COMMITTEE IV
A Critical Assessment of
the Achievements of the
Economic Approach

DRAFT - 8/15/87
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THE ECONOMIC APPROACH TO INTERNATIONAL RELATIONS

by

Peter Bernholz
Institute for Social Sciences
University of Basel
Basel, SWITZERLAND

The Sixteenth International Conference on the Unity of the Sciences
Atlanta, Georgia November 26-29, 1987

Professor Dr. Peter Bernholz
Institut für Sozialwissenschaften
Universität Basel
Switzerland

The Economic Approach to International Relations

1. Introduction

The economic approach to international relations has enjoyed growing importance over the last two decades among the different approaches employed in this field. In the USA it has been used and developed more by political scientists than by economists. A main reason for this success of the economic approach is probably the better developed apparatus of economics, which usually employs the assumption of rational actors with unchanging preferences, trying to reach their ends given certain environmental, institutional and resource restrictions. Models of this type allow the derivation of a number of powerful results, especially as a consequence of parameter changes describing changes in the environment, in institutions and in resources. Moreover, the structuring of models makes it easier to organize, to ask and to answer the problems and questions pertaining to international relations.

The economic approach is partly related to the older "realist" tradition (Waltz 1979, 1986; Keohane 1986). But it is more general since it need not, though it can assume that nation states are the only and moreover, unitary actors in the international system. For the property rights and the public choice approaches allow it to look into the reasons for the existence of states (sections 2.1 - 2.2) and, more importantly, into domestic factors influencing the behavior of states (sections 3.3, 3.4, 4.3). It is in no way limited to state actors or to consider only wars and the use or threat of force in international relations (section 3.1).

Compared to historical or legal approaches to the study of international relations the economic approach has the clear advantage (and danger) of

being able to derive general and testable relationships and propositions. In this respect, it is also more powerful than the behavioral and psychological approaches, which can turn their attention only to limited aspects of international systems. Moreover, these approaches do not adequately represent the restrictions on the behavior of actors stressed by the economic method. As far as this holds true, they have to postulate and to explain either changes of individual preferences, or in the composition of decision-making groups, to be able to derive changes of government action and in international relations. This is not only a far-reaching limitation but may also make it difficult to reach general conclusions.

The economic approach is also somewhat related to the systems approach (Deutsch 1966,) to international relations. The systems approach has the definite advantage of drawing attention to the systemic relationship between the whole international system and its parts. It takes feedbacks into account and makes clear that the behavior of the subunits is also determined by the nature and structure of the whole system. Economics has implied since Quesnay and Adam Smith the systems approach. It applies systemic restrictions influencing the behavior of individuals and groups and also feedbacks, since e.g., prices, profits, investments and incomes influence the behavior of agents and are themselves determined by their supply and demand. Similar feedbacks are also present in the model used as a framework in the following sections. One advantage of the economic approach, is, however, that it is better able to fill in concretely, the inter-relationships of the system.

The advantages of the economic approach do not imply that it is without weaknesses. The international system and the different relationships among its essential actors are highly complicated (sections 4 and 5). As a consequence, it is too demanding to assume complete information of individual actors. Moreover, in some situations it may be very difficult, or even impossible, to find out what it means to act rationally. Now one has to admit that the economic approach to international relations, like economics generally, has rather neglected these important problems, though there seems - at least to the present author - to be no inherent necessity to do so. Here psychological and behavioral approaches (see, e.g., Jervis 1976;

Boulding 1959) might be successfully employed, including the theory of satisficing behavior (Herbert A. Simon, 1957, 1958; Sauermann and Selten, 1962).

Finally, social choice, logrolling and voting theory has since Kenneth Arrow's path-breaking work of the 1950s (1963) carefully studied the contradictions and dilemmas arising from non-oligarchic collective decision-making even if all individual actors act rationally (according to transitive individual preferences). This possible reason for collective outcomes not being wanted by anyone of the acting individuals, has only been mentioned, but not been carefully studied (Bueno de Mesquita, 1980, pp. 365-368) and taken into account in the field of international relations (but see the example in Bernholz, 1985, pp. 14-15, 102-103). This, then, is certainly a problem neglected by the economic approach until now.

2. The International System as an Anarchical, Self-organizing System

2.1. Causes for the Existence of the International System

The public goods' nature of law, order, human and property rights leads to free riding and thus to anarchy among big groups of people (Hobbes, 1939). To solve this prisoner's dilemma, everybody can agree to be forced to respect law and property rights and to bear his part of the burden to provide them (Buchanan, 1975). Thus an agency (the state) is created trying to monopolize power (Max Weber, 1956).

Historically, states have often been created and enlarged by "elites" to exploit a subjugated population. Even in this case the subjects may be better off than under anarchy, if the rulers leave them part of the additional product made available through law and order to save more in enforcement costs.

2.2 Why Several States Exist and Partial International Anarchy Remains

If first, marginal enforcement costs for law and order are increasing, then the optimal size of states can be (much) smaller than a world state. In

this vein David Friedman (1977) tries to explain the size and shape of states by assuming that they maximize their tax revenues net of enforcement costs. Second, if different states exist and if their military power decreases with the distance from their "power center" (Boulding, 1962), then an expansion of states to an optimal size, which would reduce their number, may be prevented because of the military power of other states (Figure 1).

3. Consequences of Partial International Anarchy

3.1 Cooperation Among States and the Relationship Between States and Non-State Actors

With partial international anarchy, an insufficient supply of international law and property rights, as well as conflicting national laws have to be expected. States will only respect international law and the law of other states if it is either in their own long-term interest or if damage from other states is threatening if they do not comply. Examples are the very incomplete law of the sea, fishing rights (overfishing), the rights concerning deep-sea exploitation of minerals, air and sea pollution, trade wars, etc. (Frey, 1985).

But since states are participating in a repeated prisoner's dilemma game with indefinite duration, some cooperation, some body of international law and the existence of some international organizations will be observed. This is especially true, if a few big states are present (Olson's small group; see 1968, 1982) or, better, if a preponderant power exists (Kindleberger, 1974, 1976, Keohane, 1982, 1984, for a critique, Snidal, 1985). In this case, some important international public goods like the Bretton Woods international monetary system, GATT, the International Court in The Hague, the UNO or NATO will be provided. The theory predicts even (Olson and Zeckhauser, 1966) that the preponderant and (or) the other big powers will carry a larger than proportionate burden to finance these institutions.

Non-state actors can have influence in the international system, even outweighing that of some states. This presupposes, however, that they can

either control at least one state or have common interests with the rulers. Otherwise governments can use the monopoly of military power to dissolve, nationalize or restrict non-state actors like multi-national corporations, international organizations and courts.

3.2 A Model Framework to study Problems of International Relations

In the following sections we will set up, as a background, a simple model which is presented mathematically in Appendix A. Here we intend to discuss its main features graphically and verbally.

We begin with the assumption that the leadership of each country is concerned with only two aims, the well-being of its citizens, as reflected by their private consumption, and the level of security relative to other countries. The security level is defined as the amount of arms available to the country in its power center, minus the amount of arms which the strongest other country can employ at this very power center. The latter amount is determined by the arms of the potential opponent at its own center minus the costs of "transporting" them to the power center of the home country. These costs are assumed to be linearly dependent on the respective distance between the power center the amount of arma available and are measured in units of "arms". E.g., in Fig. 1, A_{3t} is the amount of arms of country 3 at its power center in period t, d_{34} the distance to 4's power center and τ_{3t} the cost for 3 to transport one unit of arms one km in period t. Thus one gets $A_{3t} - d_{34}\tau_{3t}A_{3t}$ as state 3's potential arms level in the power center of 4. The difference to A_{4t} is country 4's security level against 3 in period t, S_{43t}. The relevant security level refers to the strongest potential opponent in the own power center (for state 4 this is state 4 in Fig.1).

