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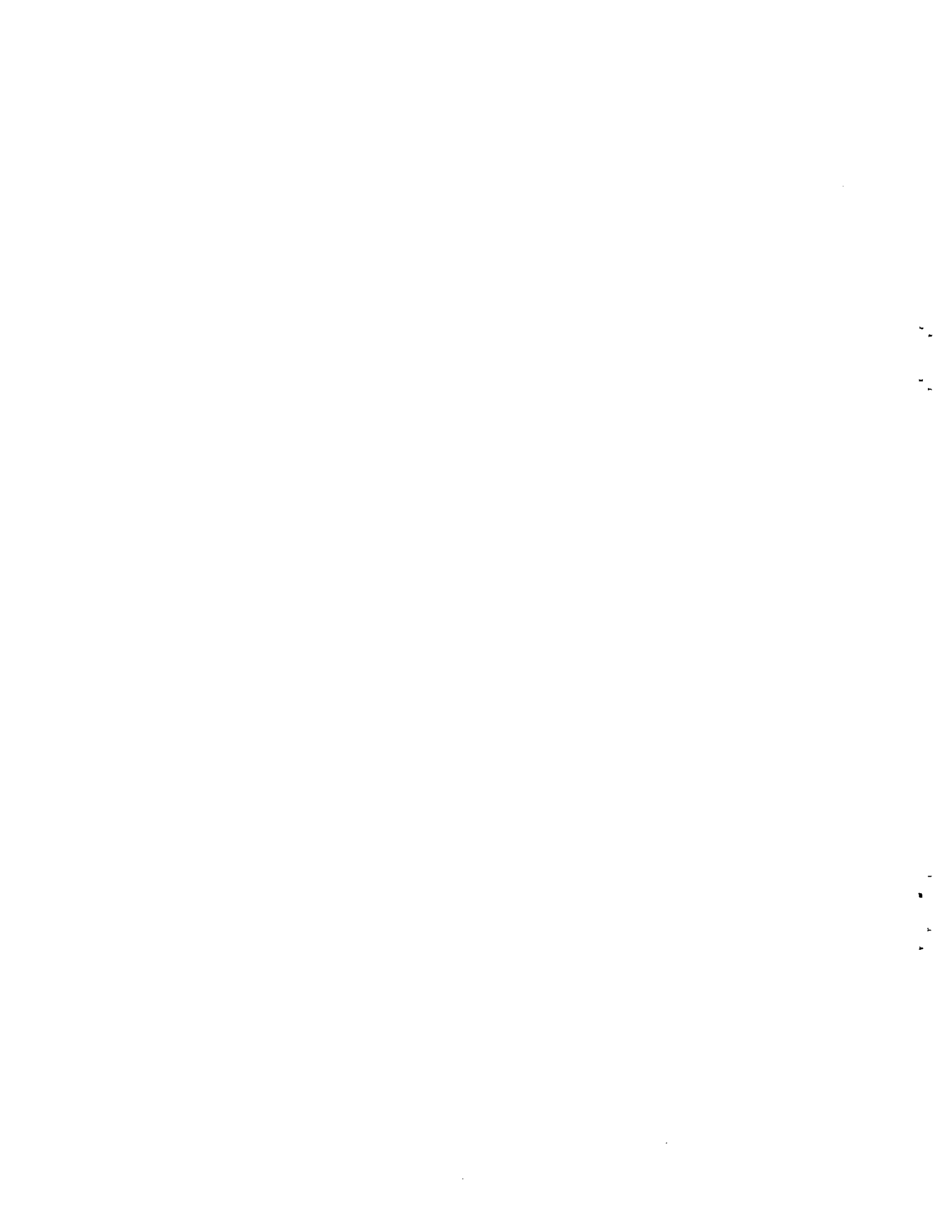
Conflict and Limits of Power:
A Suggestion for Political Economy

by

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A b s t r a c t

Since Dahl's definition, every effort to measure power has simultaneously aimed to conceptualize and substantiate what is really meant by 'power.' However, there is a substantial lack of rigorous and concrete models of power so developed as to be a basis on which various aspects and characteristics of power in international politics can be discussed. In the author's model, power, or more properly the 'limit of power,' is defined and measured as the extent to which each player in the prisoner's dilemma situation can have his own way, by defecting to maximize his payoff subject to not provoking the other player to disastrous defection. In order to define a limit of power, Axelrod's model of 'a bully' suggests a prototype of power-seeker, but Rapoport and Chammah's empirical data of intrinsic defection probability plays the most critical role in making it measurable in Dahl's sense. On this point this paper differs markedly from its predecessors. In fact, the author contends, with some illustrations, that the real power concept cannot be reached only through deductive reasoning, on which rationality is founded.

The distribution of power as related to Axelrod's Conflict of Interest exhibits very interesting features. It is directly nor inversely proportional to C.I. Instead its maximum is attained at moderate C.I. with low values at both tails. These three phases (C.I. being mild, moderate, severe) are shown to characterize three important types of international political and political economy systems; 'alliance,' 'interdependence,' and 'bipolarity,' respectively.

Other important characteristics of power are formulated; the rate of collective goods consumed, the credibility consideration, the acquisitive and punitive efficacies of power. These concepts would be very useful in analyzing various aspects of power that have traditionally been discussed. As

an illustration of the most elusive one, C. Friedrich's 'rule of anticipated reactions' is explained.

Lastly, it would be worth while for political economy reseach to ask if generally the concept of power can be rationalized from the economic point of view, i.e., derived only through deductive reasoning. This paper serves an illustration of the contention that without 'inductive rationality' power would still remain hypothetical, if we are to avoid circular arguments.

INTRODUCTION

It would be a lack of delicacy but productive to think of any politics is situated somewhere on the linear continuum,¹ where power and cooperation are on the the extreme ends, even though pure types of these extremes are rarely found.

The question is: spectrum of what? One readily obtained answer is 'conflict.' This provides practically no answer, since to characterize a conflict is almost equivalent question. So the essential question is this; how could we characterize a conflict by a criterion with power on the one hand and cooperation on the other?

By and large, the view that the concept of power is essential to politics is still dominant, and justifiably so. Karl Deutsch (19 , p.124), however, said the the contrary: "Power is thus neither the center nor the essence of politics." Thus emerged integration theory, of which he is a major initiator. This changes a point of reality. Conflict put at one end of spectrum; cooperation replaces integration at the other.

There are at least two important things to be considered. What then is power in relation to cooperation? Is it derivable from or inherent in cooperation? Are the two things close to or far from each other? Secondly, and more practically important, is cooperation stable? Is it encroached by power? Or in other words, are there any "limits of power"? These questions can be answered only by systematically investigating the 'power-cooperation spectrum'. Especially interesting is what is happening around halfway between power and cooperation, where political reality usually is to be found.

Why are these questions so important? What underlies them? The importance is both theoretical and practical. Theoretically, power has traditionally provided the 'coordinate sytem' in which to view politics. The



theoretical results of game theory. But to handle these departures from perfection one has to specify them explicitly. And it greatly complicate the problem to depart from perfection, whether it be perfect memory or perfect absence of memory, perfect knowledge or perfect absence of knowledge, perfect calculation or perfectly random choice. Anything between the two extreme requires detailed specification," (pp. 238, 239)

³⁵ One can call this game a general matching-penny game.

³⁶ These can be expressed in probability, as in the preceeding chapter.

³⁷ One may argue this is not exactly so on the ground that we are dealing with two distinct time points. . However, provided that the function F is 'operative' in the sense that x has an essential effect upon $F(x)$, which we have a good reason to assume (otherwise F has no substantial meaning), assuming $p(0)$ a priori is almost predetermining the final $p(T)$.

³⁸ Abelson and Levi (1984) review a wide variety of decision making problems as seen from psychological point of view.

most prominent advocate is Morgenthau, who contends, as is well known, that "international politics, like all politics, is a struggle for power.... Whenever they strive to realize their goal by means of international politics, they do so by striving for power." (Morgenthau and Thompson, 1960, p.31.) But now that cooperation is suggested as an alternative coordinate system, you have to first locate the coordinate (in the new one) in order to substantiate the effects of this transformation.² Analyses of how a specific phenomenon looks different in different perspectives would become less ambiguous, when these perspectives are closely examined and compared, and interrelated. The view that cooperation can accommodate to some degree the element of power and vice versa (the spectrum is continuous) is, as we will see, fundamental in analyzing the intricate character of so called 'the rule of anticipated reactions,'³ or otherwise called 'non-decision.'

Acts of cooperation may bring about beneficial consequences, called by economist collective (or public) goods. Applying this concept, Russett and Sullivan (1971) open up a new dimension with which to interpret the world order: the collective goods approach to world politics. Environmental protection, nuclear deterrence, arms control, the work of international organizations are typical and important collective goods. Before being too optimistic, conceptually one should ask if a good can ever exist stably in that political world which Morgenthau depicts as that of 'struggle of power.' If cooperation and power are just skin deep, cooperation might collapse in face of a thrust of power. Thus sustaining cooperation entails the concept of 'limits of power' in power analysis.

How then are the concepts of cooperation and power related? Clearly they are not concepts remote from each other. Both are means to attain one's goals. Yet, one must suspect that the two concepts are differentiated at some

fundamental levels. What are these? One is the level of rationality.

Unquestionably, you play purely rationally⁴ in a game which is two person zero-sum with a saddle point. With this there is not even the complication of the expected utility hypothesis. In non-zero-sum games, when you cooperate, you do so out of considerations still based on some rationality. You cannot do this only on your own. Some faits accompli have to be established between players to attain, and maintain cooperation. If, however, you hope for something beyond what you can thus rationally expect, you must be somehow acting non-rationally to accomplish your hopes. Thus maximum you can rationally attain marks the limit of rationality. For further increase in the payoff, you need some subtler rules than those based on rationality, or 'power.'⁵

How then is cooperation transformed into power? How is cooperation undermined by a potential 'power-seeker' if he is so resolved? Our model is intended first to conceptualize power in a cooperative situation, and then to formulate such power mathematically (to be called 'limit of power), and suggest other interesting qualifications of power. What determines whether or not a cooperator would go broke? A model of 'Bully' concisely described by Axelrod (1985) serves as a prototype model of such a power-seeker. Many characteristics are given to relate cooperation with power and vice versa. stability of cooperation is the most important implication of the model.

In the analysis of the model, the rule of anticipated reactions, probably the most elusive aspect of power, is tried.

COOPERATION AS INDUCTIVE CONCEPT

Using the game model of prisoner's dilemma is widespread in the analysis

of problems of cooperation in many instances on international politics. If such models were better descriptively, then they would be used more widely. more.⁶ Since, however, their real powers are to conceptualize so that a few relevant concepts will deductively explain phenomena, 'prisoner's dilemma' and 'chicken' are appropriate. Usefulness and wide applicability of the former is essentially due to the fact that, in effect, the prisoner's dilemma is moderately irrational, while in chicken irrationality is excessive. For instance nuclear deterrence, if modelled by chicken, renders a nuclear threat too incredible, casting doubt on the model itself.⁷

Prisoner's dilemma is expressed in convenient form adopted by Rapoport and Chammah (1965) as in the following table.

	C	D
C	(R, R)	(S, T)
D	(T, S)	(P, P)

Table 1 Payoffs of Prisoner's dilemma

with notations for strategies

C=Cooperation, D=Defection,

and payoffs being

S=Sucker's, P=Punishment, R=Reward, T=Temptation,

where $S < P < R < T$ and, $S+T < 2R$ is additionally assumed especially when a side payment is permitted.

