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CENTER DISCUSSION PAPER NO. 483

THE NATIONAL DEFENSE ARGUMENT FOR GOVERNMENT INTERVENTION IN FOREIGN TRADE

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Abstract

The arguments for intervention in foreign trade on national defense grounds are described and analyzed from an economic point of view. First, national security considerations are introduced as "non-economic" objectives: social goals dictate that production, consumption, factor employment or imports in a set of strategic industries be at levels different from those emerging from a laissez-faire competitive equilibrium. It is shown that only when social goals relate to imports intervention in foreign trade is optimal. Second, the pursuit of national defense is modeled as generating an economic "externality" not taken into account by private consumers and producers. Once again only when such an externality relates to foreign trade intervention in trade is the optimal policy. Third, it is shown that national security may involve an optimal response in the form of a peace time import tariff or a quota to the threat of a war time trade embargo by adversaries. Fourth, the implications of the strategic use of foreign trade controls in the form of accumulation of strategic stockpiles, economic embargoes, denial of exports of strategic commodities or technology transfer, etc. are analyzed formally and in the context of East-West relations. Finally the historical experience with embargoes and sanctions is reviewed. It is argued that such sanctions have been largely ineffective except under special circumstances.

The National Defense Argument For Government Intervention In Foreign Trade

T. N. Srinivasan*

1. INTRODUCTION

The arguments for intervention in foreign trade on national defense grounds could be classified broadly into two categories. The first category is based on the perception that the existence and continued operation (at specified levels of output) of certain industries is deemed vital from the perspective of national defense. In the absence of intervention such industries may either go out of existence or else operate at inadequate levels. If such indeed is the case, there is the further issue of the form of intervention. In particular, whether intervention is called for in foreign trade is to be established. The second category arises at one level from an extension of the dictum of Clausewitz that war is the pursuit of diplomacy through other means, with strategic use of foreign trade substituting for the more violent instruments of war to achieve political objectives in international relations. More recently

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Richard Cooper (1973) has gone so far as to characterize trade policy as foreign policy. At another level it reflects concerns that unfettered trade with adversaries in certain commodities and services will only strengthen their military (offensive and defensive) capability. In what follows the arguments under each of these categories will be described and analyzed from an economic point of view. Issues relating to the spillover effects from defense to the civilian sector of the economy are not addressed.

Section 2 models national security considerations as 'non-economic' objectives relating to production, consumption or trade and discusses the optimal policy interventions to achieve them. In Section 3 the pursuit of national defense manifests itself in the form of an economic 'externality' that is not reflected in the utility and profit maximizing decisions of private consumers and producers respectively. In Section 4 (and in the Appendix) the problem of an optimal peacetime response (in the form of market intervention) to the threat of a trade embargo by adversaries during emergencies or war is investigated. Section 5 deals with the implications of the strategic use of trade controls: accumulation of strategic stockpiles (section 5A), trade off between gains from trade and national security as seen in the literature on East-West trade (Section 5B) and in a formal model (Section 5C). Section 6 reviews the historical experience with economic sanctions and embargoes. Section 7 concludes the paper.

2. NATIONAL DEFENSE AS A NON-ECONOMIC OBJECTIVE

A. Production Expansion

It has long been argued that the viability of certain industries (particularly manufacturing industries) and of the availability of certain factors of production are vital from the point of view of national defense. From Alexander Hamilton who suggested in 1791 that the independence and safety of a country was materially connected with the prosperity of its manufactures to General Slay who is quoted by Seabury (1983) to have said in 1980 that the U.S. cannot maintain its position as a first-rate military power with a second-rate industrial base, it is a recurring theme. A case can be made for market intervention based on this viability consideration. One of the simplest models for demonstrating this is the standard static model of international trade in its two commodity version. Consider a country which can produce two commodities (with due apologies), Guns and Butter, in any combination lying inside or on the boundary of the area OTT' in Figure 1, the area being determined by the availability of primary factors and the technology of production of guns and butter. Suppose further that this country can trade with the rest of the world, exchanging guns for butter at a fixed price represented by the slope of the straight line AB. By producing the combination P* (where the production possibility curve T'T is tangential to the international price line AB) and trading with the rest of the world,

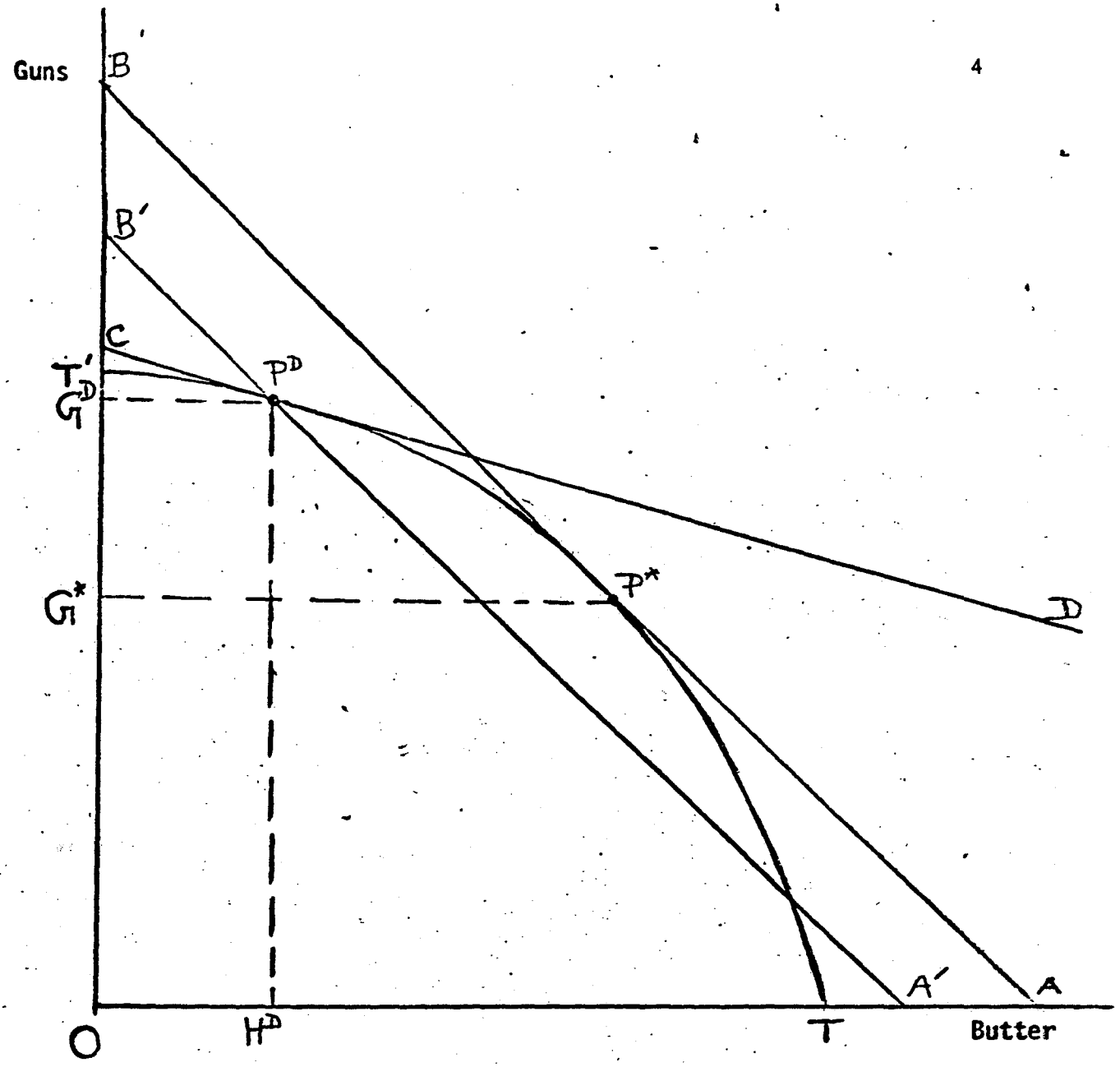


Figure 1

our country can consume any combination in the larger area bounded by OA, OB and the line AB as contrasted with those in the area bounded by T' T and the two axesthat are available from domestic production alone. Suppose now that the domestic output OG* of guns at P* is deemed inadequate from a national defense point of view and an adequate output is OG^D. It is clear that an efficient way to achieve the output OG^D is to produce the combination P^D and trade along the line A'B' through P^D that is parallel to AB. In other words, given that at least OG^D of guns is to be produced, relying only on domestic production will enable the country to consume any combination in the area OH^DP^DT'--but producing at P^D and trading allows consumption of any combination lying in the larger area bounded by OA', OB' and the line A' B'. The cost to the economy of achieving the national defense objective is the foregone opportunity of consuming any combination in the region lying between the two parallel lines AB and A'B'.