Figure 1 here

Governments are not only interested in the well-being of their citizens and in the security level of the present period, but also in that of all future periods. But obviously, the future is not as important as the present. Thus, we assume that the leadership of the country has a period utility

function which is unchanged (stationary) for all periods and in which the utility depends on the amounts of the private consumption good and the security level. These period utilities are the more discounted the further they are in the future. Moreover, we assume that the relevant discount factor is the greater, the less the country is politically and economically centralized (see next section).

Governments maximize the discounted sum of all future utilities subject to objective conditions limiting their spheres of actions (restrictions). This is equivalent to saying that they act rationally and consistently to reach their aims as far as the situation allows. Turning to the assumptions concerning the limiting conditions, we have already mentioned the restriction concerning the costs of deploying arms over a distance (Boulding, 1962). Second, we note that the possible production of the private consumption good and of arms is restricted by the available amounts of labor, land, a capital good (which, for simplicity, we take to be identical with the consumption good) and the known technology. The amount of the capital good is reduced by depreciation and can be increased by investment in the preceding period, which, however, reduces the amount of the private good which can be consumed in the period of investment.

Besides investment, innovation takes place as a consequence of accruing new knowledge which may be incorporated into the production processes by which the private goods,or arms, are produced. We postulate that the rate of innovation is the higher, the more a country is politically and economically decentralized. Next, it is assumed that war during period t destroys a part of the capital good, of labor and of arms available in that period and that this part is increasing with the levels of arms employed by the two sides of the conflict.

Some features of the model are illustrated in Figs. 2 and 3. FF' is the so-called production possibility curve which describes the combinations of private good minus investment and arms which can at best be produced in country i in period t, given the available amounts of labor, capital good and land, and the production technology. Innovation in period t shifts this curve to GG' in period t+1. The same result is obtained by investing in

period t an additional amount ΔI_{it} to get more of the capital good in t+1. In this case, however, the greatest amounts available in period t for consumption and arms are given by the dashed curve, since resources have to be diverted to investment.

Figures 2 and 3 here

I_1, I_2 and I_3 are indifference curves, i.e., curves along which the period utility is constant. Since more of the private good and/or arms is preferred by the government, I_3 represents a higher utility than I_2, and I_2 than I_1. Obviously, with OFF' as the set of feasible alternatives, A is the optimal point preferred by the government, if the utility levels of later periods are taken as given. Note, moreover, that the indifference curves are drawn for a given amount of arms of the strongest other country. For the home country is interested only in its security level, i.e., in the difference of the arms available in its power center.

We assume further that in more centralized systems the government has to respond more strongly to the wishes of the population concerning the private good (see section 3.3). This implies that its indifference curves for period t are flatter than for more centralized systems (oligarchies, dictatorships). The dashed indifference curve in Fig. 3 depicts such a situation. The corresponding optimal point B implies more consumption and less arms than optimal point A, which is selected by a more centralized system.

3.3 Some Results of Comparative Statistics

Additional investment ΔI_{it} in period t leads to an optimal plan C in that period, but to B in period t+1. (see Fig. 2, compare also Appendix A.4). This implies that more arms are produced for period t+1, but that less are available in t. Thus an effort to increase the security level of a nation by investment may endanger its present survival. Any intertemporal consideration of the development of the relative power of states and the consequences for international conflict has to take this fact into account, as has been done by Niou and Ordeshook (1987) in his balance of power model.

A shift of the production possibility curve to the right in t+1 from FF' to GG', also takes place if population and/or territory have grown in period t. Note that this also leads to an increase of the (optimal) amount of arms produced from A_{i1} to A_{i2}, though the international situation has not changed at all. The same is true if innovation takes place, even if it is limited to the production function for the private good, i.e., turns FF' around F' clockwise to the right.

Consider next the possibility that state j having the strongest arms position in the power center of country i increases the production of arms. In this case, the security level of state i is decreased, the indifference curves I_1, I_2 and I_3 in Fig. 2 are shifted to the right and become steeper. It follows that i will react by decreasing the production of the private good and by raising the production of arms. This will lead to a similar reaction by other countries if i is their strongest potential opponent etc. This implies that an arms race may be initiated (see section 5.1). It is also probable that, as a consequence, country i increases its investment to have more capital goods available in the following periods to be able to produce more arms and more private goods in these periods.

Next, it follows from our assumptions that the production possibility curve is further to the left (other factors like available technology and labor force equal) the smaller a country. This implies that the smaller the country the smaller its security level will be. If the country is small enough, the security level may even become negative. The country may then be dependent on alliances and/or the ends of other states for its security and even for its survival (but compare also section 5.2 on deterrence). This would suggest that smaller states are more "peace-loving" than bigger ones as long as they are not neighbors of other small states and/or as long as the intervention of bigger states has to be expected in wars with small neighbors.

We turn now to the assumption that states which are less centralized politically and economically do have flatter period indifference curves and do discount future utilities more strongly. What are the reasons for these assumptions and what are their consequences? First, in decentralized market

economies with private property individuals and their voluntary associations and privately formed business firms are entitled to make the major part of consumption and investment decisions. It is thus more difficult for the government than in a centralized planned economy to appropriate resources for arms production. Second, in a democratic decentralized political system, the government has to rely on majority decisions to extract resources for arms. But the parties competing for power have to win elections, i.e., majorities of votes. Now voters are usually rather uninformed, under normal conditions, about foreign policy and the levels of foreign military armament. They are not usually much influenced by foreign events and the influence of their single vote is negligible. Thus, it is rational for them not to be well-informed about foreign policy matters. Most citizens consequently prefer those parties not burdening them with perceivably higher taxes for arms. It follows that governments in democratic and market-oriented systems will spend relatively less on arms given otherwise equal conditions. The population will only be prepared to sacrifice more in case of actual or threatening war. It would seem to follow that strongly decentralized systems should be less likely to initiate war (Organski and Kugler 1980; Rummel 1983).

The fact that governments have to be (re)elected also concentrates their attention on the date of the next election. Decisions concerning the future periods after that date will be subordinated to measures helping to win a majority in the next election. This then explains the higher discount rate of politically more decentralized countries.

Some consequences of these relationships follow immediately. Politically more decentralized systems are less bent to value highly the future acquisition of foreign provinces and population, to increase their consumption and security levels in later periods. As a consequence, they will produce less arms in the present and also invest less in raising the production of arms in the following periods to a level necessary for future conquest. These results again make such countries less likely to initiate war.

We conclude by observing that more decentralized systems are usually more innovative. Private property and markets with scarcity prices motivate

people much more to innovate because they have more rights to appropriate the fruits of their efforts. Information and factors of production can be brought together by selling and buying and by financing the necessary investments with the help of credit. Scarcity prices give signals as to which innovations might be valuable and profitable. Firms not innovating are threatened by the new and better products or production processes of more innovative competitors. All this is not true for a bureaucratic and hierarchical system which is more or less centrally planned and stifled by bureaucratic decisions (Olson 1982, North 1981). It is obvious that this innovative superiority of more decentralized systems shifts the production possibility curve FF' in Fig. 3 more rapidly to the right, thus in a sense counteracting the influences of a more decentralized political system to produce less arms. This suggests that the past expansion of western European countries, their imperialism from about 1500 until 1914 is mainly a consequence of their innovative capacity and not of changes in the aims of governments (for a discussion of the relevant domestic political forces, see section 4.3).