Salient features of prisoner's dilemma are summarized in the following three statements:

1. For each player, there is a dominant strategy D, leading to the outcome (P, P). (Dominance)
2. (P, P) is a Nash equilibrium.

3. The Nash equilibrium (P, P) is not Pareto optimal. (R, R) is. C accomplishes this outcome. (Pareto optimality)

The dilemma is relieved in the third statement, although the three together present what is usually called the prisoner's dilemma.

That the individual (dominance) and the group rationality (Pareto optimality) contradict is central to this dilemma. Luce and Raiffa, however, find no point in this argument.⁸

The hopelessness that one feels in such a game as this cannot be a play on the words 'rational' or 'irrational': It is inherent in the situation. "There should be a law against such games!" (p.96, 97)

An observation that they refuse pointblank to face the problem itself would be superficial. They are quite right. If you are to cooperate, something extraneous to the game (though 'a law' is heuristic and metaphorical), needs to be called upon. More generally Axelrod (1985) says:

A variety of ways to resolve the prisoner's dilemma have been developed. Each involves allowing some additional activity that alters the strategic interaction in such a way as to fundamentally change the nature of the problem. (p.11)

He introduces the 'shadow of the future.' His reasoning goes this way: Unlike the chess game situation, a universally best strategy to play is impossible to find. How to do best depends on the other player's strategy. Here lie incentive and chance for interaction. To warrant them players should at any time have tomorrow, and 'make the future important' or 'make the future loom large in the calculation of total payoffs.' From this situation, a TIT-FOR-TAT strategy emerges as best, which is 'the policy of cooperating on the first move and doing the other player did on the previous move.'

The observation that a mere temporal repetition, called a supergame, of prisoner's dilemma per se attains the outcome of cooperation (R, R), would

miss the point in many respects. Unlike the Nash equilibrium (P, P), which is a purely theoretical concept, attainment of (R, R) is to a large extent empirical, to be attained only under specific conditions, the most critical of which, as is well known, that the number of repetitions be indefinite (instead of finite.) In a major empirical study of Rapoport and Chammah (1965) experimens show a persistent recurrence of cooperation. That Axelrod's result, unlike his predecessors, depend on computer simulation leads one to suspect that it is based on deductive reasoning. The answer will be yes or no, depending upon how one interprets the of 'the shadow of the future.' Specifically,

"What makes it possible for cooperation to emerge is the fact that the player might meet again. This possibility means that the choices that the choices made today not only determine the outcome of this move, but can also influence the later choices of the players. The future can therefore cast a shadow back upon the present and thereby affect the current strategic situation." (op. cit., p.12)

Certainly it is dependent on a discount parameter, w , which appears in evaluations of the payoff. Nevertheless it is open to doubt that it deserves universal acknowledgement as the 'rational man' assumption.

Unlike the concept of cooperation, any effort to deduce the concept of power would be futile, since it is essentially extraneous to game theory. Luce and Raiffa, in discussing the game of 'the Battle of Sexes,' states that:

If 1 announces that he plans to choose [going to boxing] and that no argument will alter his choice, and if 2 has faith in 1's stubbornness in sticking to his announced intentions, then she has no alternative but to choose [going to boxing] Thus we see that it is advantageous in such a situation to disclose one's strategy first and to have a reputation for inflexibility. It is the familiar power strategy: "This is what I'm going to do; make up your mind and do what you want." (p.91. italics added)

One has here to note that the way they define 'power strategy' is to assume a certain a priori (extraneous) situation. There are similar examples

in abundance.⁹ Thus using game theory to describe environments where power is concerned is of course possible and useful, but to define power deductively in the game theory context is impossible. Why is it that way? If rationality is the course of action which is taken so as to maximize (expected) utility, or payoff, from a well-defined set of alternatives, then certainly game theory is such a theory of rationality. In contrast, many political theories of power, such as J. March's, state, explicitly or implicitly, that power is essentially that which narrows the range of the set of alternatives, that is, obstructs, or at least lowers the degree of, freedom of choice. Thus power cannot be rationally deductively defined. This is a very important characteristic of power.

REPUTATION : PROTOTYPE OF POWER

If game theory is taken as a theoretical frame of rationality, power cannot be deductively derived. Power is an essentially an inductive concept in that it is based on on accumulated facts, or fait accompli. Power needs data for its definition though in fairly general sense. As seen in the above quoted Luce and Raiffa's illustration quoted above of 'power strategy,' to have a reputation of having been tough is a source of power. The concept of a power base (area, population, GNP, etc. of a nation-state) in international politics is another, more typical, example. Without any recourse to these 'data' terms one almost cannot explicate why such and such a state or person has power.

Reputation is not only a widely observed phenomenon in bargaining but almost (not completely, as will be seen later) is inherent in the concept of power. Luce and Raiffa make no mention of it when speaking of power. T.C.

Schelling, in 'Strategy of Conflict,' gives a substantial role to reputation in seeking a theory to substantiate the strategy of credible deterrence. He suggests that:

"How can one commit himself in advance to an act that in fact prefer not to carry out in the event, in order that one's commitment may deter the other party " "One may try to stake his reputation on fulfillment, in a manner that impress the threatened person."
(p.36).¹⁰

These two illustrations suggest, but not yet established that reputation is a central concept to power. If we succeed in building a model where reputation is a crucial variable that explains and measures power, then his assertion is warranted.

Axelrod's metaphor, or even model, of a bully is very important in that it characterizes the nature of power-seeking among cooperation and provided in essence the conception of measuring it. It deserves quoting in full :

Having a firm reputation for using TIT-FOR-TAT is advantageous to a player, but it is not actually the best reputation to have. The reputation to have is the reputation for being a bully. The best kind of bully to be is one who has a reputation for squeezing the most out of the player while not tolerating any defection at all from the other. The way to squeeze the most out of the other is to defect so often that the other player just barely prefers cooperating all the time to defecting all the time.....
Fortunately, it is not easy to establish a reputation as a bully. (p.452, italics added.)

Thus, while cooperation is to be attained although not perfectly, by an unambiguously defined strategy, TIT-FOR-TAT, power is in contrast not easy to obtain. The difficulty of obtaining it is the leading characteristic of power. This is no truism. That power is sought on the top of what one deserves for cooperation accounts for this contrast. More fundamentally, it is at this point that rationality fades into obscurity, and into non-rationality. For, although once again the reputation operates as prototype power, it is not a theoretical concept, but instead a crude, empirical fact

even a psychological fact. Axelrod goes on to say: "Until your reputation is well established, you are likely to have to get into a lot of very unrewarding contests of will." We cannot theorize so far without some a priori assumptions. Still, to model and measure the process is a part of conceptualization of power. Power is inductive, and a measure of it is a part of the concept.¹¹

'Reputation' is mathematically characterized as a temporal process of subjective probability that changes as relevant facts get accumulated according to time. Bayesian statistics are a suitable method to describe, model and in part predict it, and the method should be of wider applicability in political science. The problem of reputation is illustrated as follows. For Bayesian model applied here, refer to Edwards (1968).

Suppose we have two indistinguishable urns called, metaphorically for political science purpose, 'Bully,' B, and 'Non-bully,' NB. There are two varieties of balls contained in them, called 'Defection,' D, and 'Cooperation,' C. B contains 70 D's and 30 C's, and NB contains 30 D's and 70 C's. Now B or NB is chosen randomly only once, without knowledge of which it is chosen. You have to infer.

A ball is drawn one after another (with replacement) from the chosen urn, with its label, D or C, recorded each time. Suppose you now know that, out of 12 balls drawn, you have observed 8 Defections and 4 Cooperations. Given this fact you naturally believe that in the chosen one being a Bully, but how much? How much probability (credibility) do you put on a Bully? A simple calculation by Bayes theorem, with equal prior probabilities¹² $P(B)=P(NB)=1/2$, yields

$$P(\text{Bully} \mid 8 \text{ Defections and } 4 \text{ Cooperations}) = .97,$$

which in turn may well mean that Bully's reputation, perceived by you, is

0.97. Edwards gives some experimental result significantly lower, 0.75, which he terms 'conservatism in human information processing.'

Thus Bayesian statistics are very useful in theorizing about an inductive process. It is cited here to exhibit its essential nature and we do not incorporate it into the theory of power unless the problem of assigning a priori probabilities is cleared.

DERIVING 'LIMITS OF POWER'

The model set-up to measure power or, to be more specific, limits of power in cooperation is given by four components as follows. (See Table 2.)

(a) A varying degree of prisoner's dilemma games, I, II, III, IV, V, XI, XII, as used in Rapoport and Chammah (1965). Seven sets of Rapoport's payoffs will be given with

$$(i) r_1^p = (R-P)/(T-S),$$

$$(ii) r_2^p = (R-S)/(T-S), \text{ and}$$

(b) A non-cooperative version of Axelrod's (1970) Conflict of Interest measure,

$$C. I. = (T-R)(T-S)/(T-P)^2 .$$

(c) A defection probability, D, as measured by Rapoport and Chammah in the 'pure matrix condition,' and

(d) The critical probability for one player's credibility to fail

$$P_c = (R-P)/(R-S).$$

Before proceeding, several things are to be noted. The first is on the structure of payoffs, S, P, R, T. (See the Table 2.) They are rather well-behaved payoffs, primarily to observe some standard results. Symmetry with respect to player's payoff is introduced, as is often the case. Sucker's payoff and Temptation too are made symmetric, $S=-T$. This deletes those effects which otherwise would be caused, envisaging other two factors, how Reward, R,

Table 2 Summary of conflict situations by various characteristics related to cooperation and power

(1) Rank Order of C.I.	1	2	3	4	5	6	7
(2) Game Labels	I	IV	II	XII	XI	III	V
(3) Rapoport's Payoffs							
S	-10	-2	-10	-10	-10	-10	-50
P	-1	-1	-9	-5	-1	-1	-1
R	9	1	1	1	5	1	1
T	10	2	10	10	10	10	50
(4) Rapoport's Ratios							
r_1	.5	.5	.5	.3	.3	.1	.02
r_2	.95	.75	.55	.55	.75	.55	.51
(5) Conflict of Interest	.17	.44	.50	.80	.83	1.49	1.88
(6) Defection Probability	.266	.338	.226	.406	.365	.542	.732
(7) Comparison	∧	∧	∧	∧	∧	∨	∨
(8) Critical Probability	.526	.667	.909	.545	.400	.182	.039
(9) Max. Reputation	.550	.671	.605	.898	.952	1.0	1.0
(10) Limit of Power	.284	.333	.379	.492	.587	.458	.268
(11) Efficacy (Aquisitive)	.053	.333	.818	.818	.333	.818	.961

DEFINITIONS

(1) ref. to (5), (2) Given by Rapoport & Chamah

(3) $S < P < R < T$, $2R > S+T$. ($S = -T$, $P < 0$)

(4) $r_1 = (R-P)/(T-S)$, $r_2 = (R-S)/(T-S)$

(5) Non-cooperative Version of Axelrod's Conflict of Interest;

$$C.I. = (T-R)(T-S)/(T-P)^2$$

(6) D ; Given by Rapoport & Chamah under 'Pure Matrix Condition'

(7) Credibility Consideration, $D \geq P_c$

(8) $P_c = (R-P)/(R-S)$ (9) $D^* = \frac{R-S}{T-P} D + \frac{T-R}{T-P}$ (if $D < P_c$), and 1 (if $D > P_c$)

(10) Limit of Power in Dahl's sense, $L = D^* - D$

(11) e , efficacy of power (as aquisitive); $e = (T-R)/(R-S)$

for cooperating and Punishment, P, for not cooperating work together. Also P is made negative. There is no reason against assuming otherwise. Since R is necessarily positive, as $S+T=0$ and $2R>S+T$ imply, it insures at least that punishment be significantly punitive, not being positive. Payoffs are set on the interval scale, which validates subsequent probabilistic calculations later. Thus we are dealing with a considerably normal type of prisoner's dilemma.