In this simple analysis even though the mechanism by which resource allocation and production decisions are implemented was not spelled out, it is nevertheless clear that once at P^D not availing the opportunity to trade along the line A'B' cannot but hurt the economy. Hence the policy intervention to attain the needed shift in production, given that the defense objective has been defined in terms of production level of guns, will not involve intervention in foreign trade, if by intervention is meant the restriction of the choice of combination of guns and butter to some proper subset of those available by freely trading from the desired production point.

In order to go beyond the above analysis one has to spell out the institutional arrangements in which production and consumption decisions are taken in such an economy. For instance, if it is a 'command' economy, the authorities simply decide that production will be at P^D and consumption at some point on A'B'. In the polar opposite case of a perfectly competitive economy atomistic producers decide what and how much to produce (given commodity and factor prices which they assume will be unaffected by their own decisions) on considerations of their profit. Given the relative price of guns in terms of butter as represented by the slope of the line AB (or A'B') production at P* (and not at P^D) is consistent with profit maximization. A government wishing to shift production to P^D from P* has to provide the needed incentives to private producers, that is, it has to ensure that the prices faced by producer makes their profit maximization consistent with production at P^D. From Figure 1, it is clear that such a price is the slope of the production possibility curve at P^D (that is the slope of line CD) making guns relatively more expensive compared to the slope of line AB. Since the objective is to shift production and not necessarily to restrict consumption choices, consumers will be allowed to choose from any combination that is achievable through trade at prices represented by A'B' through trade from P^D. In other words consumer prices are the same whether production is at P* or at P^D while producer prices are different. A policy intervention that will achieve this wedge between producer and consumer prices is an output subsidy to producers of guns

or equivalently an output tax on producers of butter. One can think of other equivalent taxes or subsidies on factor use (see Bhagwati and Srinivasan (1969)). But the important point is that the intervention affects production and does not restrict trade. As such an import tariff (which is equivalent to an output subsidy and a consumption tax at the same rate on the importable) is ruled out as an instrument to achieve the objective of national defense.

If we relax the assumption that the country faces fixed terms of trade (the slope of AB in Figure 1) but instead it has market power in the sense that its trading volume affects its terms of trade, an influence not perceived, and hence, not taken into account by atomistic domestic producers and consumers, the traditional argument for the use of import tariff for exploiting its market power holds. However, the introduction of national defense objective defined in terms of the level production of guns in such a context will call for the use of an output subsidy for gun producers (or its equivalent) in addition to a tariff to exploit market power. Even though the level of the optimum tariff could be affected once such an objective is introduced, the relevant policy intervention that is associated with the objective is still the output subsidy. In any case, since producers have to be induced by the subsidy to produce what is deemed adequate rather than rely on the market forces to achieve without intervention, defense objective can be termed non-economic.

B. Consumption Expansion

One could have stated the national defense objective in terms of consumption rather than production of guns. For instance, imagine that guns could be used for private recreation (thanks to NRA) as well as for national defense. While each consumer takes fully into account the recreational value to him of his gun, being one among a large number of consumers, he ignores the fact that his purchase of a gun contributes to national defense by adding to the total volume of gun purchases in the economy. Assuming as before the economy can trade with the rest of the world at a fixed terms of trade and representing private preferences (for simplicity assuming that all individuals are alike) by an indifference map, one can depict the non-intervention equilibrium in Figure 2, with production at P* and consumption at C*.

Clearly, the fact that private consumption of guns contributes to national defense as well means that a point other than C* from among those available through production and trade will be socially desirable. Since producing at any point other than P* and then trading (at terms represented by the slope of AB) will only shrink the set of available consumption points, adding the defense consideration will not dictate any change in production plans. Once its contribution to defense is accounted for, private consumption of guns ought to be higher than at C*, say at G_c^D. The consumers have to be induced to consume at C^D. This can be achieved by making consumers face a relative price of guns equal to the slope of their indifference curve through C^D, i.e. making guns relatively cheaper

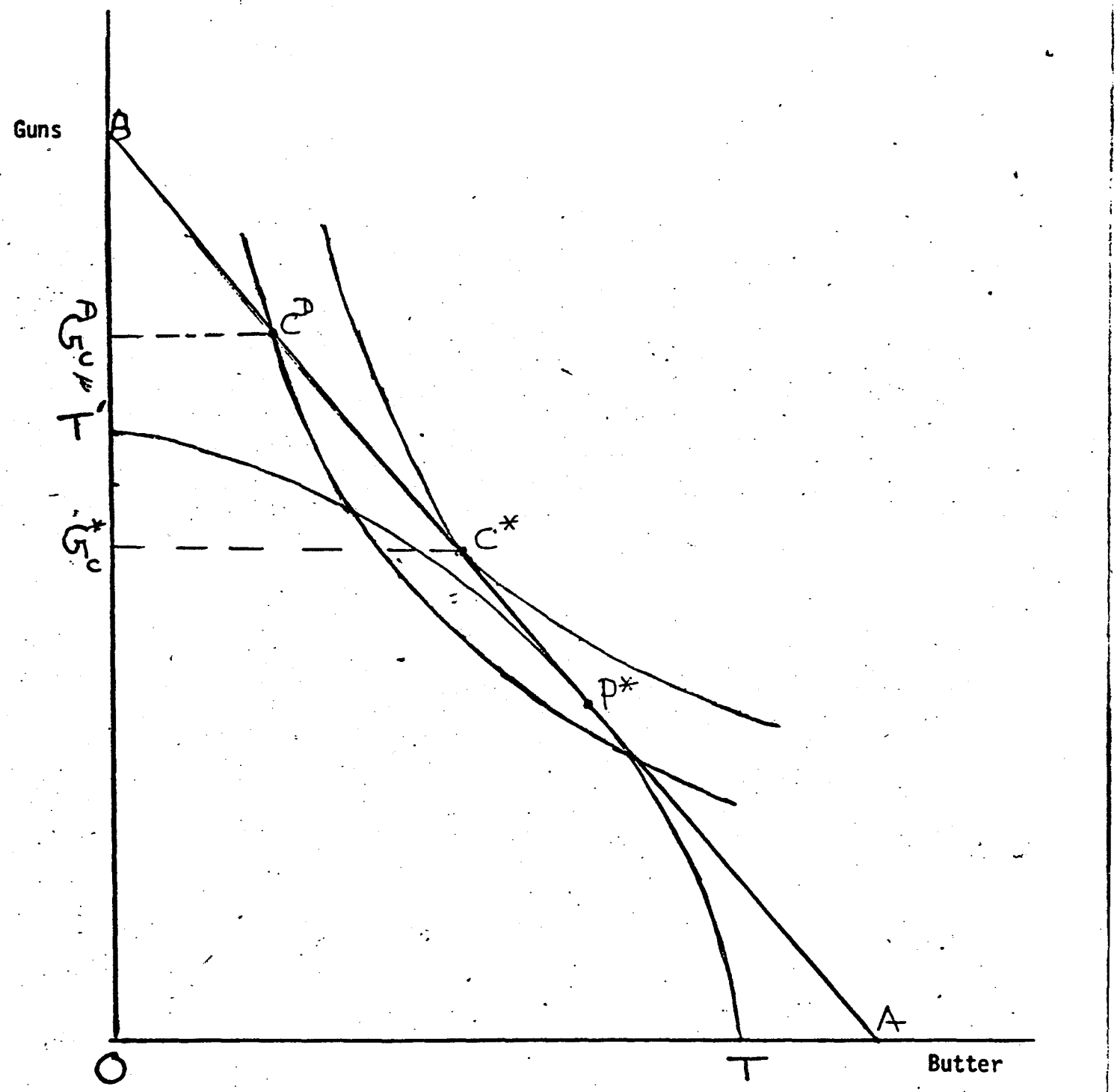


Figure 2

than at C*. This involves a consumption subsidy equal to the difference between the producer price (slope of AB) and consumer price (slope of indifference curve through C^D). Once again it is not optimal to intervene in trade through tariffs or quotas. With national defense considerations manifesting themselves as a consumption externality, a consumption subsidy is the appropriate form of intervention. Again such a subsidy will be in addition to an optimum tariff to exploit any market power that the country may have.