3.4 Factors Shaping the Long-term Developments of the Power of States and the Structure of the International System

We begin by introducing some definitions (for formal definitions see Appendix A.3) A state will be called an essential actor if no other nation has a greater amount of arms available in its power center than itself. This implies that its security level is positive. In Fig. 1 states 1, 3, 4, 5 and 7 are essential actors. All other nations are inessential.

Second, a country is invulnerable if its amount of arms is bigger in its power center than the combined arms of all other states.

Finally, a country is a hegemon or a dominant power, if the amount of arms which it can employ in the power center of each other state, is bigger than the combined forces of all other states in these centers.

We turn now to the factors of the relative power of states.

According to the above model, the question which states are, will remain or become essential actors, is determined mainly by the level of economic and technological development, size of territory and population reached and distance from other essential actors in any given period. In the long-run, the relative position of states depends on the development of these factors. Now, growth of population is widely determined by size of territory and (up to a certain per capita income) by economic growth. But the latter itself depends on technological innovation and on available territory. Thus, if, in fact, growth of population, economic wealth and territory are responsible for the development of the international system (de Tocqueville 1945, Bernholz 1985, Gilpin 1981), then the factors responsible for technological and organizational, as well as for territorial growth, have to be looked for.

Modern developments in the theory of property rights and of public choice seem to suggest, that those states will be most successful concerning innovation who, in return for revenue, provide a set of law and property rights narrowing as much as possible the difference between private and social costs and benefits (North 1981; North and Thomas 1973). Doing so would imply a strongly decentralized system with effective private property rights and free markets, but also rules or arrangements for the elimination of externalities and a sufficient supply of public goods. Regulations and too high taxes and kinds of taxes otherwise distorting relative prices, should be absent. Under such conditions and with sufficient competition the economy will become as efficient and as innovative as possible, since individuals will be motivated by possible profits (and losses threatening from more successful competitors) to work as efficiently and to innovate, to search for and to apply available and new information as much as feasible.

Such development furthering the relative international position of states has often been prevented historically. First, this has happened because rulers wanted to extract as many resources as possible from the economy and second, because of the efforts of citizens hurt by the negative side-effects of economic developments to escape from these consequences with the help of government regulations and interventions to restrict competition (North 1981). In time, moreover, interest groups are formed, since even

large potential groups learn to overcome the free-riding problems (interest groups provide public goods) by applying force (e.g., closed shop) or delivering the public good as a by-product to private goods supplied to their members. Competing parties in democracies respond to the pressures of voters and interest groups, cartels and other restrictions on competition, subsidies etc. are introduced and make the country in time less and less efficient and innovative (Olson 1982, North 1982, Weede 1985, Bernholz 1986). These are the factors determining innovation and growth, thus population growth and the relative power of different states.

The other important factor for the relative power of states is the growth of territory. As can be seen from Fig. 1, states bordering the system of essential actors like country 3 and 7 have a much better chance to expand their territories than the centrally located essential actors. This has been the case for Russia and the United States as predicted by de Tocqueville in 1835.

4. The International System, Crises, and War

4.1 Consequences of Different Structures of the International System

Definitions

Let us denote by n_e ($n_e \leqq n$) the number of essential actors present in the international system in a given period. The international system is called
(1) a multipolar system if $n_e \geqq 8$,
(2) a balance of power system if $3 \leqq n_e \leqq 7$,
(3) a bipolar system if $n_e = 2$, and
(4) a hegemonic system if $n_e = 1$.
Finally we speak of a universal empire, if $n = 1$.

The different structures of the international system thus defined set different restrictions for the participating actors and motivate them to act differently. Consequently, each system has different characteristics (Bernholz, 1985).

The balance of power system, which resembles an oligopoly, has been early and closely studied (Hume 1854, Dehio 1948, Kaplan 1957, 1968, Tullock 1974). Since only a few essential actors are present, their actions are interdependent with those taken or expected by others. Governments are aware that the survival of their countries or their independence would be threatened if one state should succeed to gain hegemony. As a consequence, there exists a tendency for the weaker powers to form an alliance against the strongest state to contain it. But in case the strongest state has been defeated in war and been sufficiently weakened, there is no reason not to take away too much of its territory, population, economic or even military power, or to divide or obliterate it. For now another state has become the stronger nation. To contain it and the growth of its power, the former enemy should not be weakened too much and be kept as a potential ally. It is clear, that these factors tend to stabilize the existence of the balance of power system.

Recently, Harrison Wagner[1)] (1986) has tried to give a rigorous proof of the existence of short-term equilibria for a simplified balance of power system with 3-5 member states striving to maximize their power and with no geographical structure. Wagner modelled the system as an n-person non-cooperative game in extensive form. He "found" not only that constant-sum systems are stable but also " ... that stability is actually fostered by conflict of interest among states". (p. 574) Further "there is a well-defined sense in which the most stable system is one with three actors. Moreover, there is at least one distribution of power that leads not only to system stability but also to peace. Some of these peaceful distributions are more stable than others in the sense that small deviations from them will lead, not to the elimination of any actors, but to another distribution of the same type". (p. 575)

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1) In a model without distances there is only one essential actor present, except in the improbable case that two or more of the strongest states should have equal power. Thus it is always necessary to have an alliance weakening or containing the strongest, only essential state.

Following Wagner, Niou and Ordeshook (1986), have also modelled a balance of power system without geographical structure. They take, however, "a more traditional game theoretic approach" (p. 697) using cooperative solution concepts. [2] Wagner, Niou and Ordeshook consider only one resource (called power by Wagner), which governments seek to maximize. The latter authors, moreover, start from a lexicographic utility function by assuming that the maximization of the resource is subordinated to the survival of the state. Since they allow for no costs of warfare or of other measures to transfer the resources among states, they have further to postulate that a peaceful transfer is always preferred to a transfer of the same quantity of resources by war.

The results are, as a consequence, somewhat different from Wagner's. It is shown that whereas the balance of power is stable as a system, this is not true generally for the distribution of resources among the essential states, which can thus be of different and shifting sizes. The latter result is not surprising, since we know from Public Choice Theory that each distributional outcome is dominated by another one and thus member of a cycle (Bernholz 1972, vol. 1,pp. 120-123, 1975, vol.2, pp. 25-28). System- and resource-stability are only both present, if one country controls exactly half the resources. This implies that a bipolar system is only stable if both states control each half of the resources. Finally, "three-country systems are no more or less stable than n-country systems, provided that resources are distributed to satisfy the conditions ..." (p. 712) If not, then there exist inessential actors (in the sense of Niou and Ordeshook) which will be eliminated.

If we look at the situation from a long-term perspective, then wars to preserve the balance of power (system stability), may be necessary just because parameters of the system are changing as a consequence of unequal economic, technological and population growth, of changes in military tech-

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2) In doing so the authors develop a different definition of essential actor than that used above. For them an essential actor is a state who is a member of at least one minimal winning coalition.

nique, of the aims of states or of their internal organizations. Wagner "found that, if the power and interests of states vary over time, and if states always act so as to minimize the probability that they will be deprived of some of their resources by other states, than a nonconstant-sum system will have most of the properties of a constant-sum system. Thus, paradoxically, uncertainty about the future, by fostering conflict, promotes stability". (pp. 574-5). Given the unequal shifts in the power of states, wars are necessary to preserve the existence of the system. Otherwise a hegemonic power might even evolve peacefully.