Secondly, the Conflict of Interest has an important meaning; a normalized (so that $T-P=1$), integrated loss (over all possibilities of the first player's outcome, x) to be incurred by the second by complying to the first player's demand.¹³ Axelrod shows it is unique and deducible from five assumptions. By this property C.I. now assumes the obvious and intuitive meaning as the 'severity of conflict,' the greater, the severer, but it implies more than that. It 'linearizes' in a nice way a set of all conflicts in the research; other characteristics of similar concept, most notably r_{ij}^0 (see the Table 2), reversely agree well in rank order with C.I.. Rank correlation coefficients are close to -1. All prisoner's dilemma games here are arranged along well-defined, meaningful one dimensional axis. This greatly facilitates interpretations of results in terms of our proposed 'power-cooperation spectrum.'

Thirdly, r_{ij}^0 stands for 'non-zero-sumness' of a prisoner's dilemma. Its value lies between 0 and 1, since $S < P < R < T$ and hence $R-P < T-S$. (Note that $T-S$ represents a full range of outcomes.) $r_{ij}^0=0$ means $P=R=0$, eliminating all cooperation-related elements from a dilemma. Possible outcomes would be $(T, -T)$, $(-T, T)$, or $(0, 0)$, and the game would be completely zero-sum. $r_{ij}^0=1$ means a 'perfectly cooperative' case, so to speak, where the Pareto-optimal (R, R) is at the same time a Nash equilibrium, and the dilemma aspect

completely disappears.¹⁴ One could readily infer that r_v measure roughly the inverse of C.I.; mildness and severity of conflict. The rank orders are the reverse of each other. Thus we find again that conflicts we have are nicely arranged. C.I. will differentiate the conflicts better because identical values of r_v may obscure a situation, despite its direct and obvious with game payoffs.

Fourthly, but nevertheless the most important for us to note is that the defection probability D is the only concept defined here empirically. The introduction of this empirical concept, or something similar would be essential in theorizing about power, because it is inductive. However, this does not imply that any relevant empirical results can serve as a measure of power. At the minimum, experiments must be founded on a well established theory, conditions systematically controlled, and results admit interpretation that are consistent over a wide range of conditions. Rapoport and Chammah's experiments yield very good values of D , the plots of which are almost perfectly linear against C.I. under two conditions, 'pure' and 'block matrix.' (See Figures 1, 2.) This shows that D is a substantial concept and not a speculative one, and that C.I. becomes still more established.

Lastly, we call r_2 'reward coefficient,' which locates the effect of cooperation, R , relative to the whole range from S to T . The condition $2R > S+T$, long-term meaningfulness of cooperation, implies $r_2 > 1/2$.¹⁵

Suppose players are 1 and 2, and 1 is going to be a Bully. If 1 defects with a probability p , then payoffs would be, for 1,

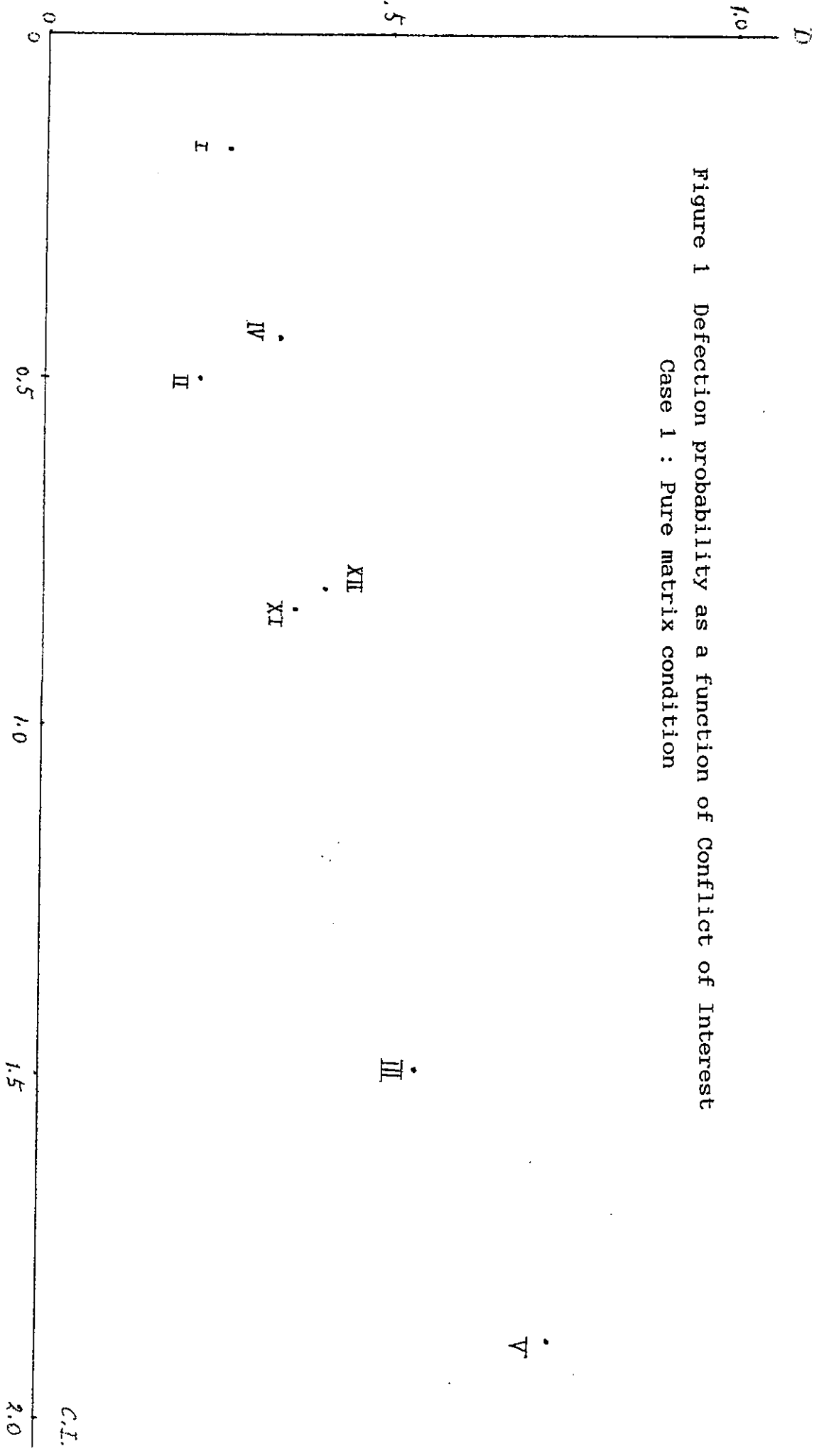
$$e = pT + (1-p)R \quad \text{when 2 cooperates}$$

$$f = pP + (1-p)S \quad \text{when 2 defects, and}$$

for 2,

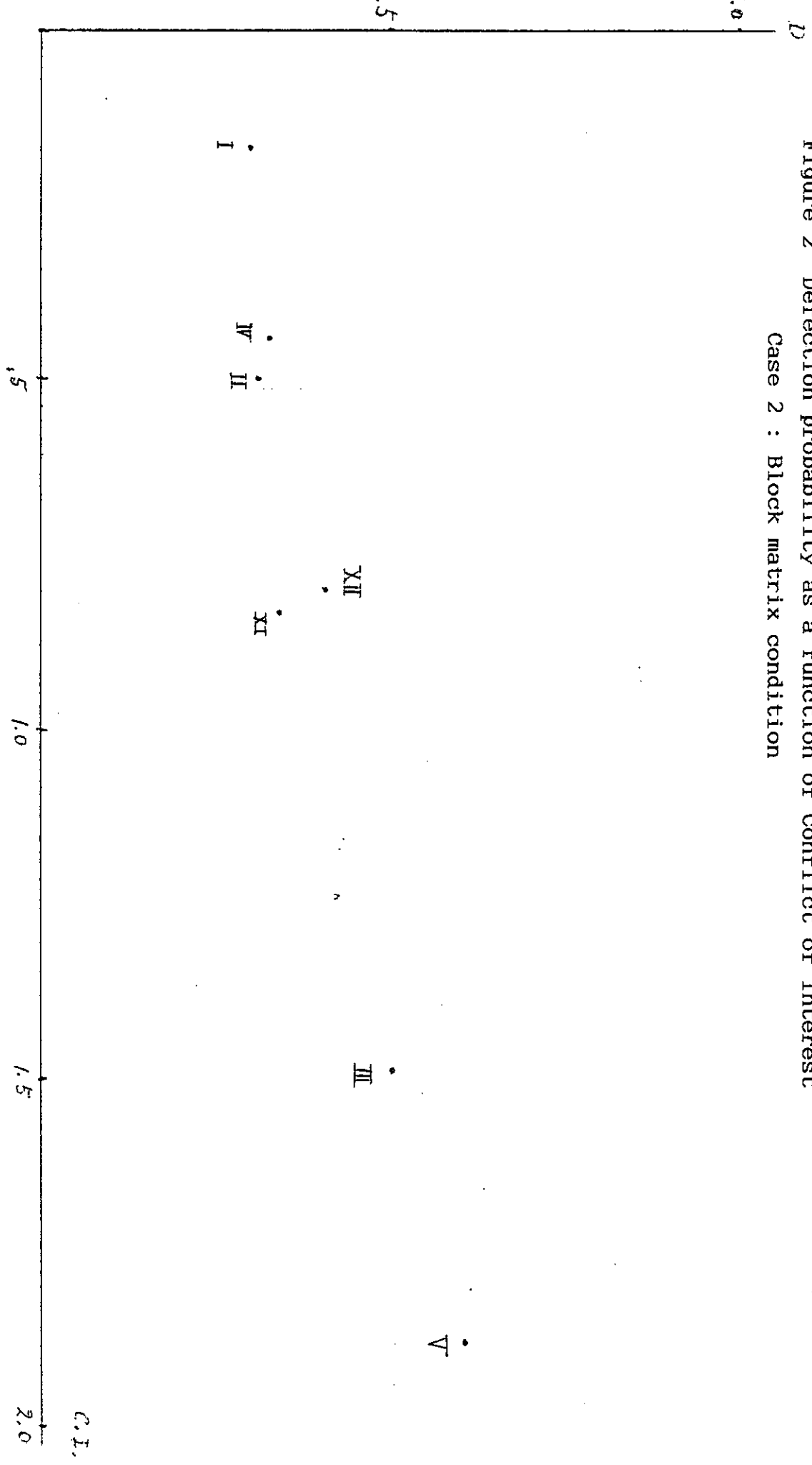
$$g = pS + (1-p)R \quad \text{when 2 cooperates}$$

Figure 1 Defection probability as a function of Conflict of Interest
Case 1 : Pure matrix condition



Ref. Axelrod, Rapoport - Chammah

Figure 2 Defection probability as a function of Conflict of Interest
Case 2 : Block matrix condition



$$h = pP + (1-p)T \quad \text{when 2 defects,}$$

in terms of utility. e , f and g , h are functions of p ; $e(p)$, $f(p)$ and $g(p)$, $h(p)$. All are linear in p . e and f are increasing, and g and h are decreasing, with slopes

$$e'(p) = T - R > 0, \quad f'(p) = T - S > 0, \quad g'(p) = S - R < 0, \quad h'(p) = P - T < 0.$$

It would be useful to note that, by dominance,

$$e(p) > f(p) \quad \text{and} \quad g(p) < h(p)$$

for the whole range of p .