C. Export (Import) Restriction

An alternative formulation of the national defense or security objective is in the form of restricting the volume of exports, particularly of commodities (e.g. computers) that have both civilian and military uses or of imports. Seabury (1983, p. 13) for instance, argues that 'the fact that manufactures critical to U.S. defense needs may be made more cheaply abroad is a small comfort to anyone who would commonsensically conclude that the resulting dependence (on imports) would entail unacceptable risks'. In the context of the institutional assumptions of the previous examples, private producers and consumers responding to the prevailing prices in the international market decide on their privately optimal production and consumption levels, thereby leading to an export (or import) level that may be too large from a national security perspective. In Figure 3, the privately optimal production and consumption points are P* and C*, respectively, resulting in an export of P*E guns. To reduce the export to the level P^DE^D, it is natural to impose a tax on the export of guns (or

equivalently a tax on the import of butter). Such tax being an output tax and a consumption subsidy on guns (both at the same rate) simultaneously reduces the output and raises the domestic consumption of guns thereby reducing the export level. Clearly with the trade level, in this case the level of exports of guns, being the target of policy, the appropriate instrument is a trade tax, namely an export or import tariff. It can be shown that for achieving a specified reduction in exports, a production tax by itself (or a consumption subsidy by itself) is inferior to an export tax in that it leads to greater welfare loss to consumers compared to the situation of no intervention (Bhagwati and Srinivasan (1969)).

D. Employment Expansion

It is sometimes suggested that neither the level of output nor the level of consumption of a specific commodity, say, guns, is of interest from the point of view of national defense but the skills of the workers involved in its production are. One can view this consideration as requiring that the employment in the production of guns should not be allowed to fall below some specified level. It is easy to show that the optimal policy instrument to achieve this is an employment subsidy (or equivalently an employment tax) to producers of guns (or producers of butter).

In sum, except in the case where national defense and security objectives directly involve the restriction of foreign trade, trade taxes (or equivalently quantitative restrictions in the form of trade quotas) are not the optimal policy instruments to achieve the

objectives. This conclusion however does not in general hold if the policy intervention in the form of taxes (on production, consumption, employment or trade) or quotas involves the use of resources in their implementation or diverts resources to lobbying activities by private citizens to appropriate the revenues (rents) generated by the taxes (quotas). For instance, under some circumstances, an import tariff which is the optimal instrument to restrict imports in the absence of any lobbying for the disposition of the tariff revenue, may become inferior to a consumption tax on the importable once the resources diverted to lobbying is taken into account. Similarly a production or consumption tax may not be the optimal policy instrument for achieving national security objectives defined in terms of domestic output or consumption once allowance is made for lobbying (Anam (1982), Bhagwati (1984), Bhagwati and Srinivasan (1982, 1984). The intuitive explanation of this phenomenon is that resources diverted to lobbying or for enforcing the chosen policy not only shrink the production possibility set but also distort the production possibility frontier. Thus with lobbying there are two distortions: the distortion due to the policy instrument that triggered the lobbying in the first place and the lobbying induced distortion. The net effect of the two distortions may vary depending upon the policy instrument used.

3. DEFENSE AS AN EXTERNALITY

It was pointed out in Section 2B that consumption of certain commodities may not only generate welfare to private consumers but

contribute to national defense as well. A consumption externality arose when in private consumption decisions its contribution to national defense was not reflected. As contrasted with this static argument, Thompson (1979) develops two other dynamic national defense arguments which could also generate externalities. In his model, defense expenditures are necessary social expenditures to prevent one nation from acquiring the assets, (i.e. capital stock) of another. National defense expenditures are set at a level that ensures that the expected gains for a successful aggressor net of the resources he spends in his aggression are zero. It is reasonable to assume that defense expenditures so determined are an increasing function of capital stock and that private investors in their investment decisions that affect the capital stock will not take into account the effect of their investment on defense expenditures. Obviously an externality (in this case an external diseconomy) then arises. A suitable ad valorem tax on capital will be needed to internalize such an externality in private investment decision profitability calculus. Thompson generalizes the model to allow for two opposing tendencies. First, private capital accumulation increases the defense expenditures needed to deter aggressors because an increase in capital stock ceteris paribus increases the return to successful aggression. Second, it increases the nation's defense capacity because, given any level of defense expenditures, the larger the private capital stock the greater are the resources available for mobilization in the event of aggression. Seabury (1983) for example makes a similar point: the U.S. as a guarantor of Western security has to have an adequate

industrial capital that can be mobilized during a war . He adds that the U.S. industrial base (i.e. capital stock in industry) should include industrial assets readily fungible in case of major international crises and conflicts. Ignoring the issue of the composition of domestic capital stock, whether the appropriate form of intervention is a capital tax or subsidy depends on which of the two tendencies dominates. Thompson's empirical analysis based on data from a cross section of countries leads him to conclude that in fact that first effect dominates so that a capital tax rather than a subsidy is called for on national defense grounds.

Thompson's second argument is based on the fact that in war and other national emergencies price ceilings and quantity rationing are often imposed. To the extent they cannot be evaded, they result in rational private investors undervaluing their peace time investment in capital stock producing such goods. Thus a capital subsidy raising its peace time private value to its social value is called for. Many examples of possible private undervaluation of investment can be given. For instance, if individuals with particular skills are drafted into service in the armed forces (without an option to buy out of one's draft obligation) for a wage below market wage, then human capital investment in the acquisition of such skills in peacetime may be undervalued. Indeed generous military retirement plans have often been justified on the grounds that they compensate for underpayment during service. Investment in petroleum exploration in peacetime may be undervalued if during wartime price ceilings and rationing of petroleum supplies are certain to be imposed.

It is clear that peacetime tariff protection against import of goods subject to wartime price controls would be an inefficient instrument compared to capital subsidy. While a tariff would attract capital resources to the production of such goods in peacetime, it does not encourage investment needed to augment their output in wartime to the same extent as a capital subsidy. However, if the country is a sufficiently large importer of capital as to affect its import price, under the usual assumptions there is a case for an optimum tariff in order to exploit the country's market power. To the extent imports are restricted during wartime and price controls on outputs apply as well, the optimum tariff substitutes in part for the capital subsidy since it increases the domestic production of import competing capital goods in peacetime as well as wartime.

In the case of goods (other than capital imports discussed above) that are wholly or largely imported, wartime rationing and price controls at home lead to undervaluation of peacetime foreign investment in foreign production of such goods. Since investment subsidy to foreigners is infeasible, domestic peacetime stockpiling of such goods and/or encouraging a foreign cartel are alternatives to capital subsidy.

Thompson also argues citing Kahn (1960) that credibility of a nation's defense posture requires that the nation be willing to commit itself to punishing an aggressor even if it costs more than capitulating once aggression has taken place. In a system of majority voting, so goes Thompson's argument, the citizenry will vote just enough resources to defense that will ensure that the expected net

gain to an aggressor is zero. But in wartime when the nation's pre-commitment is being tested, the citizenry will not find it in its interest to devote more resources to fighting the war than its assets are worth. Thus credible commitment dictates that the military be assured a level of resources above what the citizenry will be willing to vote for. Since the military cannot tax the citizenry directly, the ability to purchase goods and services at controlled prices enables them to achieve the required level of real defense expenditure levels given the level nominal expenditures voted by the citizenry. This rationale for wartime price controls also implies that the political process will not eliminate the peacetime undervaluation of investment that price controls generate. Thus a corrective fiscal intervention to offset the undervaluation is needed.