Recently, Niou and Ordeshook have extended their model to take into account one of the parameter changes mentioned (1987). They allow different growth rates of "the resource" for different states, and assume that these growth rates can be influenced by investing part of the available resource in the present. Obviously, the invested resources are not available for warfare or for threats in the present period. Investments are thus limited by the goal of survival of the state.

With the help of rather complicated arguments, the authors can show several results of which the following ones are mentioned: first, some states may not be able to prevent, even with the help of coalitions, to become inessential (in their sense) and thus to be obliterated. Second, preventive action against a state threatening to become predominant, may be taken by some coalition. But this need not imply war, since the state may prefer to cede resources "voluntarily". Finally, "if one country threatens predominance, then although we predict a redistribution in which this predominance is prevented, the coalition effecting this change may include the largest country. This is, threatened predominance does not imply a coalition of n-1 countries against the one. Alternatively, if fewer than n-1 countries are threatened with becoming inessential, then rather than a preventive war in which those so threatened join, we might also observe the threatened countries attacking each other in conflictual coalitions". (pp. 43-44) These countries threatened to become inessential and thus to be obliterated, may fight each other to gain enough resources to stay essential. It remains to be seen whether and how these results will be changed if one or the other of the rather strong assumptions of the authors are relaxed.

We have seen, and the models discussed show that the balance of power is a stable system even in the long run. Historically it has, however, always broken down after some long time usually lasting several centuries (for a discussion of the historical background see Bernholz 1985). It has been pointed out in section 3.4 that and how this could happen because of factors (especially the geographic situation) not included in Wagner's, Niou's and Ordeshook's models.

In a model without distance, a bipolar system is usually unstable, except in the case that the two states have just an equal amount of power. With distance, it is possible that both essential actors are invulnerable. Even here, however, parameter changes can make one of the actors inessential in time, and this can either not be prevented by war, or inessential actors would have to join forces at the right time with the weaker essential state to contain the stronger one. Because of these reasons, the bipolar system has, in history, not been long-lasting. The advent of nuclear arms and missiles may have changed this for the first time in history.

The multipolar system corresponding (with distance) to the model of monopolistic competition, is also not a very stable situation. The motivation to retain, and only slightly weaken a former enemy, is not present in this system. For there exist always enough potential future allies. It is more important under these conditions to participate in victorious alliances and in the booty to become one of the stronger states or not to lag in power behind other strong countries (Bernholz, 1985). Finally, in this system, some aggressors will usually be present because of the big number of states, so that wars will usually take place in some region. The number of states in the system shows a tendency to decline until a balance of power system is reached. Which states will survive depends on the development of the parameters discussed above, on the skill to join the right alliances and on (other) chance events.

A hegemony is a quite different system. The hegemonic state may, in its foreign policies, mainly be determined by its domestic political structure. It may be thus very peaceful and supply international public goods to the benefit of all. But it may also exploit other states or even subjugate them

and found a universal empire.

4.2 Relative Power of States, Crises and the Occurence of War

Quite a number of theories for the occurrence of crises and wars have been proposed. Given the analogy to oligopoly, this is no surprise to the economist, if he looks at the balance of power system. A first theory starts from what has been discussed in the last section. The equilibrium of balance of power systems, is in the long-run, again and again upset by parameter changes. But then, alliances should either be formed and, if necessary, wars be initiated by the old established powers in danger of being overtaken by more rapidly developing and expanding "newcomers", with the aim to preserve the status quo. Or the states whose power is growing more rapidly and at the point of becoming greater than that of the most powerful old nation want to redress the balance in their favor, or even to establish a hegemony by reaching a redistribution of territory and people with the help of war. It has been argued, and empirical evidence has been presented (Organski and Kugler 1980, Bernholz 1985), that this "power transition" is a necessary, though not sufficient condition for the outbreak of major wars.

A different, expected utility maximizing approach to explain wars has been applied by Bueno de Mesquita (1981, 1985). He assumes that the state acts as a unified actor and initiates war if expected utility from doing so is greater than the expected utility connected with peace. The utilities relating to the different alternatives "are determined by the congruence of policy and ends between states". Congruence is operationalized in the empirical application by the different types of military agreements between two states and with third states (as possible allies or opponents). The probability of success reflects the relative strength of the respective actors as measured by demographic, military and industrial capabilities. Maoz (1985) extended this theory by introducing interdependence of the decisions of the states with the help of a game-theoretic setting. Moreover, the costs of war are now explicitly taken into account.

Our own background model provides an intertemporal utility maximizing ap-

proach. A country would only go to war, if the present value of the additional future utility from gained territory and population outweighed the present loss in population, capital good and arms, brought about by war. But it is obvious from the model, that the respective utilities for the different future periods are very difficult, or rather impossible to calculate. To mention just one important factor: in a balance of power system the decisions of states are interdependent. Consequently, it is very difficult to foresee which nations might join which coalition, in which period, and for how long they will remain in the alliance. Here uncertainty in the Knightean sense is present, and it is not really possible to calculate objective probabilities.

Finally, we have already argued in section 3.3 that the discount factor, as well as the shapes of the indifference curves in each period, are dependent on the degree of political and economic decentralization, i.e. on the domestic political and economic system. The propensity to initiate war was derived to be lower for less centralized systems.

In other approaches, crises leading possibly to war have been modelled for individual cases with the help of game-theoretic situations. Brams (1975), Snyder and Diesing (1977), and others have used games like the prisoner's dilemma, chicken, hawk and dove to explain specific historical episodes like the outbreak of World War I or the Cuban Missiles crisis. These studies are very valuable to understand better individual crises, their sometimes peaceful resolution or the factors leading to the outbreak of war. They may thus prove helpful for the peaceful solution of future crises, but can scarcely lead to a more general theory.

4.3 Domestic Political Regime, War and Imperialism

The relationship of domestic political regime and the initiation of war has already been discussed in section 3.3. We have to add, however, that the more peaceful character of economically and politically decentralized regimes may not prevent them from following aggressive and expansionary foreign policies under certain conditions.

After the discussion of section 3.3, these conditions can be easily stated: 1) The costs of aggression and expansion have to be so low, that they are not perceived by the general voter as an additional tax burden 2) There must be minorities like potential colonial administrators, military officers, and business interests, as well as those employed by them who benefit from the territorial expansion, the additional jobs and possibilities of promotion or the preferential business relations to be expected. Then the political parties can hope to gain votes by the expansionary policies without losing the support of the rationally uninformed majority of voters (Bernholz 1966, 1985). Such a theory can possibly help to understand the imperialistic colonial expansion of democratic European states in the decades before 1914. From this approach, one would also expect the abolition of colonial empires as soon as their costs began to increase because of independence movements in the colonies prepared to follow a course of civil disobedience, strikes, boycotts or even guerilla warfare.

5. Arms Races, Deterrence and Strategy

The literature applying the economic or the game-theoretic approach to this field is perhaps the most extensive part of its application to international relations. Some works have been pathbreaking (Boulding, 1962; Rapoport 1960; Schelling 1960, 1966), others are developing the basic ideas or present reviews (Intriligator and Brito 1976, 1977, Moll and Luebbert 1980; see also Brams, Davis and Sraffin 1979, Brams and Kilgour 1985; McGuire 1986; Brennan and Tullock 1982, Tullock 1974, Zagare 1985, Morrow 1985). Because of the excellent surveys, I will be short and confine myself to problems of armaments races and of deterrence without trying to be complete (see Intriligator and Brito 1985, for a recent paper on these problems). Actual warfare, strategy and tactics, as well as bargaining theory, will not be taken up.