Now, Axelrod's logic of a Bully applies to our model like this: Given a conflict situation, S , P , R , T , there is an intrinsic defection probability $p = D$, which puts players 1, 2 at current payoff levels $e(D)$, $g(D)$, respectively, provided that 2 cooperates. Since e increases and g decreases with p , any move for 1 to defect more often, with a greater probability q ($q > D$), would increase 1's payoff level up to $e(q)$ and decrease 2's down to $g(q)$;

$$e(q) > e(D) \quad \text{and} \quad g(q) < g(D)$$

This attempt by 1 to prevail surely worsens 2's situation but not as an imminent prospect as long as 'the last resort' remains available (but not always appealed to) for 2 himself to defecting thus¹⁶ recovering, or getting more than, his current payoff $g(D)$;

$$h(q) \geq g(D)$$

On passing such a limit, however, if 1 defects too frequent, it will make 2's situation even worse, so bad that even by defecting himself he will fall short of his current position $g(D)$, that is, $h(q) < g(D)$. His defection will be rational, complete certain, and bring the collapse of cooperation, too. This defines limits of power, as power to prevail. (K. Deutsch, 19__).

To put this in mathematical formulation and figures greatly facilitates

thinking. 1 seeks to¹⁷

$$\text{maximize } e(q), \text{ subject to } h(q) \geq g(D),$$

that is, to maximize his payoff while keeping the other party away from any idea of defecting, by holding him at the cooperative strategy. This sets the limit of the range of q , which is equivalent to getting a solution, if¹⁸ one exists, to the linear equation in q ;

$$(\#) \quad h(q) = g(D).$$

In Figures 3a, 3b, we can see more clearly what is happening. The payoff for 2 (Figure 3a), given $p=D$, is at 2's current level line of $g(D)$ provided he cooperates. When q moves to the right of D^* , the point at which he is just at that level, then for 2 neither defection nor, of course, cooperation succeeds in sustaining the level. Both payoffs are less than $g(D)$. (But 2 defects, thus losing less.) So D^* is such a probability of 1's defection below which 2 always¹⁹ cooperates and above which 2 always defects. This is exactly what Axelrod says.

The equation (#) has a solution $q=D^*$ in the range between 0 and 1, except the case that the current case D is at too far to the right, shown by D' in Figure 3a. The resulting D^* is given by

$$D^* = \frac{R-S}{T-S} D + \frac{T-R}{T-P}$$

D^* is the maximum value of the frequency, (or probability,) of defection by 1 in order to 'squeeze' the most out of 2. He is thus a Bully measured by the degree

$$L = D^* - D.$$

This increment of the probability is the same as power defined and measured in the sense of Dahl (1957), with the slight modification that the control over actor is replaced by the control over outcomes (Hart, 1976). For, given that

Figure 3a
Payoff for 2

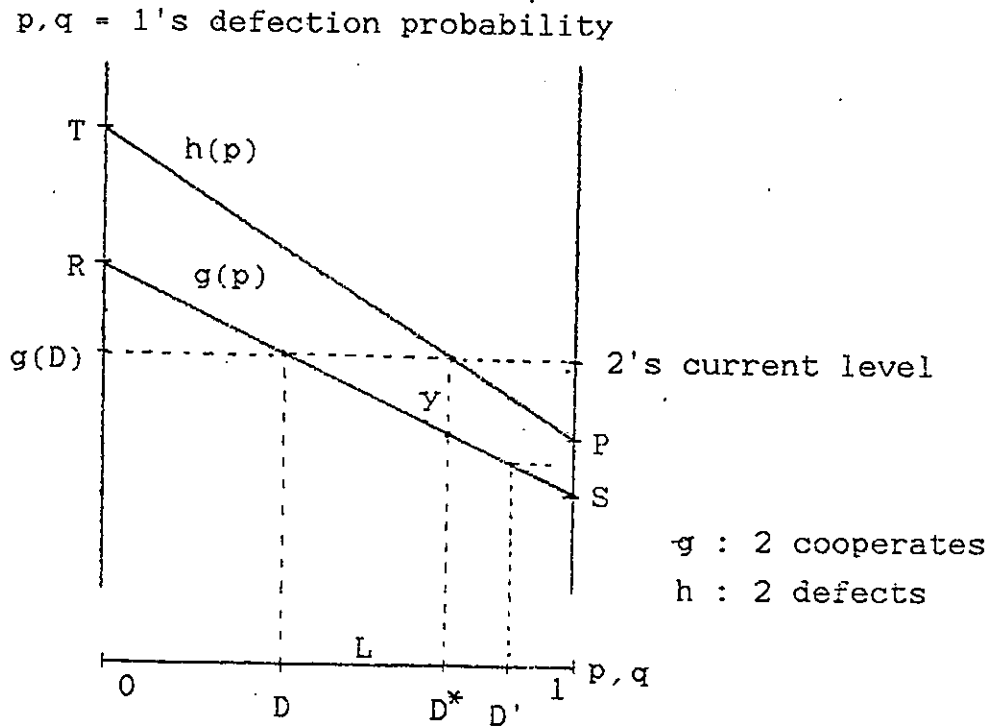
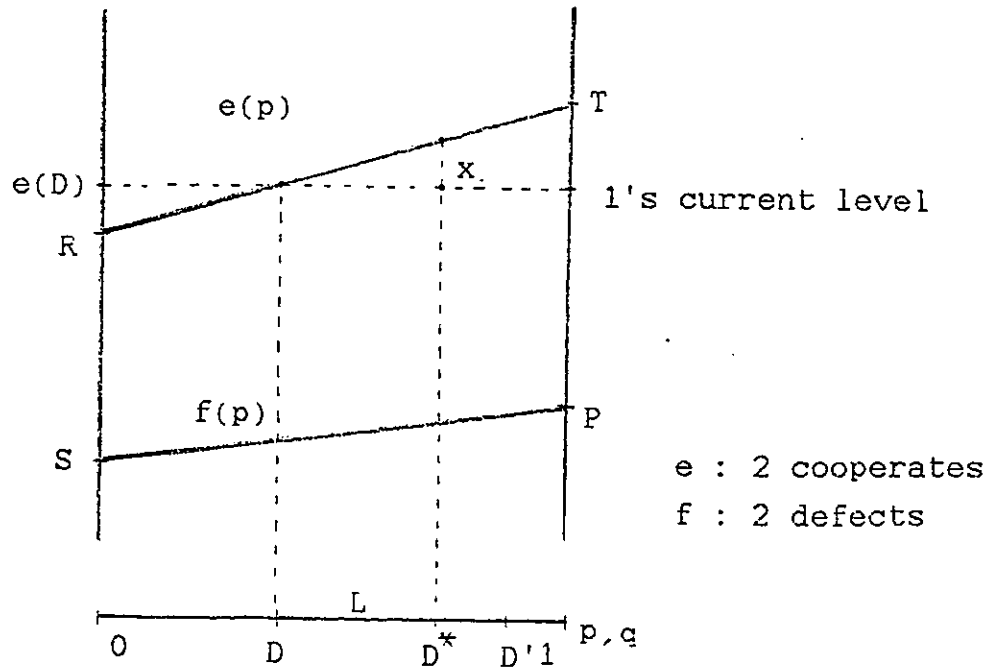


Figure 3b
Payoff for 1



2 cooperates; D is the probability of 1's defection provided he is a Bully, and D^* is the maximum (as long as 2 remains a cooperator) probability of 1's defection provided he is not a Bully. If we let the events

$$E = [1 \text{ defects and } 2 \text{ cooperates }],$$

which is favorable for 1, and

$$B = [1 \text{ is a Bully }],$$

then the probability of E increases by the existence of B by the degree

$$L = P(E | B) - P(E | \text{Not } B).$$

PROPERTIES AND QUALIFICATIONS OF LIMITS OF POWER

These values of D^* and L are obtained through solving the equation (#). We see in Figure 3a that a solution exists if and only if

$$T \geq g(D) \geq P.$$

When $P > g(D)$, it has no solution between 0 and 1. This, however, poses no difficulty. In fact $D^*=1$, for 1 can defect all the way up to complete certainty without provoking 2's defection certain.) (Remember that

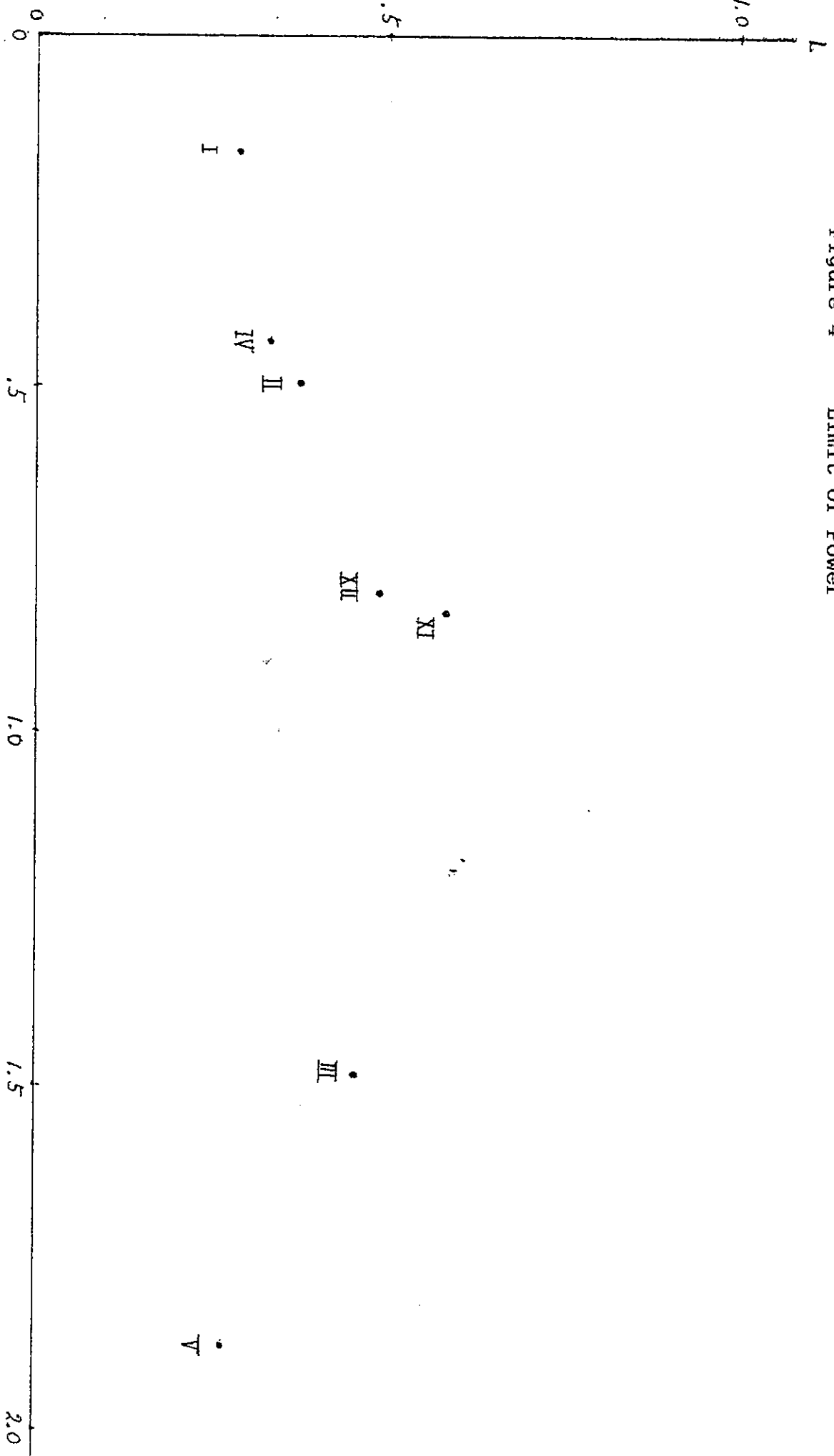
$$g(q) < h(q) < g(D)$$

will make the defection completely sure.)

