any of the six products, agriculture, industry, fuels, metals, chemicals, and military power can be traded in any combination), there are usually many possible trade arrangements a nation like A' can make to suit its basic peace or war strategy.

Thus, with a complex market of many players and several products that each player needs in varying quantities, with the possibility that a war anywhere in the system might change the supply and demand balance of the market, and with correct information about each nation's production profile hard to obtain (since each nation wishes to maintain some strategic security silence about its strengths and weaknesses), developing a safe and workable strategy is very complicated and requires much experience and practice by

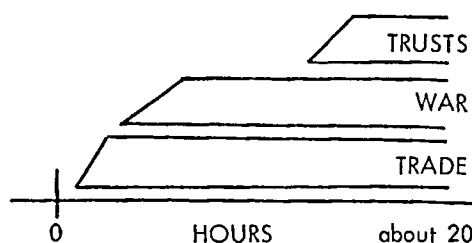


FIG. 4. General time of emergence of the three strategies, based on hours of experience in playing the game.

players of the game. Funds from the Carnegie Institution permitted me to hire a group of Johns Hopkins undergraduates to play the game many times, with different national production profiles used in each game, until the players had developed fairly sophisticated strategies that permitted them to compete skillfully and efficiently for survival and prosperity in their group. The strategies that these players developed in order to survive lend themselves to an analysis of why and how they work (or don't work), and the analysis will point up several of the "factors that operate in determining which strategy, theft or exchange, war or trade, an actor will use in his attempt to obtain a desired good from another."

II. Economic Analysis of Strategies

As players repeatedly play the peace and war game, three basic strategies for winning the game emerge. Figure 4 shows the sequence and general time of emergence of the three strategies. Players learn very soon how to bargain and trade in order to use their resources most efficiently. Only after several games do the players begin to use war efficiently as a strategy for gaining their own ends. Perhaps part of the slowness in taking advantage of the war strategy is caused by our culture's negative evaluation of aggressive behavior; but much

of that slowness is directly caused by the complexities of war strategies, as compared with the relative simplicity of trade strategies. Only after several wars have been fought do players begin to learn when and how wars should be fought in order to be profitable. The third strategy, forming alliances based on mutual trust, emerges as an effective means of producing stability in a war-rocked system only after war strategies have become menacingly efficient. In a game where the players are completely free to trade with or destroy their fellows, it is of theoretical importance that, within alliances, self-imposed norms arise to determine fair trade and to prescribe when and on whom wars should be fought, and that the norms are strictly enforced by the threat of expulsion from the alliance and, thus, destruction.

This section will consider these three basic strategies in the order in which they developed in the game. The discussion is in theoretical terms, but it traces the actual development of the strategies used by the players of the game as they gained experience in the game situation.

TRADE

If we use the example of nation A given above in Figure 1, we can demonstrate on the two-nation, two-product level the fundamentals of the trade and war strategies. Turning first to the trade strategy, we will represent nation A's two-product profile by a single point in a two dimensional graph, as is done in Figure 5. On the X and Y axes of Figures 5 through 11 are the quantities of industry and agriculture that the particular nation produces and has for trade. The vertical dotted line at 50 units of industry represents the satiation level for industrial products when industry is consumed as prosperity. Any point to the right

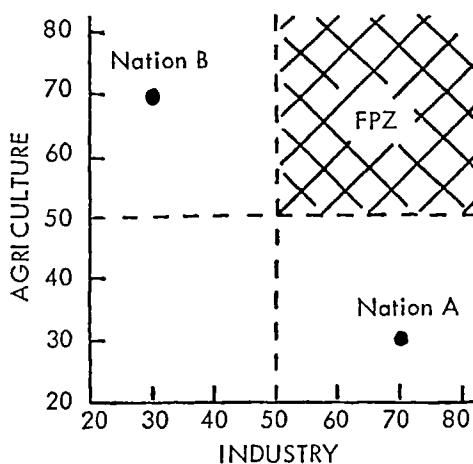


FIG. 5. Two-product profile of each nation, A and B, represented by a point. The axes themselves are the subsistence levels (20 units), and the full prosperity levels (50 units) are indicated by dotted lines. The hatched area is the Full Prosperity Zone (FPZ) for each nation.