5.1 Arms Races

We have already derived reaction functions for arms races from our model. It has been shown in section 3.3, that a government i raises the amount of arms available, A_{it} in response to an increasing arms level A_{jt-1} of a

critical potential opponent j. For simplicity, let us consider the case of just two essential states and draw their reaction functions as straight lines (Fig. 4). Intersection of these functions gives the Cournot equilibrium C, at which the arms rate stops, if both countries i and j follow their reaction functions. C is stable, if A_{it} cuts A_{jt} from below.

Figure 4 here

But it is not necessary that both states behave according to their reaction functions. For doing so implies that they do not perceive or not take into account that their opponent reacts to their own decisions. To make this clear, we have drawn several indirect indifference curves (representing indirect utility functions derivable from our model) for both countries. An indifference curve represents a period utility which is the higher, the closer it is to the horizontal (for i) or the vertical axis (for j). For, e.g., with less arms A_{jt}, the security level of i is greater for a given A_{it}. Moreover, for a given amount of A_{jt}, a smaller A_{it} is preferred if we consider a point to the right of the reaction function of i, since it allows a higher production and consumption of the private good. Indifference curves for i are concave towards the horizontal, those for j towards the vertical axis. Again, the farther below or to the left, respectively, the indifference curves, the lower the utility level they represent. This is obvious, since the indifference curves have to reach their maxima relative to the respective axes on the reaction functions. For these curves were drawn in a way to maximize the utility, given different constant arms levels of the other country. Thus, if we move on a line parallel to the horizontal axis, at a given arms level for j, then we reach a maximum of utility for i on A_{jt}. It follows, that points to the right or left of this point, must imply lower utilities and thus belong to indifference curves representing lower utility levels. Similar conclusions hold for the indifference curves belonging to j if we move vertically.

Now assume that i realizes that j follows its reaction function and takes this fact into account when making its decision concerning its arms level. Then it would obviously select point A, since the corresponding indifference curve represents the highest feasible utility level, given A_{jt}. This

is the so-called Stackelberg solution of oligopoly theory. D would be a corresponding Stackelberg solution for j. But if both states assume wrongly that the other follows its reaction function, then Bowley point B would result, which is not an equilibrium. Note that in all these latter cases, no arms race would be observed (Organski and Kugler 1980, from the empirical evidence, suggest that no arms race has taken place between the USA and the USSR). Taking a general game-theoretic perspective, it is not clear whether and which non-cooperative equilibrium will be reached. Note also, that the arrows indicate into which direction each country would move to increase its utility, if the arms level of the other were given. This shows that Cournot point C is an individually stable equilibrium.

Next, possible cooperative solutions have to be discussed. If we could assume that each country could at least realize C, whatever the other state did, then EE' (the core) would contain all cooperative solutions which are feasible and Pareto-optimal. At each of these solutions, i and j would be better or, at least, as well off than at C. And for each point within the area confined by the two indifference curves running through C but not on EE', a point on EE' better for both could be found by mutual agreement limiting arms levels. But such points like F are not individually stable, as indicated by the arrows. i and j would each be better off, if the other kept the agreement and they moved secretly to the right or upward, respectively. Thus viable arms agreements have to include inspection and control mechanisms. Moreover, we realize that both participants find themselves in a prisoner's dilemma. They are both motivated to violate the agreement by moving to the right or up, but this would lead them to a point like G, where both are worse off than in F.

Finally, we observe that an arms race equilibrium like C (both follow their reaction curves) does in no way imply peace. E.g., the arms level of i in C could be much greater than that of j. Thus state i might be tempted under certain conditions to declare war on j.

5.2 Deterrence

To discuss deterrence, we first assume (see section 3.2 and Appendix A.2)

that the losses in capital good, available labor and arms are proportional to the arms employed against each other by states i and j in war during period t in the case of an attack by j on the power center of i. We thus postulate that each of the two countries can apply arms in the power center of the other (see Appendix B.1). Otherwise, an attack on i's center by j would not be possible. Next, what do we understand by deterrence? It follows from our assumptions, that a country j would not attack i, even if it could - given the available arms levels - be victorious, if the damage it had to expect would outweigh the expected benefits acquiring territory and additional population. There exists thus a critical level of arms, A_i^D, (Fig. 5), at which j would be indifferent as to waging war or to keep peace. It is obvious that this level, which would allow i to bring about enough damage for j, depends not only on the damage inflicted and the spoils to be expected, but on the period utility function and the discount factor, which depend themselves in a complicated way on the political system of i (see section 3.3).

The minimal deterrence level A_i^D is, therefore, very difficult to calculate, but we will assume that it is known to the leaderships of j and i. Moreover, it will be assumed that this minimum deterrence level is a straight line and increases somewhat with A_j (Fig. 5), though this is not necessary for the following analysis. Similarly, A_j^D denotes the minimal deterrence level for j against i. It follows that in Fig. 5, Cournot point C lies within the region of mutual deterrence, so that no war would occur if both states behaved according to their reaction curves. But it is clear that with smaller slopes and/or smaller intercepts on the axes (a_i and a_j) the Cournot point would be outside of this region, so that war could happen. Moreover, even with the reaction functions as drawn, some points of the core EE' in Fig. 4, (not depicted in Fig 5) are presumably outside of the region of mutual deterrence. It follows that some Pareto-optimal arms agreement could lead, e.g., by abolishing point C, to war and that this can be a bargaining strategy of one of the powers in the process of negotiations, which would be rather dangerous for the other nation.

Finally, let us discuss nuclear deterrence. In this case the concept of an essential power loses its clear meaning. Transport costs of arms to the

power center of the opponent are very small with intercontinental missiles, and each country can do terrible damage at the power center of the other. If it strikes first with a sufficient part of its nuclear forces, then the other state is, after the attack, presumably weaker militarily in its power center than the aggressor. This means that it depends on who strikes first whether i or j will be an essential actor.

Given this situation, it is decisive for mutual deterrence to work, whether both countries would retain a sufficient level of arms even after a first strike by the other to be able to deter the potential aggressor from striking first.

The remaining arms capacity after a first strike of the opponent with all its arms is given in Fig. 5 by the straight lines A^W_{it} and A^W_{jt}, respectively (for a derivation see Appendix B). This capacity increases with the amount of arms available before the strike of the opponent. Also, the absolute amount of arms destroyed (i.e., $A_{it} - A^W_{it}$ and $A_{jt} - A^W_{jt}$) rises with the arms level of the attacking country before its strike.

As depicted, the functions give points A and B, respectively, as the remaining arms levels after a first strike with all arms of the opponent, if both countries followed their reaction curves, and thus had initial arms levels corresponding to C. In this example, both points are in the region of mutual deterrence, so that war is prevented. But with somewhat different parameters this would not be true any longer.

It is important to realize that a potential opponent must be convinced that a first strike will lead to a retaliating strike. Otherwise, deterrence is not going to work. But is it always in the interest of a country after it has been hit by a first strike to retaliate? From our model this would not necessarily be true in all cases. But if the potential aggressor perceives this, it will attack (for a further discussion of such problems, see Schelling 1963).

Appendix A

In this Appendix, we present the model which is used as a background in sections 3.3 - 5.2.

A.1 Symbols

i (i = 1, 2, ..., n) and t refer to country and period.