L is called limit of power in order not to break the existing cooperation. L is measured across various conflict situations, i.e., prisoner's dilemmas. (See Table 2 and Figure 4.) It is at this point enough only to note that the most prominent and interesting feature observed is its unimodality, as may or may not be expected. It has a maximum at around a moderate degree of Conflict of Interest. Either departure, milder or severer, tends to make the limit more stringent. (The value of L lessens.)

Now L is power concept. We ask what is its nature bearing in mind

Figure 4 Limit of Power



distinction between deterrence and compellence (Schelling , 1966). He states that;

Deterrence involves setting the stage ----- by announcement, by rigging trip-wire, by incurring the obligation ----- and waiting Compellence, in contrast, usually involves initiating an action that can cease, or become harmless, only if the opponent responds. The overt act, the first step, is up to the side that makes the compellent threats. To deter, one digs in, or lays a minefield, and waits ----- in the interest of inaction. (p.71, italics original.)

Our concept is a deterrent.²⁰ 'Setting the stage' is I's defecting too much, 'obligation' is in order to avoid a disastrous 'downward spiral into a long series of mutual punishments,' as Axelrod calls it, and 'inaction' is to remain cooperative.

That we are dealing with a power concept of a deterrent variety may be the most fundamental elements, though not initially explicitly stated, in our analysis. Roughly speaking, deterrence is comparatively easier to carry out than compellence, and this facilitates analysis itself. For, as Schelling puts it,

"In addition to the question of 'when,' compellence usually involves questions of where, what, and how much. 'Do nothing' is simple, 'Do something' ambiguous." (op.cit., p.72)

Russett (1974) puts this comparison in rather perceptual terms, stating that

"Compellence is usually harder to do successfully because it is applied one must try to persuade the opponent to change his mind and change his acts, where as with deterrence one only needs to persuade him to keep on not doing whatever it is that one wants him not to do so." (p.256)

Thus analysis of deterrent situation is conventionally less difficult than that of compellent situations.

On the same ground economic analysis is more applicable to a deterrent situations rather than to a compellent ones. How much does I acquire by

having a power, and 2 lose by yielding to 1's power? In this respect we have meaningful results. The payoff to 1 of his defecting more often than L designated by x in Figure 3b, is $L(T-R)$, just as one sees by looking at the slope. To 2 the loss is $L(R-S)$ in absolute, designated as y in Figure 3a. Provided that the interpersonal comparison is legitimate, we then have three mathematically equivalent comparisons between the two;

$$(i) \quad x < y$$

$$(ii) \quad x - y = -2L\{R-(T+S)/2\}$$

$$(iii) \quad e_{x/y} = (T-R)/(R-S) < 1$$

The proof of (ii) is enough. It is usually assumed with prisoner's dilemma, mutual cooperation, with payoff R for both, has positive 'net' advantage over the strategy of alternating C and D. Thus the expression in (ii) is positive, and x-y negative.

1 wins x and 2 loses y. The relationship between x and y, (i), (ii), and (iii) has many meaningful interpretations, and different connotations as well. First, the most important observation is that the power-seeker, 1, acquires less than the other party, 2, loses. This fact itself proves (some degree of) the inefficacy for 1 himself of his own power-seeking moves. For 2, 1's moves may be construed as 'more punitive than acquisitive.' (Schelling (op. cit., p.34) uses these adjectives to characterize military power to deter.) In such a case, our power concept, L, is exactly 'deterrent power,' e.g. in alliance. For the group of players 1 and 2, as a collective, what nature of act is 1's power-seeking move? $x < y$ means that 1 fails to receive what 2 surrenders to 1. Where does the difference go? His act has 'drained' welfare away from the existing cooperation. The amount of welfare the group has lost is x-y, shown in (ii). The implication is obvious. What has drained is exactly the net mentioned above, advantage of cooperation which is 'nibbled,' by power of, and

in the proportion of, L.

Secondly, 1's power-seeking is as a whole punitive than acquisitive. However, this comparison is sometimes very close, as seen in the prisoner's dilemma V, where $x:y = 49:51$ meaning that it is a rather acquisitive case across all seven cases of prisoner's dilemma considered. The comparison of this kind cannot be given by $x-y$, since it is on a differing range of $T-S$. Thus $e=x/y$ denotes an 'efficacy of power' as acquisitive. Obviously $e < 1$, as is shown in (iii). It signifies acquisitive power around $e=1$, and punitive power around $e=0$. One may well define another 'efficacy of power' as punitive by the inversed ratio $e'=1/e$, Schelling's (op.cit.) 'power to hurt.'

Relationship between efficacy of power as acquisitive, e , and Conflict of Interest is almost clear though there is an anomaly. The greater (smaller) C.I. is, the more acquisitive (punitive) power tends to be. One may argue; when conflict is mild and the two parties cooperate well, the exercise of one's power will gain comparatively little while it hurts the other party substantially more. This is an ambiguous statement. Relationship between e and C.I. is anomalous at XI. Indeed C.I. is too global (in incorporating all elements S, P, R, T) to make analytic statement with. A closer look, instead, at e and r_2^r suggests some relation behind. In fact we have

$$e = (T-R)/(R-S) = (1-r_2^r)/r_2^r,$$

where r_2^r is called the reward coefficient;

$$r_2^r = (R-S)/(T-S),$$

and high R relative to S, T is equivalent to high r_2^r . e decreases with r_2^r and $r_2^r=1/2, 1$ correspond to $e=1, 0$.

An illustration using r_2^r , or R , is given. Various punitive actions of the U.S. taken recently against its trade partners, especially Japan, to eliminate their trade barriers are essentially punitive. The US already enjoys

a high level of reward, R , for cooperation. By its actions it would get relatively marginal additional benefit, while for the partners the effects could be catastrophic since their prosperity rests on the whole structure of cooperation. Of course the partner's 'free riding' behavior also can be analyzed from the viewpoint of prisoner's dilemma, as in collective goods approach (e.g. R. Hardin, 1982), There is fundamental distinction between the two, however, as to whether a power-seeker (or Bully) is conscious of the 'limit of power,' or equivalently, he feels himself responsible for maintaining cooperation. U.S. is conscious (and fits our model), but a free rider generally not.²¹

Efficacy of power is a 'transfer rate' of a payoff from one party to the other. We have another meaningful attribute of power, this time power itself. If one has power by the degree L , is it operative by the full amount? Should it be somehow qualitatively modified? In this respect, 'credibility' is probably an appropriate, if not the quite right, choice of word. Our model serves an approach to credibility questions as the following;

(a) If $T > g(D) \geq P$ then as seen in Figure 3a, 2 is threatened almost to his worst, D^* , because, we repeat, at the left of D^* one and the 'last' choice (defection, which he dare not take) is reserved for sustaining his current payoff level $g(D)$, whereas at the right even that choice does not achieve it. Mathematically speaking, a comparison with his current level

$$H(p) = h(p) - g(D)$$

alters its sign from positive to negative at $p = D^*$.

(b) If, in contrast, $P > g(D)$ (as when D is far at the right like D'), $H(p)$ stays positive ^{a//} the way, as in Figure 3a. He is not threatened to the very 'brink.' Despite the fact that $D^* = 1$ this case, the all certain defection of 1 poses no perfectly credible threat. This is due to the payoff structure that,

since the current payoff level is already so low, even below the mutual defection level P , he has not so much to lose, and 1's threat will go somewhat idle. This would endorse Russett's (op. cit.) insightful statement that

"In international politics, the establishment of trade and aid relations with another country ----- so that if necessary one may have something to withdraw ----- is a more subtle kind of investment." (p.259)

What is it that condition

$$P > g(D)$$

signifies? To solve the inequality would put it in the plain form to understand. This is equivalent to

$$D > (R-P)/(R-S).$$

Letting

$$P_c = (R-P)/(R-S)$$

we will readily understand that $D > P_c$ is warranted if and only if, the conflict is severe (C.I. is large in value.) For then obviously D is large, and furthermore P_c tends to be small although not proportionately. Thus two things work together to make the inequality very likely to hold. Table 2 (the 7th column) establishes this. A critical value, P_c , for values of D is called 'a critical probability'²² for credibility of power. When D goes beyond this value P_c would make the face-value power less rational and some moderation more reasonable, since the conflict is now too severe. This reasoning will lead to analysis of so called 'rule of anticipated reaction,' which will be discussed later.

[Illustration] In conclusion, we take as an illustration the prisoner's dilemma V, the most conspicuous one with

$$S=-50, P=-1, R=1, T=50.$$

Thus the game is almost zero-sum with $r_f^i = 1/50 = 0.02$, and the Conflict of

Table 3 Summary of various characteristics

Characteristics	Attributes	Game	(Rank Order)	Values
Conflict of Interest				
	the severest	V	(7)	C.I.=1.88
	the mildest	I	(1)	C.I.=0.17
Non-zero-sum				
	the least	V	(7)	$r_1 = 0.02$
	the most	I*	(1*)	$r_1 = 0.5$
Long-term advantage of cooperation				
	the least	I	(1)	$r_2 = 0.51$
	the most	V	(7)	$r_2 = 0.95$
Defection Probability				
	the largest	V	(7)	D=0.732
	the smallest	I	(1)	D=0.266
Critical Probability				
	the largest	II	(3)	$P_c = 0.909$
	the smallest	V	(7)	$P_c = 0.039$
Credibility Consideration				
	credible	I, IV, II, XII, XI (1, 2, 3, 4, 5)		
	incredible	III, V (6, 7)		
Maximum Reputation				
	the largest	V*	(7*)	$D^* = 1.0$
	the smallest	I	(1)	$D^* = 0.550$
Limit of Power				
	the largest	XI	(5)	L=0.587
Efficacy				
	the most acquisitive	V	(7)	e=0.961
	the most punitive	I	(1)	e=0.053

* has ties.

Interest is $C.I.=1.88$, the severest of all. It naturally means the defection probability is high, $D=0.732$. Benefit and the chance for cooperation are therefore low with $r_2=0.51$, which is very close to the absolute minimum, 0.5. The critical probability is as low as $P_c=0.039$. Thus we have $D > P_c$ by wide margin. This implies;

(i) We have $P > g(D)$ and therefore $D^*=1$. The limit of power is calculated to be $L=1-0.732=0.268$.

(ii) Even this small margin of the limit of power is to be discounted due to the credibility consideration.

Lastly, being almost zero-sum, the game transfers (by power) payoffs from one to another very efficaciously with $e=49/51=0.96123$. This time (limit of power) concept is acquisitive almost to the same degree that it is punitive.

Table 3 reviews various characteristics for conflict situations.

LIMITS OF POWER AND STABILITY OF COOPERATION

Since Olson (1968) considerably extended the horizon of the theoretical foundations of various forms of cooperative behavior, or 'collective (public) goods' in economic terms, much has been contributed from that viewpoint to political science in dealing with how cooperative action is achieved. A most prominent one is by Russett and Sullivan (1971), who propound ten useful recommendations, or even 'commandments,' as Olson dubs them, for strategies for achieving collective goods in international organizations. They range from such perceptual dimensions as an educational approach to the economic dimension of willingness to bear one's 'fair share' of the burden of paying the cost, but the latter dimension is more pragmatic and, relatively more tractable theoretically. The conditions set in economic terms for achieving collective goods are predominantly discussed in subsequent studies.²⁴

Despite these significant contributions, there is a serious lack of

elaborate analytic models to analyze cooperative behavior relating them to the most traditional perspective used to understand international politics; the realist view. Failure to link two fundamental concepts, cooperation and power, could hamper consistent and meaningful political science research into international politics. One may in principle assume, by limiting the issue to the economic or other non-security areas, that cooperation is insulated from any exercise of 'naked' power, but such an assumption seriously misrepresents the actual situation.