of that line provides no more industrial prosperity for the nation than a point on the line itself. Likewise, the horizontal dotted line at 50 units of agriculture is the satiation level for agricultural consumption. Since a nation is maximally prosperous when it is fully prosperous both agriculturally and industrially, all points above both satiation levels, that is, in the shaded "Full Prosperity Zone" (FPZ), provide the same 60 units of full prosperity. Nation A in Figure 5 is not receiving full prosperity and will not until it can attain at least the 20 units of agriculture necessary to move into the FPZ. Trade with a nation like nation B discussed in Part I can make A fully prosperous. Nation B's production profile from Figure 2 is also shown in Figure 5. If we imagine the two nations' profile-points on two separate but otherwise identical graphs, rotate one of the graphs 180°, and place it on the other so that the point representing nation B coincides with the point represent-

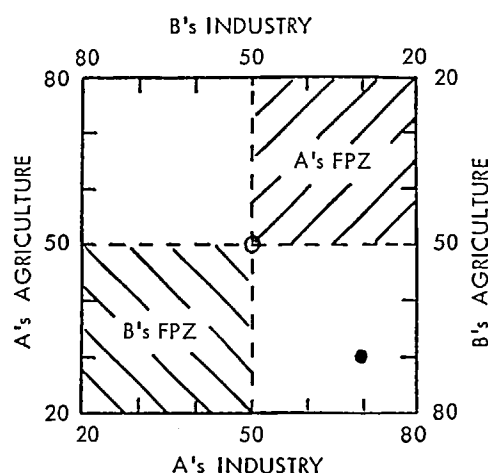


FIG. 6. Both nations' production profiles represented by a single point in a graph akin to the Edgeworth box diagram. FPZ = Full Prosperity Zone. (Cf. Figure 5.)

ing nation A, both nations' production profiles can be considered as a system, as shown in Figure 6. In a two-nation system where no goods are lost, both nations are represented by one point, since any gain to A can only come from B's losses (and vice versa). Figure 6 is similar to the Edgeworth box diagram used in economics to analyze the process of exchange.

If the two nations, A and B, attempt to trade with each other, each will want to trade so that his eventual outcome will be within his own FPZ on the graph. In Figure 6 there is only one point where both nations can be fully prosperous. If A trades 20 units of industry for 20 units of agriculture from B, this single solution can be reached. In our actual games, when there was only exactly enough prosperity to go around, as in Figure 6, even when one nation did not know much about the other's production profile (because of the second's security secrecy), and even when there were six instead of two products to trade, if both

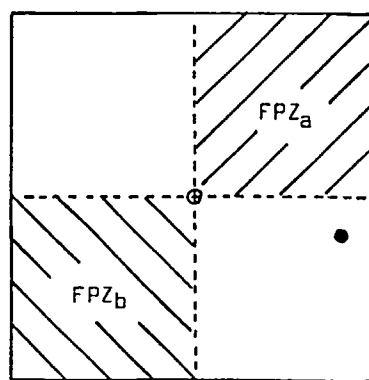


FIG. 7. Example of a single trading solution when the goods to be traded are not distributed equitably in the beginning, as they were in Figure 6.

nations were using trade strategies, the process of bargaining almost always led the two nations to discover the single solution at the intersection of the FPZs. Even when the goods to be traded are not distributed equitably, as in Figure 7, if the trade strategy is being adhered to by both players, the single solution is still reached or no trade is made at all.