$_tU_i$ Present value of expected utility of rulers of i

U_{it} Utility of rulers of i expected for period t

ς Time discount factor

Z Degree of political and economic decentralization

C Consumption of private good in period

S^o Minimal security level

G Amount of private good produced in period

A Amount of arms produced and available in period (lifetime one period; durable good will be considered)

L_g, L_a, K_g, K_a, T_g, T_a inputs of labor, capital good and land per period to produce private good and arms, respectively

L, K and T total amounts of labor, capital good and land available in period

g, a Coefficients representing the degree of organizational and technological development in the private good and arms industries

I Rate of investment per period in capital good (equal to private good)

α Rate of depreciation per period per unit of capital good

S_{ij} Security level of state i vis a vis country j

d_{ij} Distance in km between "power centers" of i and j

τ_j Transportation costs per unit of arms per km of country j

K^W Amount of capital good remaining after military combat.

L^W Amount of labor remaining after military combat

A^W Amount of arms remaining after military combat.

A.2 The Model

(1) $_tU_i = \sum_{t=1}^{\infty} U_{it} e^{-\varsigma t(Z_{it})t}$

$$\frac{\partial \varsigma}{\partial Z_{it}} > 0$$

(2) $U_{it} = U_{it}(C_{it}, S_{it}; Z_{it})$

(2a) $\partial U_{it}/\partial C_{it}, \partial U_{it}/\partial S^{o}_{it} > 0$

(2b) $\partial^2 U_{it}/\partial C^2_{it}, \partial^2 U_{it}/\partial S^{o2}_{it} < 0$

(2c) $\partial^2 U_{it}/\partial G^{o}_{it}\partial Z_{it} < 0, \partial^2 U_{it}/\partial S^{o}_{it}\partial Z_{it} > 0$

(3) $G_{it} = g_{it}G_{it}(L_{git}, K_{git}, T_{git})$

(4) $A_{it} = a_{it}A_{it}(L_{ait}, K_{ait}, T_{ait})$

(5) $g_{i,t+1} - g_{it} = g_i(Z_{it})$

(5a) $d_{gi}/dZ_{it} < 0$

(6) $a_{i,t+1} - a_{it} = a_i(Z_{it})$

(6a) $da_i/\partial Z_{it} \leqq 0$

(7) $L_{git} + L_{ait} = L_{it}$

(8) $K_{git} + K_{ait} = K_{it}$

(9) $T_{git} + T_{ait} = T_{it}$

(10) $G_{it} = C_{it} + I_{it}$

(11) $K_{i,t+1} = (1-d)K_{it} + I_{it}$

(12) $S_{ijt} = A_{it}-(A_{jt}-d_{ij}\tau_{jt}A_{jt})$

(13) $S^{o}_{it} = \min_{j \neq i} S_{ijt}$

(14) $K_{it} - K^{W}_{it} = \beta_{it} A^{e}_{it} + \gamma_{it}(1-d_{ij}\tau_{jt})A^{e}_{jt}$

(15) $L_{it} - L^{W}_{it} = \beta_{it} A^{e}_{it} + \gamma_{it}(1-d_{ij}\tau_{jt})A^{e}_{jt}$

(16) $A_{it} - A^{W}_{it} = \beta_{it} A^{e}_{it} + \gamma_{it}(1-d_{ij}\tau_{jt})A^{e}_{jt}$

K^{W}_{it}, L^{W}_{it}, and A^{W}_{it} are the amounts of capital good, labor and arms available after A^{e}_{it} and A^{e}_{jt} have been employed in fight during period t by i and j against each other. $A^{e}_{it} \leq A_{it}$, $A^{e}_{jt} \leq A_{jt}$. Arms are here treated as a durable good and A^{e}_{it} and A^{e}_{jt} are the amounts of arms which i expects itself to employ and to be employed by j.

All variables are ≤ 0, all parameters are > 0, and $d < 1$, $1-d_{ij}\tau_{jt} \geq 0$.

A.3 Definitions:

State i is an Essential Actor, if $S_{ijt} > 0$ all j;
an Invulnerable Actor, if

$$A_{it} - \sum_{j \neq i} (1-d_{ij}\tau_{jt})A_{jt} > 0;$$

a Dominant, hegemonic power, if

$$A_{it}(1-d_{ij}\tau_{it}) - \sum_{k \neq i} (1-d_{kj}\tau_{kt})A_{kjt} > 0,$$

$$d_{kk} = 0.$$

A.4 Some Comparative Static Results Deriving from the Model

Eq. (3), (4), (7)-(10) imply, assuming l as constant, the production possibility function FF', whereas indifference curves I_1, I_2 and I_3 depict (1)-(2) taking U_{it+k} (k=1, 2, ...) as constant. The optimal level of arms and consumption is then given by A. Additional Investment ΔI_{i1} leads to a new equilibrium in period t at C, thus not only reducing consumption, but also A_{it}. In period t+1, however, the additional investment shifts the production possibility curve to the right, and implies an equilibrium B with higher consumption C_{i2} and arms production A_{i2}. The latter shift also takes place, if population and territory have grown in period t, or if technical organizational progress has taken place, i.e., if g and/or a have increased. Thus more arms will be produced in all these cases and the security level S^o_{it+1} increases (with A_{jt} = constant) because of (12) and (13). Note that this is also true, if technological or organizational progress only takes place in the industry producing the private good.

A rise in some A_{jt} or a fall of τ_{jt} implying a smaller S^o_{it}, would lead to a non-optimal U_{it}. As a consequence, state i would react with an increase of A_{it} and a reduction of C_{t+1} in the following period. The reaction would also lead to higher investments. Country j would then react to these changes, etc. Thus we get reaction functions implying a kind of arms race (section 5).

In (1)-(2a) we have assumed that an increase of Z_{it} leads to a lower discount factor, a lower level of consumption, a higher arms production and a higher security level. We make these assumptions, since in market economies with democracies and party competition, the government cannot extract as many resources for arms from the population than in more centralized oligarchic systems (perhaps even with a state-owned centrally planned economy), except in cases of actual or threatening war. Voters are rationally uninformed under normal conditions about foreign policies, since they usually do not influence their well-being perceivably and since their vote has only a negligible effect on national policies. Most citizens thus prefer those among competing parties not burdening them with perceivably higher taxes for arms. Moreover, since governments have to be re-elected,

their attention is usually concentrated on the situation at the date of the next elections. Thus future utilities are more heavily discounted. In Fig. 3, it is shown correspondingly, that a greater decentralization implies the flatter broken indifference curve and an equilibrium B instead of A. Moreover, the higher Z_{it} implies a smaller τ_t, consequently a greater I and a higher arms level in later periods. Also, decentralized states would presumably react less to an increase in foreign arms levels. Further, since the losses to be expected from war are more heavily weighted than the future gains in territory, population or security level (ζ_t is higher), democracies with market economies should be less likely to instigate war (Rummel, 1983).

Finally, let us note, that the size and the resources as depicted by the production possibility curve limit the amount of arms which can be produced. Thus for small and/or poor countries, the reaction functions of Fig. 4 have to end earlier than for the big powers. Still, such countries may be able to prevent great powers from attacking them if they maintain a security level inflicting such damagaes on an agressor that the expected future (discounted) benefits are outweighed in (1) by the war damage to be expected (eq. (14)-(15).

Appendix B

Deterrence

To derive the arms level of country i remaining after it has been attacked by country j, we make several assumptions. It is first assumed that i expects to employ a constant part of its arms to defend itself against a first strike:

(17) $\beta_{it} A^e_{it} = k_i$ with $0 < \beta_{it} < 1$.

Further, in case i would expect that j would employ all its forces oberv-able in period t-1 in a first strike, we get:

(18) $A^e_{it} = A_{jt-1}$.