Thompson's interesting empirical analysis though casual by the canons of econometrics, leads him to conclude that the actual fiscal policies in the United States turn out to be close to what would be optimal under his theory of national defense. In his view this occurred because the U.S. political system is guided by a compensation principle which meant that any Pareto dominated policy has no chance being approved.

4. RESPONSE TO THE THREAT OF TRADE EMBARGOES AND SANCTIONS

Yet another rationale for intervention arising from broad national national security grounds is based on the possibility that a trade embargo might be imposed once hostilities break out. Indeed even

a disruption of imports short of an embargo may have serious consequences in an emergency. The embargo threat is just another aspect of the fear of excessive import dependence mentioned earlier. A partial equilibrium analysis of the implications of a trade embargo is provided by Tolley and Wilman (1977). Mayer (1977) and Bhagwati and Srinivasan (1976) provide general equilibrium analyses. The following discussion is based on the latter. Consider a two-period model in which in the first period (peace) there is no threat of an embargo and in the second period (war or national emergency) with probability P an embargo will be imposed by the adversaries. Suppose the maximum national welfare achievable in the second period with (without) an embargo is $\underline{U}$ ($\bar{U}$) so that the expected welfare in the second period is $P\underline{U} + (1-P)\bar{U}$. It is clear that as long as P, $\underline{U}$ and $\bar{U}$ are not affected by any action taken in the first period, there is no argument for intervention in the first period.

There are two possible but not mutually exclusive ways in which actions in the first period could affect the outcomes in the second. First, the production possibilities in the second period could be influenced by actions in the first, either through investment in capacity creation or because the first period output (capacity) levels in various sectors of the economy restrict the choice of output levels in the second due to, say, adjustment costs. Second, the probability P may depend on the choices made in the first period, for instance, on the level of imports. It is plausible to argue that the level of a country's imports may be taken by its adversaries as an indicator of the vulnerability of its economy and as such, it is natural to assume

that P is an increasing function of the level of imports. It should be stressed however that even if either of the above circumstances prevail, there will be no case for intervention if private agents anticipate and allow fully for the dependence of outcomes in the second period on actions in the first.

Taking the case of investment first, it can be shown (see Appendix) that if a risk neutral private investor correctly anticipates the expected return to investment given that an embargo may be imposed, there is no need for intervention. If on the other hand, the investor either ignores the possibility of an embargo or while correctly assessing the probability of an embargo nevertheless does not allow for the possibility that the marginal product of capital with embargo in place may differ from that in the absence of an embargo, intervention in the form of a investment subsidy (assuming that the above mentioned difference in marginal products in positive) will be called for. If the first period choice of production levels constrains those in the second period, once again an intervention in the form of an appropriate production tax (or subsidy) in the first period will be necessary if private production decision do not anticipate and appropriately allow for the relevant effects. Lastly, if the probability of the imposition of an embargo is an increasing function of the level of imports in the first period and this effect is not allowed for in private decisions regarding imports, an import tariff is the appropriate form of intervention.

5. STRATEGIC USE OF TRADE RESTRAINTS, EMBARGOES AND ECONOMIC SANCTIONS

The threat and, less often, the imposition of economic sanctions by one country against another in pursuit of mainly non-economic goals such as foreign policy objectives are of ancient origin. From Pericles' Megarian decree of 432 B.C. that may have played a role in triggering the Peloponnesian war (Hufbauer and Schott (1983)) to the U.S. trade embargo on Nicaragua and the serious consideration allegedly being given to imposing some economic punishment on New Zealand for the latter's refusal to let U.S. naval vessels carrying nuclear weapons into its ports, economic sanctions have been viewed as an alternative to the use of force in the pursuit of policy objectives. The offer of economic concessions linked to changes in the policies of the recipient nation in directions desired by the offerer is another aspect of the same phenomenon. The literature, originating mainly from political scientists and political economists writing on East-West relations generally and U.S.--Soviet relations in particular, has been concerned with issues relating to the significance of East-West trade in enhancing the military as well as economic capability of the East. Another example of the strategic use of international trade is the policy of accumulation of and release from stocks of certain commodities. The well known recent example is the strategic petroleum reserve policy initiated by the U.S. after the first oil shock. Of course stockpiling of certain non-ferrous metals

is of longer standing. Even stocks of agricultural commodities that were compiled mainly to serve domestic policy objectives have come to have strategic significance in the pursuit of security objectives. Among the economic punishments being considered against New Zealand, apart from withdrawing the preferential treatment given to its lamb exports by the U.S., is the possibility of releasing butter and other dairy products from U.S. stocks to the international market in order to hurt New Zealand's export earnings from the same products.

5A. Strategic Stockpiles

Thompson's (1979) analysis (see Section 3 above) suggested the accumulation of stocks of imported goods during peacetime as an alternative to an infeasible policy of subsidizing foreign investors for their peacetime undervaluation of investment for wartime exports reflecting price controls and rationing. Tolley and Wilman (1977) in their study also examine the role of stockpiling in pre-embargo times as a way of responding to the threat of a future embargo. In the absence of any externalities private storage activities will bring about the right amount of storage in response to an embargo threat. However, if, as was discussed in Section 4, externalities arise, either government subsidization of private storage or government storage itself may be called for. Neither of these two analyses views stockpiling from a strategic perspective. Eaton and Eckstein (1984) on the other hand develop a model in which the petroleum reserve policy is examined in a strategic context that takes into account that

petroleum is an exhaustible resource so that imports for stock accumulation in any period not only affect equilibrium prices in that period but in all future periods as well.

The model postulates a two period world in which a single good in each period is produced with capital stock and oil as inputs. In the first period the output of the single good is allocated between current consumption and addition to capital stock. Oil can be extracted from the ground for current use and for storage. While all the oil left in the ground in the first period is available for extraction in the second, only part of the oil put in storage above the ground becomes available for use in the second period thus reflecting cost of storage. Total amount of oil available in the ground may be known by all agents with perfect certainty in period 1 or alternatively it is uncertain in period 1 but becomes known at the beginning of period 2. It follows that in a world of perfect foresight in which markets for claims contingent on any possible stock of oil to be revealed in period 2 (in case it is uncertain) exist in period 1 and all agents behave competitively, no government intervention is necessary to sustain an intertemporally Pareto-Optimal allocation of resources.

From a competitive world Eaton and Eckstein move to a world of bilateral monopoly in which a monopolistic seller of oil (OPEC) faces a monopsonistic buyer (US). OPEC's strategy variables are oil prices in the two periods and its investment in U.S. capital markets in the first. The U.S. government's strategy variables are import tariffs in

the two periods, the tax rate on OPEC's investment in the U.S. and the level of strategic petroleum reserve accumulated in the first period. Private agents behave atomistically correctly anticipating U.S. and OPEC policies but treating them parametrically. Alternative rules of the game between OPEC and US are considered. One dichotomy is between open loop policies in which strategies for both periods are chosen in the first period and feed back policies in which the strategy for the second period is contingent on the outcome of the first period and the choice for the first period is made taking into account its influence on the second period choices. Of course open loop policies may result in time inconsistency--once the first period component of the policy is implemented and its outcome known, one or the other of the players may not have an incentive to implement the second period component of his open loop policy. Thus open loop policies may not be credible. Within each of these categories, two types of behaviour can be distinguished: (i) one of the players acts as a (Stackelberg) follower in choosing his strategy given the strategy of the other player. While the latter, acting as a leader sets his strategy taking full account of the follower's reaction to his choice (ii) both choose their strategies simultaneously acting as non-cooperative Nash players each taking the other's choice as given. In the case of feed back policies, the Stackelberg or Nash behaviour applies to each period separately while in the case of open loop policies it applies to the choice of strategies made in the first period but applicable for both periods. All agents are assumed to have perfect foresight. The U.S.

and OPEC policymakers correctly anticipate the effect of their policies on private behaviour.