There are three basic ways in which goods can be present in a two-nation or several-nation system. There can be just exactly enough goods to go around, such that only one distribution of goods makes both players of the two-nation system fully prosperous, as in Figures 6 and 7 above; or there can be a dearth or an excess of goods in the whole system, as shown in Figures 8 and 9 respectively. In Figure 8, no solution makes both nations fully prosperous. Limited trades can be made as A and B attempt to get rid of their small excesses of goods, but one nation's excesses are not large enough to fill the other's needs. Since bargaining and trade alone will lead to only submaximal prosperity for both nations, the militarily more powerful nation will prob-

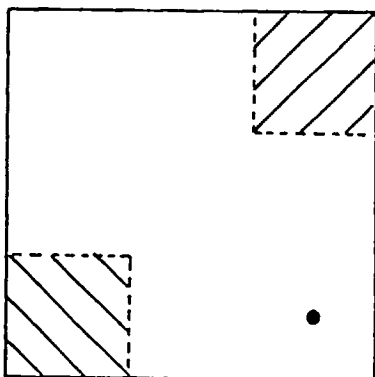


FIG. 8. In this case, there is a dearth of goods in the whole system, and one nation's excesses are not large enough to fill the other's needs. (Cf. Figure 6.)

ably use coercion to arrive at a solution favorable to him. In Figure 9, there are enough excess goods in the system that many trade solutions will produce full prosperity for both players, and only the relative bargaining skill of the two players will determine the exchange on which they will settle.

Often trade is the only strategy used in a game, either because the wealth of the economic system (as in Figure 9) makes

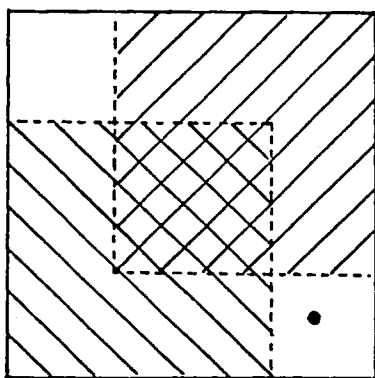


FIG. 9. In the system represented above, with excess goods in the system, many trading solutions will produce full prosperity for both nations. (Cf. Figures 6 and 8.)

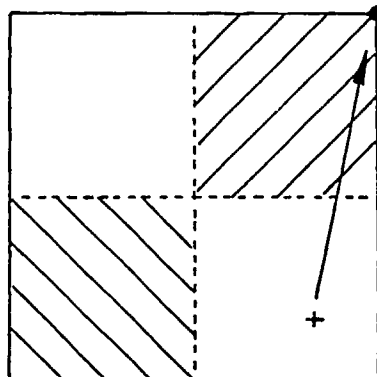


FIG. 10. Outcome for the system shown in Figure 6 if nation A should go to war on nation B.

trade easy and profitable, or because the players restrict themselves to stable, non-aggressive interactions; but there are many reasons why war is a valuable strategy and why it breaks out even in situations where peaceful trade agreements could be reached.

WAR

If nation A goes to war on nation B, as discussed in Part I, Figure 10 shows the outcome of that war. Nation A would gain possession of all the goods in the system, leaving B with subsistence only; but nation A would not be any more prosperous than if it had traded with B, because both the trade and the war outcomes lie in its FPZ. The following matrix shows how prosperity would be given to A and B under trade and war situations:

	Trade	War
A	60	60
B	60	0

If there were no factors in the game other than those already discussed above, there would seem to be no advantage to war: A does not become more prosperous and B loses everything it has. To understand why wars are fought when some nations in the

system have sufficient goods and some do not, let us examine the advantages nation A sees in possessing nation B rather than trading with it.