This equation is postulated since we want to determine the amounts of arms which i expects to be left to it in case j has attacked with full force. This does, of course, not imply that j would necessarily attack with its full (nuclear) force.

Equation (19) describes the fact that τ_{it} and γ_{it} cannot be changed in the short-run:

(19) $(1-d_{ij}\tau_{jt})\gamma_{it} = c_i$.

Finally, (20) recalls our simplifying assumption of a linear reaction function:

(20) $A_{it} = a_i + b_i A_{jt-1}$ $\qquad a_i, b_i > 0$

This assumes, moreover, that i reacts with its arms build-up with a time-lag of one period.

Inserting (17)-(19) into (16) we get

$$A^W_{it} = A_{it} - k_i - c_i A_{jt-1},$$

and by inserting (20) into this equation:

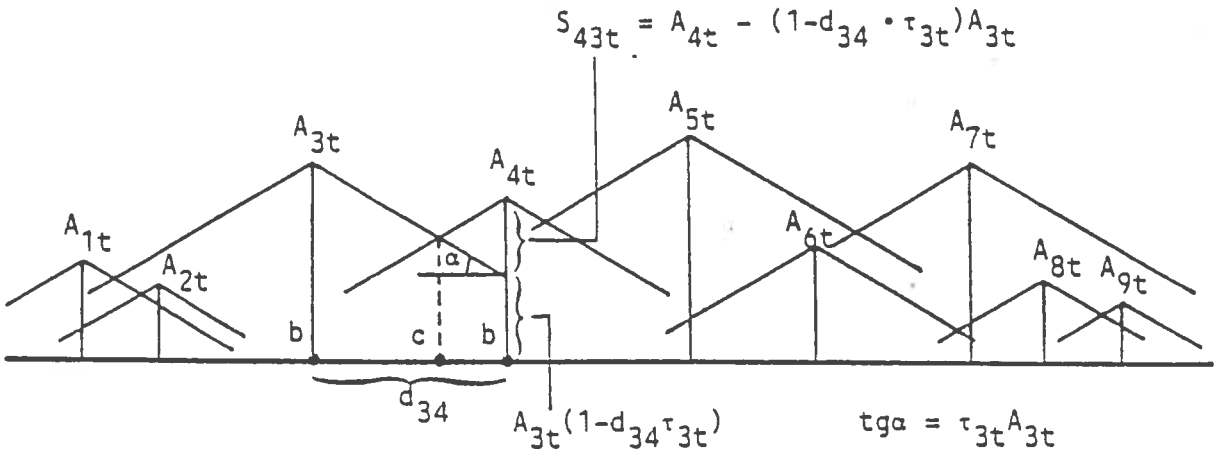
$$A^W_{it} = a_i + b_i A_{jt-1} - k_i - c_i A_{jt-1}$$

$$(21)\quad A^W_{it} = (a_i - k_i) + (b_i - c_i) A_{jt-1}$$

A similar relationship can be derived for A_{jt}. Both lines depicting the arms levels of i and j, after a first strike of the opponent, have been drawn in Fig 5.

Figure 1

Essential Actors and the Employment of Arms over Distances



States 1, 3, 4, 5 and 7 are essential actors. States 3 and especially 7 can relatively easily expand their territories. For simplicity we have made the unrealistic assumption that α is identical for all states.

Figure 2

Effect of Economic, Population, Technological or Territorial Growth

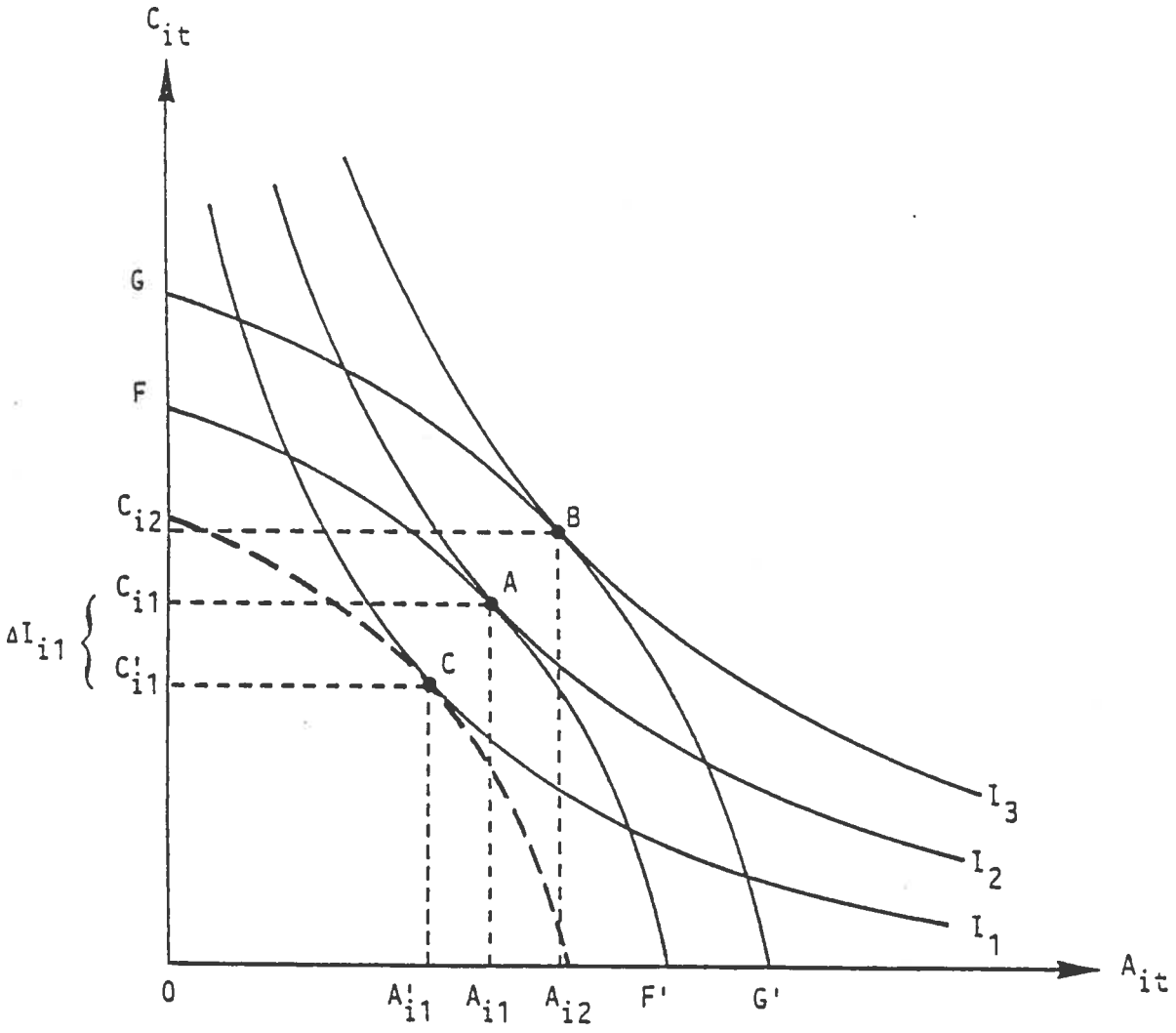


Figure 3

Effect of Greater Decentralization
(short-term)