In that respect, special reference should be made to the 'Power and Interdependence' by Keohane and Nye (1977), which almost pinpoints the question. They

"use the concept interdependence to integrate rather than further to divide modernist and traditional approaches." (p.9, italics added), and contend

"There are important continuities, as well as marked differences, between the traditional politics of military security and the politics of economic and ecological interdependence." (p.10)

In their view, interdependence, if asymmetrical, can also be a source of power. For,

"A less dependent actor in a relationship often has a significant political resource, because changes in the relationship (which the actor may be able to initiate or threaten) will be less costly to that actor than to its partners." (p.11)

"Political bargaining is the usual means of translating potential [to affect outcome] into effects, and a lot is often lost in the translation." (ibid.)

The bargaining model is yet needed to substantiate the possibility of, and to measure, power.

The concept of limit of power is a rigorous, analytical framework to define how in general cooperation can persist among egoistic actors' maneuvers to prevail. One must here be cautious about what is implied by 'limit.' It signifies at the same time 'limit of cooperation,' since, by definition, if it

is exceeded cooperation will cease. In a very appropriate sense, we could say that limit of power is a 'cooperation-related' as well as a power-related concept. It enables us effectively to differentiate all possible political realities between two ideal types, the realist assumption and the interdependence assumption. Some possible applications are immediate. One is a concern with Keohane's (1984) 'after hegemony' question, which is in essence to ask if the decline of hegemony, such as the U.S.'s after World War II, leaves the world political economy more unstable. Another is that limit of power gives a clear and definite characterization to what Snidal (1983) states rather vaguely:

"Few of the issues of concern between nation states are of of a life and death nature where elimination from the international political system is at stake. The cost of being taken advantage of may be considerable, and they merit certainly being weary of, but risks of them are not unbearable." (p.26)

Essentially the limit of power is 'a margin' within which one actor's propensity to defect will not jeopardize an existing cooperation. An internal stability as it could be called, inherent 'flexibility' of cooperation would be a better choice of words to understand the substance of the problem. If it is large, cooperation can be sustained even by comparatively loose management. If small, then a partner's defection would constitute a considerable threat to cooperation, provided that it is credible. Liability to defect, if there is any, could be contained only by elaborate management. In case, however, it is not credible, inflexibility and incredibility work together yielding varying effects.

The magnitudes of L and C.I. characterize three phases of limit of power as seen in Table 4. The most remarkable fact observed is in phase (b) where L is maximal at the moderate degree of C.I.. First of all, since it covaries with the non-zero-sumness parameter, r_1^* , this is a highly meaningful result in

that limit of power is not a simply a matter of zero-sum or non-zero-sum. It means substantially more than that. In fact, Keohane and Nye rightly say;

"...power has always been an elusive concept....;now it is even more slippery [in power and interdependence]."
 "The difference between traditional international politics and ecological interdependence is not the difference between a world of 'zero-sum' and 'non-zero-sum' games." (op. cit., pp.10, 11;italics original).

The implication of the above result (maximality of L) would emerge in still more clear-cut manner, when cast in terms of their assumption that military power has become less effective²⁵ than fundamental power resource. Keohane and Nye's following observations provide the most relevant interpretation.

"Yet among industrialized, pluralist countries, the perceived margin of safety has widened: fears of attack in general declined, and fears of attacks by one another are virtually nonexistent." (First italics added.)

A rather loose management by 'the set of governing arrangements that affect relationships of interdependence,' referred to as 'international regimes,' is taking a substantive role for hegemony in the world political economy. (Keohane and Nye, 1977; Keohane, 1984; Axelrod and Keohane, 1985).

Phase	Game	C.I.	L.	Credibility	Illustrations
(a)	I	0.17 (small)	0.284 (small)	Credible	Alliance
(b)	XI	0.83 (medium)	0.587 (large)	Credible	Interdependence
(c)	V	1.88 (large)	0.268 (small)	Incredible	Bipolarity

Table 4. Three phases of limit of power (with game examples)

To the phase (a) also we could readily provide a sound interpretation. Obviously, Conflict of Interest is so mild that it is not hard to achieve cooperation. But the effect is not trivial. Successful cooperation is not

free from disputes and controversies, as Russett (1963a, p__) says metamorphically, "The seas were not entirely smooth, of course" concerning the Anglo-American alliance during the period of 1890-1913. During that period five outstanding issues had to be settled. (American tariff policy, the Bering Sea quarrel, the Alaskan boundary disputes, the Central American canal issue, and the Venezuelan boundary controversy.) A threat to defect is credible, since a crisis would tend to be more noticeable, highlighted against the already high level of cooperation, and sometimes unnecessarily magnified at the perceptual dimension.²⁶ Furthermore, as is shown by the low value of L, the margin dividing from the risk war is low. If both parties think of it worth while to keep cooperating, the danger of war should require serious and elaborate management. On these points Russett states;

"Thus five outstanding issues were settled over a fairly a short period, illustrating the basic underlying strength of Anglo-American relations. Neither government wanted war with the other. In the most serious crisis [the Venezuelan case], once the danger in which their intransigence had put them was apparent, both backed down to allow a peaceful settlement." (op.cit., p.5)

Generally speaking, of course, managing not to surpass the limit of power usually requires many long-term, multilateral, and even socio-psychological relationships and/or favorable external factors. In the case of the Anglo-American alliance, it was made possible by longstanding mutual 'responsiveness,' as Russett calls, between two countries, and Britain's fear of the German Empire.

The interpretation of the phase (c) seems less obvious. A high degree of Conflict of Interest, low limit of power i.e. inflexibility, and incredibility characterizes the situation, but with no clear interpretation. Nonetheless the most salient feature of three, severe Conflict of Interest, would suggest the realist's assumption. We then to ask about the stability,

since we have been largely interested in that consideration. In that respect, the balance of power was one of the most commonly pursued goals in various periods of history, but a large number of different models employed exist to interpret the world political system after the World War II. K. Waltz (1967) believes that "balance of power has ended" and bipolarity persists as an underlying characteristic of the system, whereas K. Deutsch and Singer (1964), denying the stability of polarity, and assert multipolarity. The model cannot deal with this argument, as it concerns the two-person game only.

We ask instead if the phase (c) is a suitable model with which to represent even approximately bipolarity after the World War II, as described by Waltz. In many respects it is suitable to the degree that the credibility of nuclear deterrence has been, and is being, questioned. Waltz contends

"Admittedly, the old balance-of-power model cannot be applied without modification to a world in which two states far exceed all others in the force at their disposal." (p.306)

New style balance of power is essentially bipolar. Two styles, old and new, contrast sharply. He characterizes flexibility as a main dividing factor, going on to say

"In balance of power politics, old style, flexibility of alignment made for rigidity of strategy or the limitation of freedom decision. In balance of power, new style, the obverse is true: rigidity of alignment in a two power world makes for flexibility of strategy or the enlargement of freedom of decision." (ibid., italics added.)

'Examination of national power as a means of control and national effort' is in a new perspective instead of 'international maneuver as a mode of adjustment.' Credibility is a typical question. The postwar American alliance network on the periphery of the Soviet Union and China was a successful strategy for the U.S.. Despite all this effort, including nuclear weaponry, maintaining credibility is generally a hard and not necessarily successful

task, as is shown by numerous studies.²⁷

UNDERSTANDING 'THE RULE OF ANTICIPATED REACTIONS'

Control over outcomes is a principal characteristic of power (Hart, 1976). If you control, then naturally you foresee. Not only you but he (your opponent, competitor, partner, etc.) will foresee and probably act accordingly. This 'rule,' or 'law,' is essentially what Carl Friedrich (1963) terms as the rule of anticipated reaction. Thus established power would assume a new, sophisticated characteristic that is related to learning. When first devised, the rule is was intended a role to explain influence virtually all by itself, but influence, according to him,

"is of vast scope and frequently serves to adjust an institutionalized structure of power, a system of rule, to the actualities of the power situation." (p.200)

Inevitably it renders the rule 'a relatively crude device,' (p.206) as Friedrich himself admits, for it provides neither a well-defined model nor a measure for the intensity. He should nonetheless be credited with proposing a general and pervasive law that is of great use in explaining power in various fields of politics. To cite some:²⁸ we have cases in; community power (Bachrach and Barartz, 1962, 1963), American government and politics (Neustadt, 1970, pp.45,238), international politics (Russett, 1974, p.259; Russett and Starr, 1984, p.557), public administration (Fesler, 1965, p.557), and power analysis itself (Nagel, 1975; Dahl, 1968).

The rule of anticipated reactions is the most mature and most highly developed stage that the concept of power has attained. Power then has become so unquestionably 'learnt' and established that only to have it is enough. You need not even exercise it. (Oppenheim, 1961) At least, neither an indication nor trace of exercising it is usually to be seen. So the rule

would challenge any theory of power analysis: Why is it so 'natural' and 'smooth'? Bachrach and Baratz suggest a very useful device for getting an answer, the concept of 'non-decision,' which we will later give a model since otherwise it too remains crude. Nagel (1975) briefly attempts the problem incorporating a feed-back model of learning. However, his success is partial and lacks conviction that the rule is explained as natural, presumably because he is too occupied with Simon-Blalock's causality approach to power, as translated in the so called path analysis. Though the approach is largely successful in Nagel's descriptive analysis of power, it is still open to doubt whether such a rigorous concept as 'causality' is the best paradigm to understand a full range of power. In fact, causality has many traps, pitfalls, and paradoxes.²⁹ There is more fundamental question whether there does exist such a thing as 'causality.' Rather, power is one of the most teleological concepts in social sciences, as most notably shown by K. Deutsch's (1966, esp. pp.30, 92) cybernetics approach to politics and power, whereas causality is the most non-teleological concept.

Instead, rationality and non-decision based on it are principal elements that underlie and explain the rule, as in the following. First, as is put by Rapoport and Chammah (1965, p.¹⁴) rationality is most typically seen in the situation of the zero-sum game, where it is strictly determined with nothing left for you to feel uncertain about. If the resulting 'value of the game' happens to be negative, or the one that makes you badly-off, you naturally *do not* play a losing game against a potential winner. It is, however, too simple to call only this the rule of anticipated reactions. We must note that not only a single game but all such 'nearly' zero-sum prisoner's dilemmas are never played, that is to say, all such games are suppressed. It leads us to what Bachrach and Baratz (1963) call non-decision, or to be specific, 'the practice

of limiting the scope of actual decision-making to "safe" issues by community values,...' (Their case is community power.) Moreover, this truncation of games whose C.I. values are large with, say

$$C.I. > c$$

makes the defection probability D substantially lower for the rest of the game, as long as D has an upward trend,³⁰ with positive regression coefficient against C.I.:

$$(\#\#) \quad D = a \text{ C.I.} + b \quad (a > 0)$$

See Figure 5, based on recapitulation of Figures 1, 2. This would leave the observed situation more inclined to cooperation between two actors. In fact, "even the ruthless tyrant is recurrently persuaded....." as C. Friedrich (loc. cit.) puts it, and people come to possess spurious 'power.' Thus not only is the rule explained, but we succeed in restoring 'another face of power,' expounded by the same authors (1962), in a concrete model.