One factor of great importance in understanding the use of the trade and war strategies is that of uncertainty about future reward structures. Since various implications of the uncertainty factor will be explained throughout the remainder of the paper, at this point we will consider only how uncertainty increases the likelihood of war. With a fairly large number of nations bargaining in a market for several products, a given nation has little control over market prices or over who is trading what. There is a great deal of uncertainty in all the international interactions: a slight change in some part of the market, a war, or a new price offer can often affect the whole market and upset many nations' internal economies without their being able to help themselves; and since war can break out anywhere at any time, each nation is in constant danger of direct (battle) or indirect (trade) losses. A nation X has many doubts and fears: (1) Will the nation that is now trading with X be attacked and conquered, forcing X to go elsewhere looking for trades that might be hard to make? (2) Will the nation that X is now trading with decide to attack X or ally itself with an enemy of X rather than trade with X? (3) Will some nation or nations who want the goods that X is trading to Y decide to take those goods (and nation X) through war? (4) If war breaks out will X have sufficient military power to defend itself? (5) If alliances form will X have sufficient power, in terms of valuable excess goods, to guarantee its membership in the stronger alliance?—and so on. Thus there are many uncertainties about the trade market, the course of wars, and the structure of future alliances that force

a nation to consider more than simply earning prosperity for the present.

When nation A goes to war with and conquers nation B, it receives the same 60 prosperity units it would have if it had traded with B; but it also gains the following advantages: (1) Since it now possesses B, fluctuations in the market can no longer affect the flow of B's agricultural product to A, and A's prosperity is more strongly guaranteed. (2) B cannot decide to trade elsewhere or, supported by allies, to attack A. (3) A gains 30 units of agriculture and 30 units of industry more than it could have by peaceful trading, which gives it both increased power on the market (if agriculture or industry is needed) and increased military power (since it no longer needs to trade away its industry and can convert it to military power). Thus, having complete control over nation B puts nation A in a much better position for coping with the uncertainties of the future. We might predict, then, that if the uncertainties in the game were rather high and if nation A could find a nation which had (1) goods valuable to A, (2) low industrial and military strength, and (3) weak allies compared with A (and A's allies), the rewards of victory over B would be greater than the costs of war with B, and A would attack B. Before we consider the elements of this prediction, let us turn to explicit war strategies and examine their relative merits.

WAR STRATEGIES

Since industrial products can be either consumed as prosperity or converted to military strength, a nation that is considering going to war must decide how much prosperity it is willing to forgo in order to build its military strength. There are basically two strategies for allocating industry to either prosperity or war. Strategy I: all