Even though Eaton and Eckstein are able to characterize the optimal strategies of the players in the above setting, they are unable to evaluate the overall welfare effects without making particular assumptions about functional forms that describe technology and perferences. They find that the strategic petroleum reserve policy in their model can have both desirable and undersirable consequences for U.S. welfare depending on technology, preferences and rules of the game. In one scenario in which OPEC sets its prices taking into account U.S. response to its prices, a price contingent U.S. inventory policy can improve U.S and even World welfare. The authors suggest that the reason for this is that the optimal U.S. inventory policy makes U.S. demand more elastic in each period thereby reducing the consequences of the distortion due to OPEC monopoly. Be that as it may, their main conclusion is that the case for establishing strategic reserves is rather limited.

5B. Gains From Trade Versus National Security and Global Political Influence.

The traditional argument in favour of voluntary trade is that it will take place only if it leads to gains to both parties to the exchange. In international trade a country gains by pursuing its comparative advantage: with the opening of trade it exports those commodities and services which it produces relatively cheaply compared to its trading partner prior to trade and imports those which were

relatively more expensive to produce. The distribution gains from trade (measured by using some metric such as the Hicksian equivalent variation) will depend on how far the post trade equilibrium prices deviate from the pre-trade prices of each partner. And anything that has the effect of reducing the prices that a country obtains for its exports or raises the prices it pays for its imports reduces the gains from trade.

By viewing conflict between two countries as having the effect of reducing export and raising import prices in their trade, Polachek (1980) tests the hypothesis that a negative relationship between conflict and trade exists using a ten-year-thirty-country cross section data. Conflict is quantified by analyzing yearly events reported in 47 newspaper sources and coding them on a 15 point scale representing different kinds of conflict and cooperation. Between any pair of countries, a measure of net conflict is obtained by computing the difference between the frequency of conflictual events (Categories 9-15) and cooperative events (Categories 1-7). Since the direction of causality can run both ways (less conflict can lead to more trade and greater trade can lead to less conflict), Polachek estimates a simultaneous equation model in which exports, import and conflict are endogenous and several exogenous variables are included. He finds (p. 55) that '--a doubling of trade on average leads to a 20% diminution of belligerence'! In a later application of similar ideas to the East-West trade during the period of detente Gasiorowski and Polachek (1982) postulate that incentives to reduce conflict are related to the desire to protect gains from trade. If the distribution of gains is

skewed towards one partner, the other can use it as a lever to obtain political concessions. They find a strong inverse relationship between trade and conflict. With Warsaw pact having relatively more to gain from its trade with the U.S., trade leads to a greater reduction in conflicts directed from Warsaw Pact to U.S. than in conflicts directed from U.S. to Warsaw Pact. Granger causality tests suggested that the direction of causation is far stronger from trade dependence to conflict than vice versa. The authors also report correlations between conflict and trade in specific commodity groups. They find that capital goods exports from U.S. and imports of industrial supplies into U.S. from the Warsaw Pact countries have much higher (negative) correlation coefficients than trade in other commodity groups. They view this finding as confirming that the dependence of Warsaw pact countries on the West for technology imports and their comparative advantage in supplying industrial raw material to the West tend to moderate their conflicts with the U.S.

The perceived trade-off between gains from trade with the East and security interests of the West has led to the imposition of controls on such trade (including controls on investment and technology transfer, etc.) formally through a standing coordinating Committee (COCOM) consisting of all Nato countries except Iceland and Japan. Sweden and Switzerland, though not members of COCOM, nevertheless broadly conform to the decisions of COCOM. There is a vast literature on East-West economic relations in general and the functioning of COCOM imposed controls in particular (Agnelli (1980), Hanson (1981), Holzman and Levgold (1975), Roosa, et al. (1982)).

Root (1984) provides a succinct exposition of the rationale of trade controls, the inevitable conflict of interests among members of COCOM arising from unequal incidence of the economic cost of controls in individual countries, and other internal contradictions. The following discussion is based on his analysis.

The basic agreed objective of COCOM control was to prevent Western goods and technology from adding significantly to the military potential of the East. However the U.S. favoured the further use of selective export restrictions for political purposes not directly related to Western security interests and indeed attempted it unilaterally on several occasions. The other members of COCOM were opposed to it on the grounds that such selective controls could not be defined clearly let alone equitably administered and, in any case, they were unlikely to alter Soviet behaviour. The U.S. position was based on the belief in the White House that the gains from East-West trade accrued almost entirely to the East and as such, 'given Soviet needs, expanding trade without political quid pro quo was a gift. Our strategy was to use trade concessions as a political instrument, withholding them when Soviet conduct was adventurous and granting them in measured doses when the Soviets behaved cooperatively' (Henry Kissinger as quoted in Agnelli (1980), p. 1020). Other branches of U.S. government on the other hand favoured liberalized trade--the State department on the belief it would improve the political climate for negotiations in other areas such as arms control and the commerce department on traditional grounds that it would improve American business prospects. While the executive branch attempted to link

trade to external behaviour of the Soviets, the Congress went even further and linked it to Soviet treatment of some of its own citizens, in particular Soviet policy towards emigration of Jews, etc.

Even the argument that controls limited to export of items of potential military use are sensible has been challenged on the grounds that the Soviet Union would not let itself become critically dependent on Western suppliers for running its military machine and, further, controls would merely accelerate Soviet development of indigenous technology to substitute for Western imports. In the absence of peacetime controls, it is argued, Soviets would refrain from actions that will reduce their dependency and thus make themselves vulnerable during crises or wartime. This particular argument is without merit. The very same behavioural response of the Soviets to peacetime controls by the West, namely, accelerated import substitution, would be elicited if instead of peacetime controls they expect embargoes to be imposed during crisis. Indeed this is what the analysis of the threat of embargoes in Section 4 would lead one to expect.

The essential point of peacetime controls or embargoes in crisis time is to impose an opportunity cost (perceived or actual) on the Soviets. This cost is simply the foregone gains from trade, both static and dynamic. The static gains arise from resource savings in having a production and trade pattern that conforms to <u>static</u> comparative advantage and the dynamic gains arise from resource savings in having an investment (human and physical) patterns that conform to <u>dynamic</u> comparative advantage. The dynamic gains would also include any favourable impact on the rate and character of

resource productivity raising technical change that trade in goods and services, particularly equipment, brings about. The gains could be modest or large but whether the gains in productive capacity would be used for augmenting military strength or consumer welfare depends on Soviet policy maker's objectives.

There are again diametrically opposite views expressed in the literature on Soviet policy maker's objectives and response. Those opposed to controls argue that the cost imposed on the Soviets by the controls would be shifted entirely to the consumer or civilian part of the economy with no appreciable effect on the military. Those in favour of controls argue that even the Soviets could not impose a full shift and the military would have to bear at least part of the cost. Another strand in the arguments about the use of gains from trade relates to the influence of trade with the West on economic reform within the Soviet Union. Some believe that with the import of equipment and their installation, Soviets would get an opportunity to observe the technological superiority of Western equipment and the efficiency of their contractors over their domestic analogs, and would then initiate and/or accelerate economic reform. Others believe that by importing Western technology and employing Western contractors to install them, Soviets would be able to postpone the badly needed but politically risky reform of the system. This debate about Soviet policy maker's responses sometimes degenerates into imagining two opposing camps in the highest echelons Soviet policy making apparatus: the 'doves' committed to 'detente', consumer welfare and peaceful

policies and the 'hawks' inexorably pursuing global domination and arguing whether Western controls strengthens the doves or the hawks.

Root (1984) correctly argues that it would be simplistic to assume that gains from East-West trade accrues entirely to the East and, as such, there is a cost to the West as well of trade controls. For instance, the loss of potential profits from sales to the East could affect the resources devoted to research and development in the West and, hence, slow down the pace of technical change. Also freedom of scientific exchange that is inhibited by the controls could dampen fundamental research.