Quite unexpectedly, this 'truncation issue' is more than a statistical technicality.³¹ The situation appears in political science problems, so that it would be potentially very dangerous to be unaware of it political science research; phenomena we work for may not come out as data, not for practical reasons, but because of their very nature. In power analysis, the most critical decision making, which we certainly want to know about, is almost never observable, precisely because it is the critical issue. This is Bachrach and Baratz's (1962) other face of power. Concealment is innate to definition, and almost all the time "power is truncated." More dangerously, the analyst himself may not be aware of the fact that what he is given is often already truncated. The result could be catastrophically misleading. Moreover, this is not specific to power analysis. In the case of communication in an alliance, the most important issues probably need not be

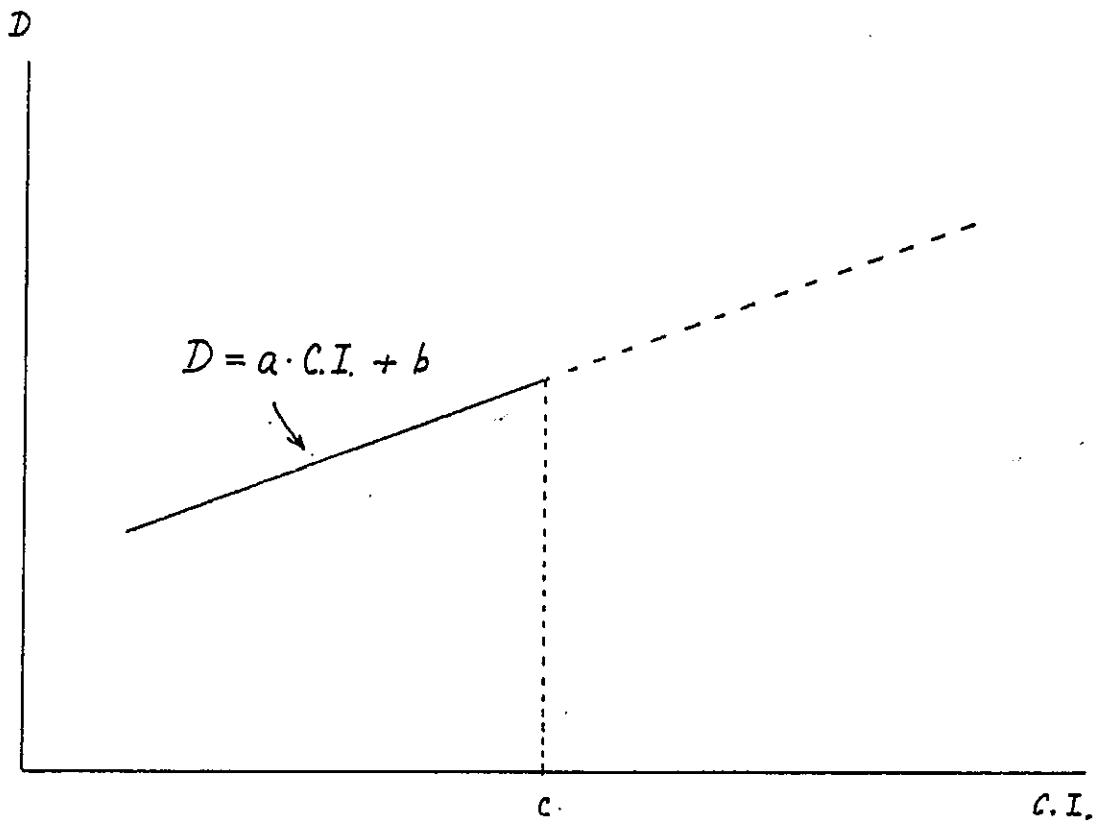


Figure 5.

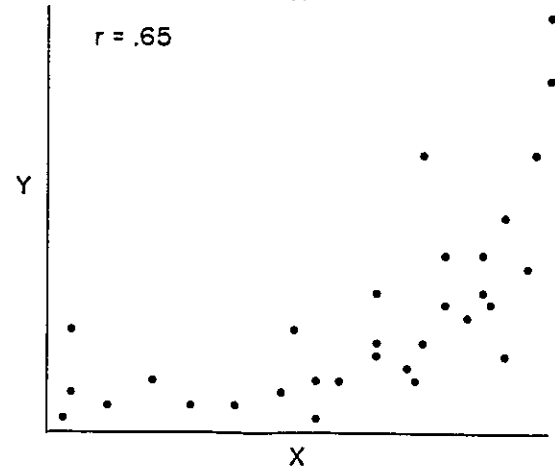
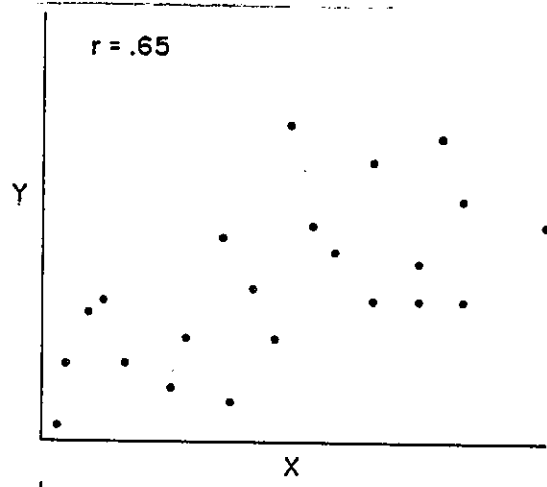
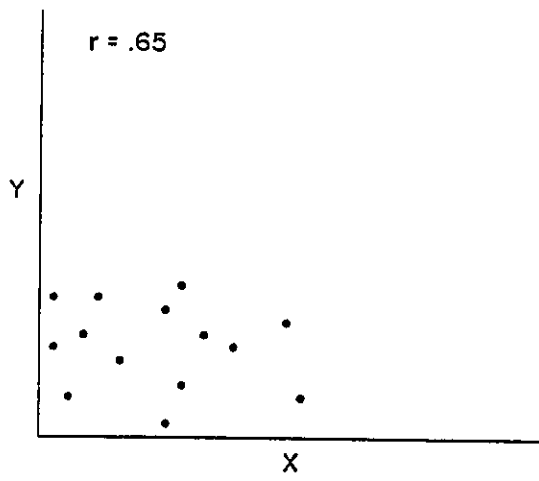
Scheme for truncation

even communicated. Russett (1963a) is in this respect very careful and modest in interpreting the decline of mutual 'responsiveness' data in the Anglo-American alliance, saying

"It is still possible in some cases that the two countries might be so close that they do not need formal agreement." (p.42)

Among 'diagnostics' of multivariate statistical data analysis, the so called multicollinearity in regression analysis seems to be most mentioned. It can greatly impair the accuracy of structural coefficient estimates, and political science research should be, and are, aware of this (Tufte, 1969, 1974; Nagel 1975). Misleading as it is, such a problem is less problematic than truncation. Truncation is related to a more fundamental level of statistics; sampling, selection of cases, and scope of analysis. Not much political science research has discussed this. To illustrate the nature of the problem, as is often observed and well known in educational statistics, a correlation coefficient between G.P.A. and entrance examination score tends to be lower than one would expect, since an entrance examination truncates (selects, statistically sensors, etc.) examinees, which probably affects the correlation, sometimes greatly. While an entrance examination is a deliberately designed process and is clearly noticeable, in political science it is easy to be less conscious of what is going on. After all, etimologically,³² 'to decide' is 'to cut off.' Electoral study provides similar examples. Unless you include data for the defeated candidates, your correlation coefficients could be greatly affected, depending upon what it is designed to detect. An electoral process is a typical truncation.

As a statistical illustration, Tufte's (1969, pp.647, 648; 1974, Fig. 3-18) three scatter plots with the same correlation coefficient, $r=0.65$, would give very instructive example.³³ If, beforehand, each were truncated at the



By the courtesy of Prof. E. Tufte

center of horizontal axis with the right half suppressed, the remaining left half would give as correlation coefficients each of nearly zero, a little below 0.65, and close to unity (linearity) respectively, completely different.

CONCLUDING REMARKS

Few single quotation would be more appropriate epitome of power in human society than Blaise Pascal's following passage in 'Pensee.' As Schelling (1984) quotes it;

The most unreasonable things in the world become more reasonable, because of the unruliness of men. What is less reasonable than to choose the eldest son of the queen to rule a state? We do not choose as captain of a ship the passenger who is one of the best of the family. This law would be absurd and unjust; but because men are so themselves, and always will be so, it becomes unreasonable and just. For whom will men choose, as the most virtuous and able? We at once come to blows as each claims to be the most virtuous and able. Let us then attach this quality to something undisputable. This is the king's eldest son. That is clear, and there is no dispute. Reason can do no better, for civil war is the greatest of evils. (p.204, italics added.)

Economics speaks of 'rationality' but politics speaks of 'reasonableness,' and the contrast is more than the connotations of the adjectives. Both are ways of reasoning, with a greatly different range of tasks; the former dealing with carefully faceted aspects of reality, but the latter with intractably uncertain³⁴ and widely diffused social reality, where uncertainty is the essence of the problem, and not the surrounding environment. To illustrate, the above 'king's eldest son' problem constitutes an N-person non-zero-sum game with each player having N strategies.³⁵ This should define as system parameters 'N to the (N+1)st power' payoff matrix elements, which by far exceeds even astronomical numbers even if the kingdom's population is only N=10,000 ! Even a committee of N=10 members has 100 billion payoff parameters for voting outcomes in electing a chairman. Such is the degree of uncertainties and one can thus imagine how greatly diffused the possibility is

confronting us in our human society. And yet, surprisingly enough, 'reasonable' thinking fights all its way to the complete elimination of those uncertainties.

'Reasonableness' is more than rhetorical. When rationality is more or less marred, as in the prisoner's dilemma, it sometimes is a virtually sole dependable guidance for sound reasoning. For Luce and Raiffa (1957) it means

that we predict that intelligent players will play accordingly and, furthermore, that they still do so even after full airing of the 'theory' of such a game.... (p.101, italics original)

By this criterion they conclude that: If prisoner's dilemma game is played but once, it is reasonable to single out the defection strategies, where as if the game is iterated for finite (!) times, then it is not despite the fact that it is Nash equilibrium. Whatever the content of 'reasonable,' at least one very simple game (actually, matching of a penny) cannot be solved without recourse to this kind of notion. Schelling (1960) asks you to

"Name 'heads' or 'tails.'" If you and your partner name the same, you both win a game." (p.56)

How can one understand that out of 36 respondents only 6 choose "tails" ? Calling the solution 'a prominent solution' or 'a focal point,' Schelling cites, as what underlies the prominence; inherent order of things, geometrical symmetry, terrain, status quo, proportionality, etc.. Less specifically, Deutsch (1966) gives 'information,' 'pattern,' 'form,' 'Gestalt,' 'state description,' 'distribution function,' or 'negative entropy' as an access to the treatment of science.

By and large, power resides in the realm of 'reasonableness.' No 'rational' thinking can explain the king's eldest son case. No purely mathematical thinking seems realistic, although this is rather extreme case. However, the area of political economy may be the one where rational thinking

is also very effective. Just as the above cited assertion of Luce and Raiffa's shows, rationality and reasonableness do differ only continuously, infiltrating into each other around the prisoner's dilemma. Many studies in economics, especially duopoly theory, challenge the limits of rationality and reach for, consciously or not, power-related concepts; 'dynamic inconsistency' in policy planning (Kydland and Prescott, 1977), 'the chain store paradox' for entrants (Selten, 1978), 'demonstration effect' (Scherer, 1980), and finally 'reputation' (Kreps and Wilson, 1982).