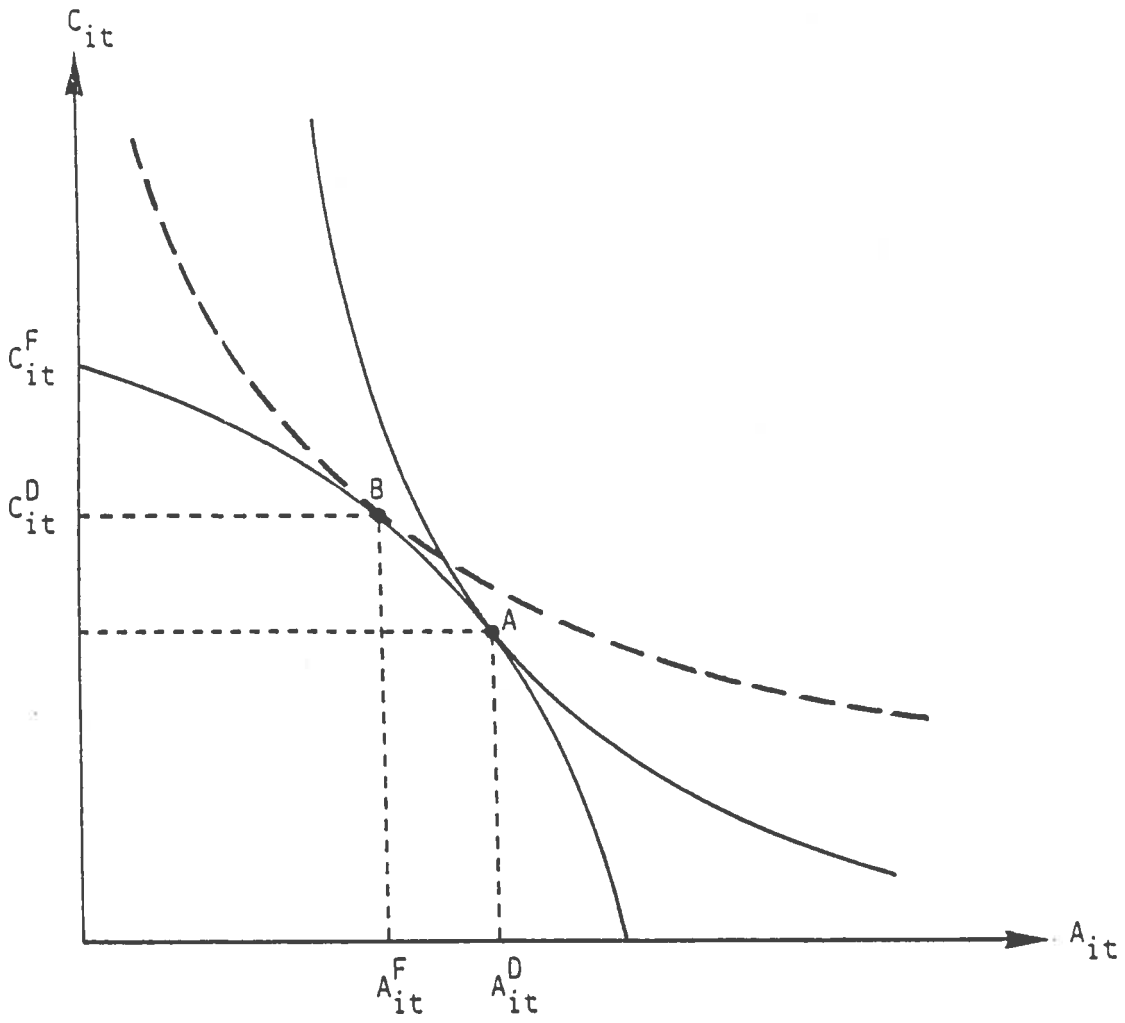
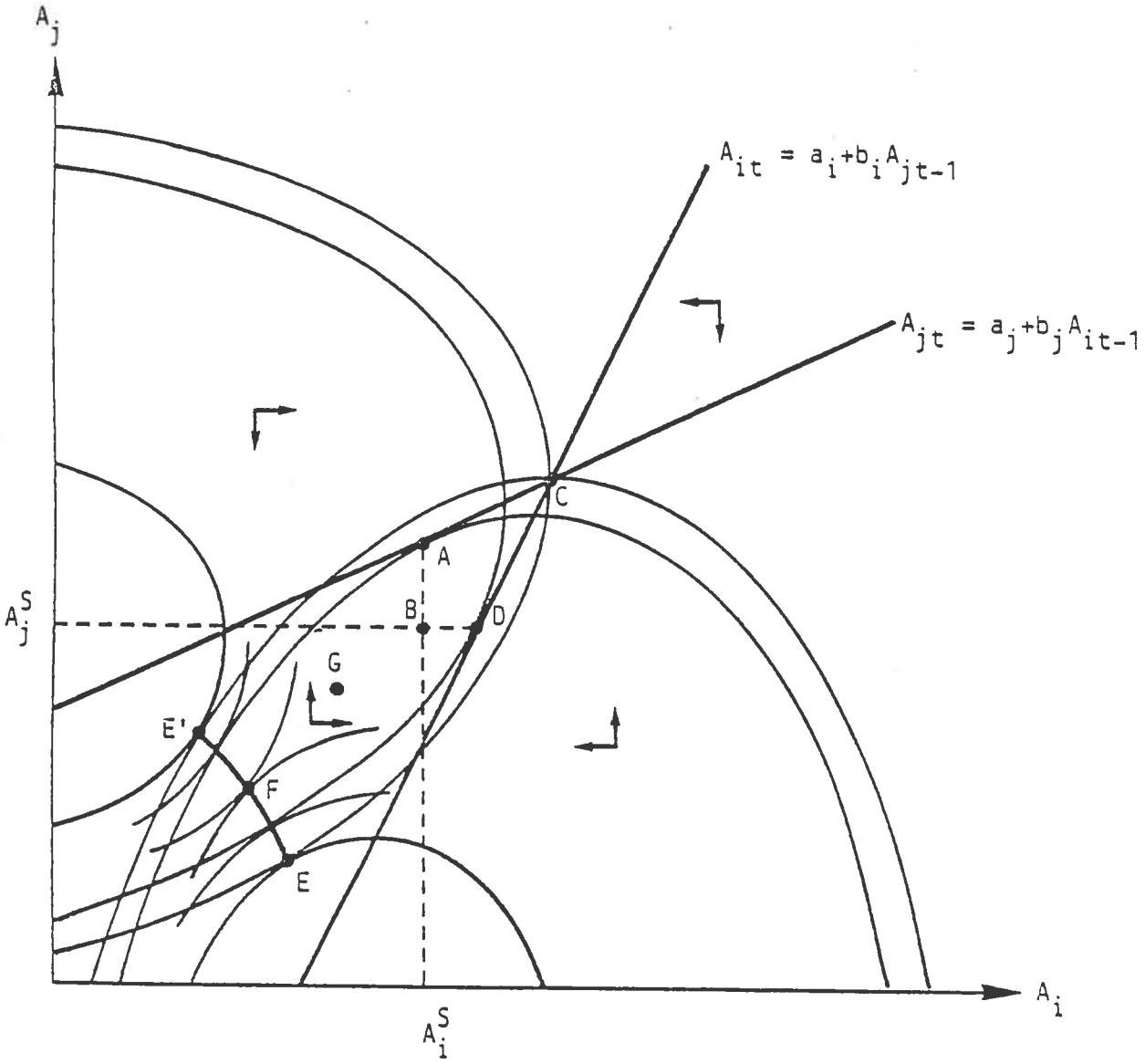


Figure 4

Armaments' Races



Explanation:

A_{it}, A_{jt}	reaction functions of countries i and j
C	Cournot point
A, D	Stackelberg solutions
B	Bowley disequilibrium
EE'	Core
F, G	Points in prisoner's dilemma game

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