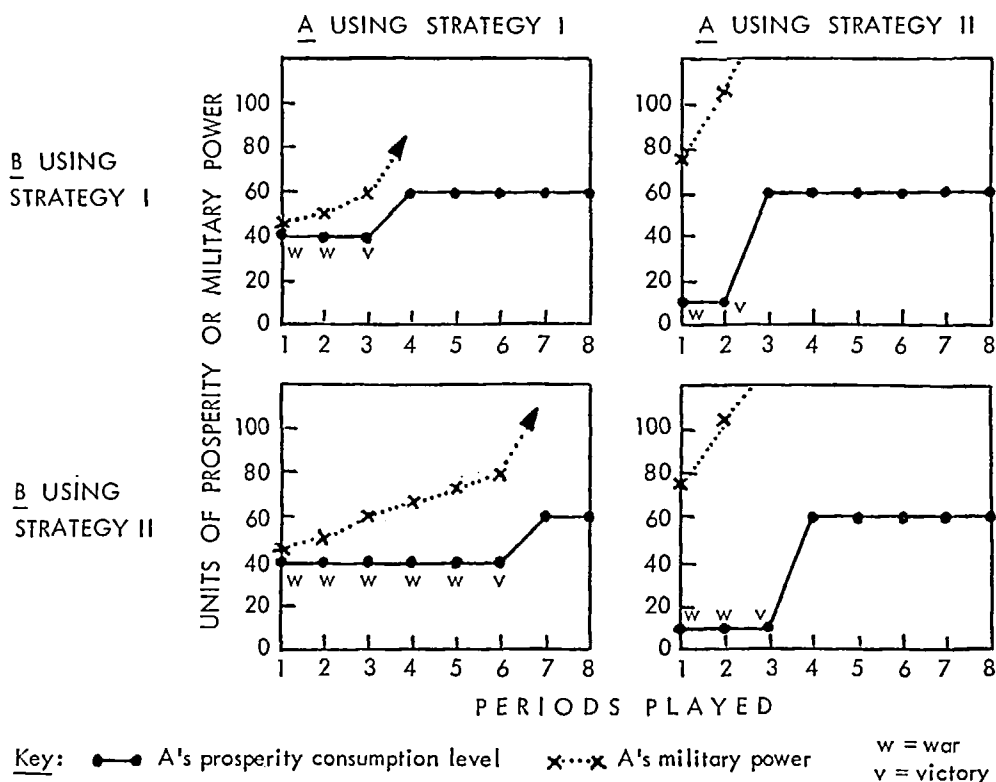


FIG. 11. The military power and prosperity of nation A during wars on nation B for the four cases of the two nations using either of two strategies. Both nations started with 25 units of military power at the beginning of the game.

industry in excess of the satiation level is converted to military units. Strategy II: all industry in excess of the subsistence level is converted to military units. For example, nation A produces 20 units of industry in excess of the satiation level, which is 50 units in excess of the subsistence level. It can convert 20 units of industry to 20 units of military power without sacrificing any of its 30 units of industrial prosperity, or it can forgo all its industrial prosperity for a concentrated war effort at the 50-unit level. Nation B has no industry in excess of the satiation level and only 10 units in excess of the subsistence level. For nation B, strategy I is to forgo no prosperity by

producing no military power, and strategy II is to forgo all 10 units of industrial prosperity by producing 10 units of military power. Figure 11 shows the military power and prosperity of nation A during wars on nation B for the four cases of nations A and B in a two-nation system using both strategies I and II. Table 1 summarizes three important aspects of Figure 11. If nations A and B traded 20 units of industry for 20 units of agriculture, for ten consecutive periods, both would accumulate 600 units of prosperity; but if A went to war on B, A could only expect to receive the prosperity indicated in Table 1(a) according to the types of strategy it and B were using.

TABLE 1
ASPECTS OF NATION A'S SITUATION UNDER BOTH STRATEGIES

	A's strategy		
	I	II	
(a) A's prosperity at period 10	540 480	500 450	B using strategy I B using strategy II
(b) A's total battle losses in the war	26 86	26 55	B using strategy I B using strategy II
(c) Length of the war in periods	3 6	2 3	B using strategy I B using strategy II

For the two-nation system, it is clear that if A chose to attack B, strategy I would net it 30 or 40 more units of prosperity than strategy II. But since nations are seldom in a two-nation system, they must consider the reaction of the other nations to their actions and must cope with the uncertainties mentioned above. Table 1(b) shows that, if nation A used strategy II, it could expect less loss of military power through the war, and with the greater military production of strategy II it would be in a much more secure situation should the war spread or should nation B find allies. Table 1(c) shows the length of the war nation A could expect, depending on the strategies used. Short wars, such as strategy II tends to produce, are safer for A because there is less time for B to find support from other nations and it is harder for B, which is fast being destroyed, to interest allies. Short wars have the additional advantage of providing the attacking nation very quickly with the spoils of war that bring it security against uncertainty. In a system of several nations where there is uncertainty, strategy II has many advantages over strategy I, and when alliances form and wars occur between two alliances, strategy II continues to have the same advantages and disadvantages it has in the two-nation system.

Wars waged by unsophisticated players are fairly unpremeditated, developing only after an industrial nation discovers an agricultural nation that looks temptingly easy to conquer. But as the players become more experienced with war, each game begins with a panicky arms race, each nation using war strategy II even before it has found enemies or allies. This stage in the development of the players' strategies most closely resembles Hobbes' war of every man against every man; each player's interest in survival makes him wary of and ready to fight with all others.