An example of Western gain from sales to the Soviets is in respect of oil and gas equipment and technology. Such sales by enabling the Soviets to develop their Siberian natural gas and oil resources for sale to Western Europe and Japan would have helped the latter to diversify their source of energy imports. The strategic significance of an assured supply of energy is obvious. The Europeans correctly perceived this and diversifying Western sources of energy had been U.S. objective as well. Yet the U.S. by attempting to achieve political objectives that related to the Soviet trial and conviction of dissident Anatoly Shcharansky in 1978, Soviet invasion of Afghanistan in 1979 and imprositon of martial law in Poland 1981, periodically suspended licenses for export of such equipment. Eventually these export controls were extended even to exports by U.S subsidiaries abroad and of foreign-made products using U.S. technology irrespective of whether such technology transfer had taken place prior

to the imposition of U.S restrictions. Other Western nations rejected the U.S. policy and finally the Reagan Administration bowed to Allied pressure.

5C. Security and Gains from Trade; A Simple Model

Many of the arguments of Section 5B can be sharply illustrated by the following two country model. Each country produces three goods, two of which are traded internationally while the third, called security or defense, is a non-traded good. Welfare of each country's citizens depends only on the consumption of the two traded goods. Consider the decision problem of one of the countries. Let C_i denote its consumption of good i (i = 1, 2) and Q_i the production of good i (i = 1, 2, 3). The production possibility frontier (PPF) of this country (given its resource endowment, not explicitly shown) is given by:

$$F(Q_1, Q_2, Q_3) = 0 \tag{1}$$

with domain of (Q_1, Q_2, Q_3) being determined by the resource endowment. Assuming the production possibility set of this economy to be convex implies that F is concave.

Suppose consumer welfare can be represented by a quasi-concave Samuelson (direct) social utility function $U(C_1, C_2)$. Let the corresponding indirect utility function be v(p, Y) where p is the relative price of good 2 in terms of good 1 and Y is consumer expenditure in terms of good 1. Given any p and given any level $\bar{Q}_3$ of the output of the defense good, maximization of consumer welfare is equivalent to maximizing consumer expenditure Y which in

turn equals the value of output of the two traded goods. Thus

$$Y \equiv Q_1 + pQ_2 \tag{2}$$

The first order condition for an interior maximum is

$$F_2 = pF_1 \tag{3}$$

Equations (1) and (3) yield the optimum values of Q_1^* and Q_2^* as functions of $\bar{Q}_3$ and p. The maximized value Y* of Y is also a function of $\bar{Q}_3$ and p.

It is obvious that $\frac{\partial Y^*}{\partial \bar{Q}_3} < 0$, as increasing $\bar{Q}_3$ shrinks the production possibilities for Q_1 and Q_2. By the envelope theorem $\frac{\partial Y^*}{\partial p} = Q_2^*$. Now substituting Y* for Y in the indirect utility function we get the maximized welfare as

$$v(p, y^*) = v(p, Y^*(\bar{Q}_3, p)) \equiv V(\bar{Q}_3, p) \tag{4}$$

It can be seen that $\frac{\partial V}{\partial \bar{Q}_3} = v_2 \frac{\partial Y^*}{\partial \bar{Q}_3} < 0$ since $v_2 > 0$,

and $\frac{\partial V}{\partial p} = v_1 + v_2 \frac{\partial Y^*}{\partial p} = - v_2 (C_2^* - Q_2^*)$ using Roy's identity where C_2^* is the consumption of good 2. Hence welfare V decreases as p increases as long as $C_2^* > Q_2^*$ i.e. good 2 is being imported. Let us denote by p^A the price at which net imports $C_2^* - Q_2^*$ are zero i.e. p is the autarky price. Thus in the region $0 < p < p^A$, welfare V is decreasing in p.

Suppose one viewed the country depicted above as the Warsaw Pact facing a Nato determined p either because Nato is 'large' relative to the Pact in the markets for the two commodities or because a Nato embargo results in the Pact facing a costlier source than Nato for its imports, the alternative source being large as well. Since even in the Socialist countries the market is used for the allocation of consumer goods, the use of the utility maximization subject to a budget constraint for depicting consumer decisions in not too unrealistic though the assumption that effective consumer prices do not differ from world prices is not. Also, the assumption that international prices influence production decisions is questionable. Nevertheless for the purposes of the present analysis, the additional welfare loss imposed by price distortions in consumer and producer decision is not central.

Suppose initially there were no trade restrictions. Let the Pact's initial defense output and terms of trade be $\bar{Q}^0$, and p^0 respectively. A Nato imposition of trade controls raises the import price to p^1. If the Pact kept its defense output unchanged at $\bar{Q}_3^0$, consumer welfare would go down by

$V(\bar{Q}_3^0, p^0) - V(\bar{Q}_3^0, p^1)$. The Pact's response to the imposition of controls could be either to maintain consumer welfare by reducing defense output to $\bar{Q}_3^1$, such that $V(\bar{Q}_3^0, p^0) = V(\bar{Q}_3^1, p^1)$, or maintain defense output at $\bar{Q}_3^0$, let the consumers bear the cost of Nato controls, or reduce defense output to a level between

$\bar{Q}_3^0$ and $\bar{Q}_3^1$ so that both the military and the consumers bear some of the costs.

The allocation of costs between consumers and the military may be determined, say,by postulating that the decision makers in the Pact maximize a welfare function W that is additively separable in consumer welfare and security.

Security is assumed to be function $S(\bar{Q}_3, Q_3^*)$ of the Pact's and Nato's defense output Q_3^*. It is natural to assume that S is an increasing and concave function of $\bar{Q}_3$ and $\bar{Q}_3^*$. Thus W can be expressed as

$$W = \alpha V(\bar{Q}_3, p) + (1 - \alpha)\, S(\bar{Q}_3, Q_3^*) \tag{5}$$

where $0 < \alpha < 1$. Maximization of W with respect $\bar{Q}_3$ given Q_3^* leads to the first order condition:

$$\alpha \frac{\partial V}{\partial \bar{Q}_3} + (1-\alpha) \frac{\partial S}{\partial \bar{Q}_3} = 0 \tag{6}$$

The assumptions that consumer preferences are convex, both goods are normal in consumption and that the transformation function $F(Q_1, Q_2 Q_3)$ is concave ensure that V is concave in $\bar{Q}_3$. By assumption S is concave in $\bar{Q}_3$ as well. Thus the second order condition for a maximum is satisfied. Some unsurprising comparative static results can be easily established using (6) and assuming that its solution $\bar{Q}_3^0$ is unique.

First $\frac{\partial \bar{Q}_3}{\partial \alpha} < 0$, i.e. <u>ceteris paribus</u>, an increase in the weight placed on on consumer welfare reduces optimal defense output $\bar{Q}_3^0$. Second, if an increase in Nato defense output Q_3^* increases the marginal security product $(\frac{\partial S}{\partial \bar{Q}_3})$ of the Pact's defense output (once again a reasonable assumption) $\bar{Q}_3^0$ will increase as Q_3^* increases. Third, an increase in p brought about by Nato controls will <u>increase</u> (<u>decrease</u>) $\bar{Q}_3^0$ according as $\frac{\partial^2 V}{\partial p \partial \bar{Q}_3} > (<) 0$, i.e. according as the marginal welfare impact $\frac{\partial V}{\partial \bar{Q}_3}$ of defense is increased (decreased) by the price increase. In principle it can be of either sign depending as it does on the substitution possibilities in production as well as consumption. It could be zero as well: for example, let preferences be represented by the log linear utility function $\beta \text{Log } C_1 + (1-\beta)\text{Log } C_2$ and let $F(Q_1, Q_2, Q_3)$ take the form $Q_1^2 + Q_2^2 + Q_3^2 - \bar{R}^2 = 0$ where $\bar{R}$ is the resource

endowment. Then it is easy to show that

$$V(\bar{Q}_3,p) = \frac{1}{2}\,\mathrm{Log}(\bar{R}^2 - \bar{Q}_3^2) + \frac{1}{2}\,\mathrm{Log}(1+p^2) - (1-\beta)\mathrm{Log}p + \beta\mathrm{Log}\beta + (1-\beta)\mathrm{Log}(1-\beta)$$

so that $\dfrac{\partial^2 V}{\partial p \partial \bar{Q}_3} \equiv 0$. In such a case Nato price controls have <u>no effect</u>

on the Pact's defense expenditure $\bar{Q}_3^0$!