Despite these advances, however, if power is really to be reached by rationality, which will be surely quite a break-through for political economy, it is essential that rationality be so revised as to include inductive rationality. For when only the deductive form "If so ... , then so" (Rapoport, 1966, p.147) is permitted as rationality, one would be trapped in a logical circularity in explaining 'power.' Most typically, successive reputations³⁶ along time $p(0)$, $p(1)$, $p(2)$,, $p(T)$ are calculated, essentially according to a formula of the form

$$p(t+1)=F(p(t)), \quad t=0, 1, 2, \dots, T-1,$$

where F is a certain function from $[0, 1]$ onto itself. An example is Bayes' rule. But the problem is this; to calculate the final reputation $p(T)$, which we want to obtain, requires eventually the initial endowment of the value of $p(0)$, for which one is in turn forced to presume like "Since, up to that time (0), so-and-so government has been very credible ... ," and hence led, practically,³⁷ to a circular argument. It thus follows that any relevant system parameters should not remain hypothetical, but be empirically, ~~but~~ consistently, determined. and

To define inductive rationality is an open task. Yet it is essential for game theory itself in order to extend its validity to a broader social science

area. Three tentative minimum conditions for inductive rationality are as follows:

(a) It should be fully consistent with deductive rationality, that is, explain meaningfully the relationship between theoretical concepts.

(b) Experimental results should be simple, stable and significant.

(c) It should be as minimal as possible not to interrupt the deductive rationality.

The contribution of the paper is to claim that an inductive relationship (##) accomplishes explanation and measurement of power. Furthermore, Kahneman and Tversky³⁸ (e.g., 1978) have accumulated very interesting findings that are related to cognitive aspects of decision making, and will be useful in formulating inductive rationality. In fact, it would be a very challenging task to incorporate them into game theory and thereby fill a gap between political science and economics. It would be even necessary in today's world of political economy.

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References with (*) are in Rosenau (1969).

Notes

¹ The use of the physical terminology 'spectrum' is not of course new in political science. A forerunner in international politics is Russett's (1971, p.261) 'coercion spectrum' with reward and punishment at each end. His usage is successful since the two concepts are distinct enough in many ways. Cooperation and power are less so.

² Mathematically, the change of coordinate system.

³ The original original writer to introduce this topic, Carl Friedrich (1963), states

"Influence flows into the human relation whenever the influencer's reaction might spell disadvantage and even disaster for the actor, who foresees the effect the action might have and alters it more or less in accordance with this foresight... It is therefore characteristic of influence that it often counteracts the explicit command relationship. The mutuality of the power relationship is frequently safeguarded by the presence of measure of influence. It has often been noted that even the most ruthless tyrant is recurrently persuaded to alter his conduct by the thought of the reaction of the 'people' or some other group to what he proposes to do." (p.201)

Bachrach and Baratz (1962, 1963) describe the rule as underlying factor for another face of their 'two faces of power.' They coin the notion of a 'non-decision' as against 'decision-making,' which is very close to the rule, but specific to the community power. It is at this point enough, however, to note that, for anticipated reactions or non-decision, people have to more or less cooperate in making the issue a 'non-issue.'

⁴ Rapoport and Chammah (1965, p.14) call this game 'rational conflict.'

⁵ One should be very cautious in contending that power is 'irrational.' First, the so called level of analysis problem (Singer, 1961) heeded. Getting the analysis level different, e.g., from international level to individual decision-making level, usually affects the assumed rationality that underlies analysis. Bureaucratic politics or organizational process explains what otherwise is not rational as being rational. Secondly, rationality depends upon the span of time, long term vs. short term, in which it is considered. As an illustration of these, "The perceptions of the issues (such as those of killing as a defector) differ when seen from the global/ecological perspective rather than from the domestic perspective [in which this kind of act may be very rational]." (Russett and Starr, 1981, p.518, italics added.) Thirdly, the connotation of the term is 'irrational' might be misleading. 'Non-rational' is more appropriate to mean simply the logical negative of 'rational.'

At the individual decision-making level of analysis, which we do not specifically assume here, the irrationality is essentially intended to mean the way exterior information is processed, one as related to 'accurate information, correct evaluation, and 'consciousness of calculation.' (S. Verba, 1961, pp.107, 108. He uses the term 'non-rationality.') Russett, however, "contends that for most purpose of analyzing national decision-making the rationality- irrationality distinction is not useful," We are not affected by these argument, since our model is set at nation-actor,

i.e., more abstract, level a rationality/irrationality approach is useful to explain, and measure the degree of cooperation, power, and their transitional phase.

⁶ Snyder and Diesing (1977) deals with 13 historical cases of crisis, from Fashoda of 1898 to Cuba of 1962, some of which, modelled in 'bully,' will partly interest us. But, we deal with only the notion of 'bully' as Axelrod (1984) describes it.

⁷ Brams (1985) disagrees. Indeed, in a general crisis management model requires: What degree of irrationality is to be introduced even to describe the situation. It is hard, since it varies from crisis to crisis, virtually as often as the number of cases themselves. What then is 'a model'? It pays more to acknowledge 'prisoner's dilemma' as a standard frame of non-rationality from which to measure dislocation.

⁸ Their direct conclusion is "No, there appears to be no way around this dilemma. We do not believe there is anything irrational or perverse about the choice [the defection] ..." Their indirect conclusion, cited here, is more important and insightful. Harsanyi (1965) contends essentially the same.

⁹ In the formulation of the Cuban missile crisis, Brams (1985) gives a 2 by 2 game, different from the usual crisis model of Chicken, where the cycle of payoffs arises. In an effort to stop the cycle at the actual outcome (blockade, withdrawal), he claims some 'qualitatively different sorts of explanation' that

"if it is reasonable to assume that, because the conflict occurred in the Carribean in the U.S. sphere of influence, the United States could exercise greater power than the Soviet Union, ..." (p.57, italics added.) Incidentally, the word 'reasonable' turns out to have important meaning. See the Concluding Remarks.

¹⁰ In connection with this point we can mention that the concept of reputation has recently been introduced in the microeconomic analysis of oligopoly, where power concept has so far been considered rather as alien, at least overtly. By employing the concept of reputation, economic analysis has come very close to using the power concept, although not exactly so, since power is not reached through deductive reasoning only. For reference, refer to the Concluding Remarks.

¹¹ Morton Kaplan (1957) contends "... the definition of power in terms of attainment of goals is tautological. It provides no independent measure of power." (p.12) By this he implies that measurability is a part of concept and/or that, methodologically, to measure power helps avoid the jeopardy of logical circularity.

See also Riker (1964) which essentially contends that to measure power is to conceptualize power.

¹² An endowment of these probabilities a priori might lead to logical circularity in political science research. The author is, however, giving the way how observed facts will transform one's prior belief, provided it is in a numerical figure. (Refer to the Concluding Remarks.)

¹³ Axelrod's Conflict of Interest is first defined for Nash's (1950, 1953) bargaining game, where 'no agreement point' should be specified. He sets it at (P, P) so that the normalization is done in reference to T and P.

After normalization of S, P, R, T to s, p, r, t so that p=0, t=1, let us denote the efficient frontier by

$$(x, f(x)), \quad s \leq x \leq 1.$$

Then we have, in a definite integral,

$$C.I. = \int_s^1 (1-f(x))dx.$$

¹⁴ This time S=P, R=T and, since S=-T, four outcomes would become (R, R), (-R, R), (R, -R), (-R, -R).

¹⁵ $r_2^r - 1/2$ signifies a relative long-term net advantage of cooperation.

¹⁶ This case where $h(q) > g(D)$ leaves some ambiguity as to how to evaluate the probability of defection. Yet, it poses no essential difficulty, since we are to get maximal, possible limit of power. If ever we are certain that there is any definite substantial contribution to that probability from that case, it would enable us to get the exact value.

¹⁷ Though a very simple one, this expression is in the form of a linear programming problem. This compares with the 'power base approach' to power, which, symbolically, could be represented as

$$\text{Power} = f(\text{Population, Area, GNP, Armed Forces, } \dots).$$

The latter may well be called a 'statistical' approach, since one can apply linear regression techniques to estimate f.

¹⁸ q should be between 0 and 1.

¹⁹ The aim of this paper is to deal with how and to what degree cooperation is undermined by power. If we let two events

$$A = [2 \text{ cooperates}], \quad B = [2 \text{ defects}],$$

we thus initiate with, or focus our attention to, A only. One may ask if it is still valid for us to use Rapoport and Chammah's data, D, which is originally defined and measured for total possibilities A U B (a set-theoretic union). Confining the scope only to A causes practically no serious problem, because there are no a priori reasons at all to assume that D would then become greater (i.e. 'people' are generally 'meanies'), or smaller (i.e. they are 'good guys' or even 'suckers'). D remains a good approximation.

²⁰ One is cautioned against thinking that L itself is 'deterrent power,' or power to deter. Instead, the fact it is power is based on the deterrent factors underlying the situation.

²¹ I do not mean that a free rider is an unreasonable and more or less capricious being who behaves rather arbitrarily. Far from that, as R. Hardin (p.) argues,

"a sophisticated egoist might successfully take a free ride on a convention for dealing with an iterated Prisoner's Dilemma." By 'convention' he (or originally D. Lewis) means whatever enables "the players of the iterated

coordination game" to "successfully achieve communication to cooperate," which is very similar to Schelling's (1976) concepts of 'prominent solution' or 'focal point.' Thus a free rider may be doing so, very intellectually, and tenaciously. Hardin goes on to say "..... for me to free ride without serious expectation of sanctions may require that I have already established a pattern of iconoclastic free riding' and "... one can establish a reputation for almost anything, including self-preserving irrationality." (*Italics added.*) To be a successful free-rider requires a reputation, as does the power concept.

²² This has practically nothing to do with Ellsberg's (1975) 'critical probability,' which is a perceived 'firmness' to stand in Chicken game. However, there is some degree of mathematical resemblance.

²³ To compute e , $(1-r_2^2)/r_2^2$ will also do.

²⁴ Cost sharing schemes in international organization (Olson, 1971), public goods in political issues cast on a two-dimensional cost plane (Snidal, 1979), group size and individual contributions (Frolich et al., 1975; Schofield, 1975; Hamburger, 1975), etc.

²⁵ Of course this basic understanding is by no means new (e.g. Russett, 1971).

²⁶ These observations could be posed in terms of the so-called Weber-Fechner's law in psychology.

²⁷ Russett (1963b, 1967), Huth and Russett (1984).

²⁸ Not limited to literatures that explicitly mention the rule.

²⁹ To cite some, the 'paradox of confirmation' is one of the most striking: We can prove, by taking contraposition, that a hypothesis that 'All ravens are black' (if raven, then black) is confirmed by any non-raven non-black things, say, a white handkerchief. (Suppes, 1966).

³⁰ In fact

$$D = 0.274 \text{ C.I.} + 0.172$$

(7.20) (4.34)

with $r = 0.995$, and $r^2 = 0.912$.

³¹ How to deal with truncated data is a very important problem in mathematical statistics, and the theory also has wide applicability in applied fields. For social scientists, Moses (1978) is a good introductory summary.

³² Webster's New Third International Dictionary

³³ The author is very grateful for Prof. Tufte, who permitted the usage of original figures.

³⁴ In this context, Schelling (1984) describes the fundamental difficulty to state uncertainty itself rigorously.

"The question is often raised whether game theory restrict its empirical applicability by postulating mental giants with nerves of steel --- perfectly rational amoral deciders who have access ex officio to the