Before we turn to the third strategy, the formation of trusts, let us consider again the factor of uncertainty.

UNCERTAINTY

The amount of uncertainty in a game is very highly correlated with the amount of wealth in the system. The less wealth there is to go around, the greater the fear that the market will be unstable, that war will break out, and that such a war will be long and destructive; and before trust strategies are developed, these fears are justified. Figure 12 shows the general correlation of uncertainty with wealth—wealth taken in terms of prosperity available to each nation per period, given an efficient distribution

of goods throughout the system.³ It should be noted that there is some uncertainty in the system even at 60 and above, when there is enough wealth in the system to make all the players fully prosperous. This results from difficulties in efficiently distributing the proper goods to those who need them, from wealthy nations hoarding their excesses, and from no nation's having enough goods in excess of its full prosperity needs to feel secure with a margin of safety. Only when a nation has, *and* perceives that most other nations have, sufficient goods to be prosperous with excesses for security does uncertainty disappear from the system.⁴

³ The level of uncertainty in a game was estimated on a hundred-point scale from responses to questionnaires that were administered at various points in each game, and from records of strategy II military expenditure.

⁴ Even when there is an excess of prosperity it takes several periods for the nations to perceive the wealth in the whole system. For one game, where there was an excess of goods for all and no wars developed, the accompanying figure shows the strategy II military expenditure per period (which is a good measure of the uncertainty in a system of experienced players). By period 6, all the players had perceived the wealth of the system; none was making military power at the cost of prosperity forgone, and none felt that anything would disturb the stability of their trade agreements and prosperity.

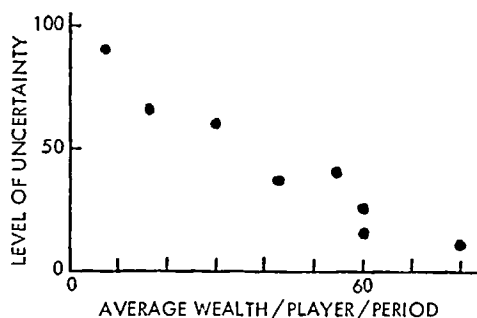
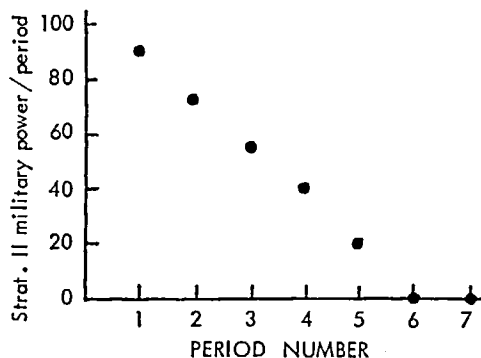


FIG. 12. Level of uncertainty related to the average wealth per player per period in the system, before the trust strategy develops.

Before the trust strategy develops, the frequency of wars as a function of the wealth of the system is very similar to the uncertainty curve of Figure 12 (see Figure 13). When there is no wealth in the system, there can be no military escalations and no wars, but as soon as industrial nations of even meager wealth arise, wars break out with a great frequency that drops off only as the general wealth of the system increases.

Uncertainty, then, is felt by a nation in situations where the reward structure is unstable and unpredictable and where it has insufficient power and control to guarantee the success of its own strategies. New players of the game do not perceive the

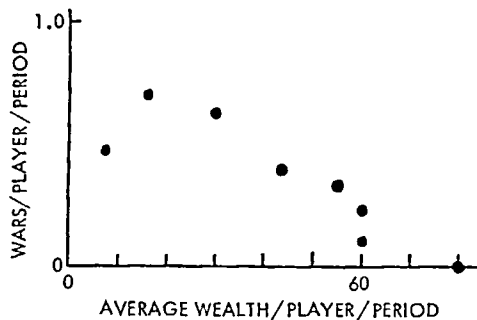


FIG. 13. Number of wars per player per period related to average wealth per player per period in the system, before trusts develop.