In the above discussion Q_3^*, the defense output of Nato, was assumed given. One could postulate a Cournot-Nash equilibrium determination of $\bar{Q}_3$ and Q_3^* by using (6) as the reaction function of the Pact. A reaction function of Nato could be derived by postulating a Nato security function $S^*(Q_3^*, \bar{Q}_3)$. Again it is reasonable to assume that S* is an increasing concave function of Q_3^* and $-\bar{Q}_3$. If for simplicity we assume consumer welfare in Nato is insensitive to p then a Nato welfare function W^* analogous to W for the Pact can be postulated, i.e.

$$W^* = \alpha^* V_3^*(Q) + (1-\alpha^*)\, S_3^*(\bar{Q}_3, Q_3^*) \tag{7}$$

The Nato reaction function is implied by the following first order condition for the maximization of W^*, i.e.

$$\alpha^* \frac{dV^*}{dQ_3^*} + (1-\alpha^*)\frac{\partial S^*}{\partial Q_3^*} = 0 \tag{8}$$

The assumptions that S^* is increasing and concave in Q_3^*, and $-\bar{Q}_3$ and $\frac{\partial S^*}{\partial Q_3^*}$ is increasing in $\bar{Q}_3$ imply that Q_3^* is an increasing function of $\bar{Q}_3$

Equation (6) and (8) together determine the Cournot-Nash equilibrium expenditures $(\bar{Q}_3^*, Q_3^*)$. Since by assumption Nato's reaction curve is unaffected by changes in p, while the Pact's curve can shift up or down, or remain unchanged, the Nash equilibrium defense expenditure of the Pact can go up, down or remain unchanged as Nato imposes trade controls.

6. EMBARGOES AND SANCTIONS IN A HISTORICAL CONTEXT.

Several studies of the historical experience with embargoes and sanctions are available (Carswell (1982), Doxey (1980), Losman (1979), Hufbauer and Schott (1983)). The sanctions reviewed included unilateral as well as multilatoral sanctions, involved trade in goods as well as financial investment and applied only to a limited set of goods or to all goods except food, medicines and others excluded on 'humanitarian' grounds. By and large, the success of sanctions in achieving the objectives of those imposing them seem to be modest. By scoring <u>success</u> in a scale of 1 to 4 (from failure to success) and the contribution of sanctions to success again in a scale of 1 to 4 (from zero to a significant contribution) Hufbauer and Schott constructed an

overall success index by multiplying the scores. Their review of 78 cases by policy goal and the period of imposition of sanctions lead to the following (success means an overall index of 9 to 16).

	Sanction Period			
	Pre 1973		1973-1983	
	Success	Failure	Success	Failure
Policy Goals				
Modest Policy Changes	7	1	8	15
Destabilization	8	6	1	3
Disruption of Military Adventure	5	7	1	2
Military Impairment	2	4	0	2
Other Major Policy Changes	0	9	1	1
Total	22	27	11	23

Source: Hufbauer and Schott (1983), p. 75 Table 5.2.

The lack of success of sanctions particularly in the period 1973-83 is evident. The reasons for lack of success were also fairly obvious. They cite the following as the major ones: (i) sanctions imposed were often inadequate in relation to the objectives which were themselves elusive, (ii) sanctions created their own antidotes in terms of unifying the target country and in successfully initiating a search for commercial alternatives by it, (iii) allies of the target country often offset the effects of sanctions with their support and (iv) sanctions created backlash in the imposing country itself from lobbies of export interests affecteds by the sanctions. Besides imposing country's allies may not share its goals and their trade with the target country may offset the effect of sanctions.

Losman's (1979) review of the cases of Cuba, Israel, and Rhodesia supports the findings of Hufbauer and Schott. He concludes that

partial sanctions covering only some goods have no hope of success and embargoes against affluent countries with large economies are not likely to succeed either. The cost of sanctions may fall mostly on a politically powerless group in the target country (e.g. black Africans in Rhodesia, middle class in Cuba) and thus, has little influence in changing government policy. In sum he found that 'political success has not been forthcoming in any of the embargo studies, despite sanctions having some very damaging economic results' (Losman (1979), p. 124).

In contrast, Carswell (1982) argues that the U.S. sanctions against Iran imposed after the taking of hostages, in particular the blocking of Iranian assets in the U.S., were effective. He attributes the effectiveness to the unique circumstances of the case. 'First, the blocking was keyed to an event (the hostage seizure) that could be quickly resolved, and the blocking itself was therefore destined to have the same resolution. Second, by accident of history a very large amount of Iranian assets was under U.S. control, far larger than the U.S. assets under Iran's control. Third, the principal allies of the United States also had vital interests to protect in Iran. Thus the United States had extraordinary leverage, a condition that did not exist in the China-Cuba-Vietnam situations and is not likely to be repeated' (Carswell (1982), p. 260). In this he is one with Doxey (1980) who points out that the effectiveness of sanctions 'must be judged on a case by case basis, and although authorized sanctions may have more symbolic value, the absence of authorization for collective measures does not necessarily rob them of efficacy. The crucial

factors will be the nature of objectives sought, their value to both coercor and coerced and the resources they are prepared to invest in them, as well as the target's ability to withstand pressure on its own, or with outside help. In a divided and economically interdependent world such help is often forthcoming—except in the hypothetical cases of extreme vulnerability amounting to total economic dependence on the states imposing sanctions, or of universal ostracism, the coercive properties of economic sanctions are limited' (Doxey (1980), p. 131).

7. CONCLUSIONS

We can be brief in our conclusions. Economic Theory suggests that a case can be made for intervention in a market economy on national defense or security grounds whenever national defense requirements create some production or consumption externality. Many of the forms of intervention were in terms of <u>domestic</u> economic policy instruments and <u>not</u> in terms of restrictions of foreign trade. Even when trade policy is viewed in a strategic context, theory does not lead to any unambiguous conclusions regarding its efficacy in furthering security objectives. Finally, the review of economic sanctions that have been applied in the past also points to their limited effectiveness.

Appendix

For simplicity assume that (i) there are two goods which can be traded internationally at a fixed term of trade p in the first period as well as in the second period in the event that there is no embargo. (ii) The embargo if imposed is total in the sense of eliminating all trade. (iii) The probability of the embargo being imposed is P. (iv) The economy lasts only two periods and as such there is no scrap value to capital stock remaining at the end of the second period. Capital does not depreciate. (v) One of the goods can either be consumed or invested in additions to capital stock that become available for productive use at the end of the second period.

CASE 1: INVESTMENT DECISION

Let $\bar{K}_1$ be the inherited capital stock at the beginning of period 1. If I is investment in period 1 the capital stock available for use in period 2 is $\bar{K}_1 + I$. The production possibilities in either period (assuming that the choice of output levels in period 1 do not affect similar choices in period 2) can be represented by the transformation function $Q_1 = F(Q_2, K)$ where Q_1 is the output of commodity i and K is the available capital stock at the beginning of the period. For simplicity it has been assumed that labour available for production is exogenous and is the same in each period. It is therefore not shown explicitly as an argument of

the transformation function. Let good 2 be used for investment as well. Let us assume that production and consumption decisions are taken in period 2 after the uncertainty about the embargo has been resolved. Also since there is no scrap value for capital left at the end of period 2, there is no investment in period 2 regardless of the embargo threat. Let the welfare of citizens in each period be represented by a quasi-concave Samuelson social utility function $U(C_1, C_2)$.