uncertainties of trade and war until a few calamities occur; as their awareness of the uncertainties of the future increases, they explore the war strategies, hoping for the security of the wealth of victory. Even secure, wealthy nations hoard their excesses, build up military power, and often go to war to keep other nations from becoming too powerful. All of these actions—hoarding, escalating, warring, etc.—add to the uncertainties and insecurity of the system. Only after much experience in the game situation do the players come upon the strategy of trusts (see below) that reduces uncertainty and, by limiting wars, permits the players to enjoy prosperity instead of turning their energies to the expenses of war.

TRUSTS

When a group of players forms an alliance in which the players make visible sacrifices of their own security for the security of the group, trust between the group members develops. Because there are no rules in the game that make international alliances or treaties legally binding, all treaties and alliances depend on trust among or coercion by the players themselves. Alliances that depend on coercion and enforcement by threats are often unstable compared to those based on trust, because members will break their alliances if they can find more attractive alternatives. Alliances based on trust (here called "trusts"), however, are quite stable, especially after it is recognized that being known as trustworthy is a valuable asset. When each player of the group realizes that a reputation for trustworthiness will earn him a solid place in his group, with stable trade relations and mutual defense assurances, each nation attempts to prove itself completely altruistic and trustworthy.

The emergence of altruism and generosity along with the trust strategy is quite logical. Before the trust strategy appears in the game, hoarding is very common. Each nation seeks to stockpile as much of everything it can in case of an unforeseen emergency. And while uncertainty leads to hoarding, hoarding produces even greater uncertainty. One of the reasons for the existence of uncertainty at points above the full prosperity level in Figure 12, where no trusts exist, is that wealthier nations tend to hoard their wealth instead of distributing it to nations that need it. Hoarded goods never appear on the market and most players perceive the system to be much less wealthy and much more insecure than it really is. But when nations turn to the trust strategy and wish to appear trustworthy, hoarding stops and nations become conspicuously generous and altruistic. Nations with excesses of any product perceive that they can gain trust and simultaneously decrease the uncertainty and likelihood of war in their alliance and in the whole system by distributing their goods.

Trusts are particularly important when uncertainty is greatest. In stressful situations, knowing that other alliance members will maintain peaceful trade and give support in the event of war from outsiders, a nation in a trust alliance feels a sense of security. The greater the stresses of uncertainty, the greater the rewards of generosity and support players give each other for being trustworthy, and the stronger the trust alliances.⁵ The effect that the presence of trusts in the system has on the uncertainty

⁵ Trust alliances that develop in low general prosperity (high uncertainty) games carry over for several games in influencing who trusts whom, whereas trusts from relatively wealthy games are superficial and seldom effect alliance structures in future games.

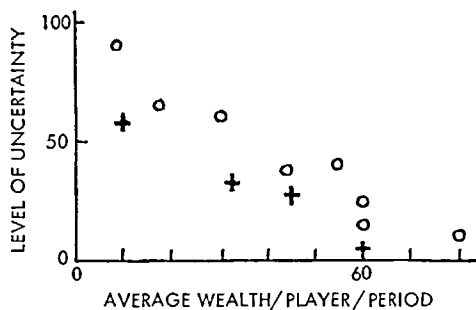


FIG. 14. Level of uncertainty *before* trusts (circles) compared with level of uncertainty *after* trusts (crosses). (Cf. Figure 12.)

in the system is shown in Figure 14. Much uncertainty is relieved, nations wage war only on members of other alliances, and goods are shared generously within alliances.

To understand the various consequences of trusts in a game, let us consider a game that was played by a group of well-experienced players. All 10 nations in the game received very low national product profiles and there was only enough wealth in the whole system of 10 nations to support two with full prosperity. In the first period of the game, two alliances of five nations each formed and warred. After a very long war between the two closely-matched alliances, four nations of one alliance and none of the other remained.⁶ The four remaining nations, each receiving about half of full prosperity per period, could easily have split into two new alliances of two nations each and fought until only two fully prosperous nations remained, but they did not. A questionnaire showed that the amount of trust that had developed among the alliance members as they fought together, shared their strength and losses, and finally won

due to their mutual effort was so strong and valuable to them that they refused to break it. They felt that, if they broke their trust to form two new alliances, they would not be able to trust each other for the remainder of the game or in future games, and that future alliances containing some of their members would be unstable and insecure. That the four players chose to remain at a low prosperity level, forgoing a monetary prize that fully prosperous nations receive, showed that trustworthiness is really valued as a long-range stability-producing strategy among experienced players.⁷

Before trusts appear, the game very much resembles Hobbes' war of every man against every man, with insecurity and mistrust keeping each player continually expecting the worst. But when trusts develop, there are fewer wars because (1) abstinence from war demonstrates a nation's altruism and trustworthiness, (2) stable trades and sharing of excesses satisfies many of a nation's needs, and (3) wars occur only between alliances and only when no trade agreements can be found. It isn't so much that the players consciously make laws or norms against war; they merely discover that to exploit the strategy of trusts they must refrain from many tempting wars, must reward others for similar "altruistic" behavior, and must punish trust- and alliance-breakers.

Thus players who at one time were continually fighting each other in free-for-all wars reach the point at which each is competing to demonstrate an unsurpassed degree of altruism, generosity, and trustworthiness.

⁷ Perhaps if there had been some natural lines of cleavage in the group of four (such as a history of antagonism or lack of trust in previous games), or if the players thought this was the last game they would ever play together, the group would have broken down further.

⁶ Once one alliance captured a nation from the second alliance and gained a definite power advantage, the second alliance fell quickly.

III. Conclusions

The purpose of this paper has been to study the "factors that operate in determining which strategy, theft or exchange, war or trade, an actor will use in his attempt to obtain a desired good from another." Although the study is based only on the analysis of a game of trade and war, we can—by designing the game to have the same general freedoms and restrictions as the real world situation that we wish to investigate—study the evolution of strategies and behaviors within the game and draw conclusions about strategies and behaviors in those aspects of the real world that the game simulates.

The most general statement that can be made about behavior in the game situation is that the players do those things that they expect will bring them the greatest reward for the least cost. In choosing whether he will trade or go to war, whether he will use war strategy I or II, whether or not he will show generosity and altruism in order to gain trust, etc., the player is basing his choice on his estimate of the rewards and costs of his actions. The players do not go through analyses like those in Part II in determining the rewards and costs of their strategies, but experiencing success or defeat due to an efficient or inefficient strategy teaches them fairly quickly what is rational and what is not.

The analysis of the game leads us to conclude that, under conditions where no trust exists between the actors, the state of war is rational for the self-interested actor

whose primary concern is in surviving as an independent agent. Even though war wastes much of the wealth of the system by sacrificing prosperity in order to support the war for survival, the actor who wants to maintain his independence has no choice but to develop the most efficient war strategy he can. The emergence of trusts, however, marks the end of costly wars of every man against every man and the beginning of peaceful bargaining, completely free trade, and increased prosperity. Because many wars are averted and because more goods are traded or given away (in exchange for trust), the wealth of the system is usually distributed and used very efficiently, producing very close to the maximum amount of prosperity possible in the system.

Thus an answer to the question of why and how those norms arise that end the continual war of every man against every man is that trust and norms among self-interested actors help each gain more than he could by single-handedly fighting for survival. That trust and norms often demand selflessness and short-term losses of an actor does not alter the fact that it is to a self-interested actor's long-term advantage not only to submit himself to, but enthusiastically to support, the trust and norms of his group.

REFERENCE

- COLEMAN, JAMES S. "Collective Decisions," *Sociological Inquiry*, 34, 2 (Spring 1964), 166-81.