Consider first the case where an embargo is imposed in period 2. Since the embargo precludes trade, the consumption of each good is the same as its production. Hence, <u>given</u> I, the maximum welfare under an embargo is $\underline{U} = \text{Max } U(F(Q_2, \bar{K}_1 + I), Q_2)$. The first order condition for an interior maximum is each

$-F_1 = \frac{U_2}{U_1}$ where the subscript i denotes the partial derivative of a function with respect to its i^{th} argument($i = 1, 2$). Under the usual neo-classical assumptions about production functions, F is concave and U is quasi-concave so that the second order conditions for a maximum are satisfied. Again under well known conditions about the behaviour of marginal products and marginal utilities as output Q_2 and consumptions C_i approach zero an unique interior maximum can be shown to exist. The first order condition states that the marginal rate of transformation $-F_1$ in production equals the marginal rate of substitution U_2/U_1 in consumption. This will be met in a competitive equilibrium in period 2 under an embargo without

any intervention other than lump sum transfers among individual consumers that are needed to justify the use of the Samuelson social utility function representation of consumer welfare. For concreteness let the dependence of $\underline{U}$ on $\bar{K}_1+I$ be indicated by $\underline{U}(\bar{K}_1 + I)$. By the envelope theorem $\underline{U}_1 = \frac{d\underline{U}}{dI} = U_1 F_2$ where U_1 and F_2 are evaluated at the optimum value of Q_2.

Similarly $\bar{U}$ the maximum welfare in period 2 when there is no embargo is given by $\bar{U} \equiv \text{Max } U[C_1, C_2]$ subject to $C_1 + pC_2 = F(Q_2, \bar{K}_1 + I) + pQ_2$. The first order conditions for an interior maximum are $\frac{U_2}{U_1} = p = -F_1$, these having the interpretation that the marginal rate of transformation in production $(-F_1)$ and the marginal rate of substitution in consumption $(\frac{U_2}{U_1})$ both equal the fixed terms of trade p. No intervention other than lump sum transfers is called for in supporting this allocation. $\bar{U}$ can be written as $\bar{U}(\bar{K} + I)$ and once again $\bar{U}_1 = \frac{d\bar{U}}{dI} = U_1 F_2$ where U_1 and F_2 are evaluated at the optimal value of C_1, C_2 and Q_2.

The choice problem in the first period can be viewed as maximizing (with respect to C_1, C_2, and Q_2) the expected

welfare $W = U[C_1, C_2] + \beta[\underline{U}\ (\bar{K}_1 + I)P + \bar{U}(\bar{K}_1 + I)(1 - P)]$ where β represents the discount factor applicable to period 2 welfare, subject to the constraint $C_1 + p\ (C_2 + I) = F(Q_2, \bar{K}) + pQ_2$. The first order conditions can be written as

$$\frac{U_2}{U_1} = p = -F_1 \quad \text{and} \quad \beta[P\underline{U}_1 + (1 - P)\ \bar{U}_1\ ] = U_1\ p.$$

The first set of conditions have the same interpretation as in period 2 under no embargo and once again show that no intervention in product markets or trade is called for. The left hand side of the second condition represents the marginal gain in expected welfare of an additional unit of investment in period 1 and the right hand side represents the welfare cost of that investment. If consumers ignore the threat of embargo they will be equating $\beta\bar{U}_1$ to $U_1 p$ if there is no intervention and the first order condition will be violated. An investment subsidy (tax) raising the return (in welfare units) by $\beta P(\underline{U}_1 - \bar{U}_1)$ will rectify the situation as long as $\underline{U}_1 > (<)\ \bar{U}_1$. If consumers correctly perceive the probability P but nevertheless ignore the possible difference between $\underline{U}_1$ and $\bar{U}_1$ and assume it to be $\bar{U}_1$, once again they will wrongly equate $\beta\bar{U}_1$ to $U_1 p$ and an investment tax or subsidy will be needed to correct it.

CASE 2: ADJUSTMENT COSTS

To make this case dramatic let us ignore investment possibilities and assume that the production choices made in period 1 cannot be altered in period 2. In this case $\underline{U} = U(F(Q_2^1, \bar{K}_1), Q_2^1)$ where Q_2^1 is the output of good 2 in period 1 and $\bar{U} = \text{Max } U(C_1, C_2)$ subject to $C_1 + pC_2 = F(Q_2^1, \bar{K}_1) + pQ_2^1$. The first order condition for this maximization is

$\frac{U_2}{U_1} = p$. Thus in period 2 no intervention is called for. For concreteness denoting the dependence of $\underline{U}$ and $\bar{U}$ on Q_2^1 by $\underline{U}(Q_2^1)$ and $\bar{U}(Q_2^1)$, by the envelope theorem we get

$\underline{U}_1 = U_1 \; F_1$ (evaluated at Q_1^1) and $\bar{U}_1 = U_1 (p + F)$ (evaluated at Q_2^1 and optimal values of C_1 and C_2). The first period problem is to

maximize $U[C_1, C_2] + \beta [\underline{U}(Q_1^2) P + \bar{U}(Q_1^2)(1 - P)]$ subject to $C_1 + pC_2 = F(Q_1^2, \bar{K}_1) + pQ_1^2$. The first order conditions for a maximum are $\frac{U_2}{U_1} = p$ and $\beta [\underline{U}_1 P + \bar{U}_1 (1 - P)] = U_1(p + F_1)$. If producers ignore the fact that they have the choice of output levels only in the first

period, even though they know P they will behave as if the left hand side of the latter equality was zero and equate p to $-F_1$. To rectify this one needs a production tax to the extent of $\frac{\beta[\underline{U}_1 P+\bar{U}_1 (1-P)]}{U_1}$ so that the marginal rate of transformation $-F_1$ is equated to the tax inclusive price $\frac{p-\beta[\underline{U}_1 P+\bar{U}_1 (1-P)]}{U_1}$. It is easy to see that if producers ignore P (i.e assume that it is zero) but allow for the effect of the production constraint they will wrongly equate $\beta\bar{U}_1$ to $U_1(p + F_1)$. Once again a production tax, this time to the extent of $\frac{\beta(\underline{U}_1 - \bar{U}_1)P}{U_1}$ will be needed to rectify the situation.

CASE 3: ENDOGENOUS EMBARGO PROBABILITY

Let us ignore investment and adjustment costs. However let the probability P of an embargo being imposed be an increasing function P(M) of imports M of good 2 in period 1. Then in period 2 the welfare levels under an embargo and no embargo are obtained by setting I = 0 in the functions $\underline{U}(\bar{K}_1 + I)$ and $\bar{U}(\bar{K}_1 + I)$ derived in Case 1. As was shown there, there is no case for any intervention in period 2. Now the problem in the first period is to maximize $U(C_1, C_2) + \beta[P(M)\underline{U} + (1 - P(M))\bar{U}]$ subject to

$C_1 = F(Q_2, \bar{K}_1) - pM$ and $C_2 = Q_2 + M$. In this formulation good 2 is imported and M is the level of imports. By assumption P(M) is increasing in M. The first order conditions for a maximum can be written as

$$\frac{U_2}{U_1} = -F_1 \quad \text{and} \quad \beta P_1(M)(\bar{U} - \underline{U}) = U_1 \left(-p + \frac{U_2}{U_1}\right).$$

Since by construction $\bar{U} > \underline{U}$, if $P_1(M) = 0$ (i.e. if the probability of embargo is unaffected by level of imports) $\frac{U_2}{U_1} = -F_1 = p$ and no intervention is called for. If $P_1(M) > 0$ and consumers (producers) <u>fully</u> take it into account by equating their marginal rate of substitution $\frac{U_2}{U_1}$ (their marginal rate of transformation $-F_1$) <u>not to p</u> the terms of trade, but to $p + \frac{\beta P_1(M)(\bar{U} - \underline{U})}{U_1}$, no intervention is called for. If producers and consumers ignore the probability of embargo they will be wrongly equating $\frac{U_2}{U_1}$ and $-F_1$ to p. Then an intervention in the form of an ad valorem import tariff at the rate $\frac{\beta P_1(M)(\bar{U} - \underline{U})}{U_1}$ is called for to satisfy the first order condition.

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