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THE EFFECTS OF NUCLEAR PROLIFERATION

Richard E. Hayes

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I. INTRODUCTION

There are a number of states which have the capacity to build nuclear weapons today and may develop the motivation to do so within the foreseeable future. India, Pakistan, Israel and South Africa were listed in 1972 by the Stockholm International Peace Research Institute as keeping a nuclear option open and likely to face serious security threats in the near future.¹ Other states, such as Brazil and Argentina, have refused to sign the Nuclear Non-Proliferation Treaty (NPT) because they claim it might interfere with the peaceful uses of atomic energy for economic development. Japan and Egypt have signed the Treaty, but not ratified it. Moreover, states like West Germany, which have signed and ratified, cannot be considered forever committed to non-nuclear status. Article X of the NPT explicitly recognizes the right of states to withdraw from the Treaty on three months notice. International situations and governments will change in the future as they have in the past. Hence, policies will change. In short, there are now and will be in the future national decision-makers evaluating the costs and benefits of acquiring nuclear weapons.

A large segment of the scholarly community and a number of statesmen feel that further nuclear proliferation--an increase in the number of states possessing nuclear weapons--is dangerous for the world and should be avoided. This implies that they know the effects of nuclear proliferation and that those effects are bad. If these two things are known, then all that remains is to communicate them to the

decision-makers in potential nuclear states. Unfortunately, however, writing on the subject of nuclear proliferation generally makes two errors which greatly reduce its influence as policy advice. First, arguments and analyses of the effects of nuclear proliferation generally focus at the global level. Nuclear proliferation is viewed as bad for the international system as a whole. While systemic affects no doubt play a role in national decisions, they are often subordinated to national considerations. Hence, analysis should focus on the effects of nuclear acquisition on proliferating states themselves, rather than on the world as a whole. Second, the study of decisions to "go nuclear" and their consequences have been dominated by speculative research. Analysts have failed to take advantage of the evidence available from past cases of proliferation.

As a consequence of these two errors--ignoring the effects of acquisition on the new nuclear state and failing to study the past experiences of the existing nuclear states in a comparative way--the scholarly literature on nuclear proliferation has become largely irrelevant to decision-makers in potential nuclear states. This article argues that there is a need for examination of the major propositions about the effects of nuclear proliferation on both international system and the proliferating state. It selects one proposition--that direct economic costs of defense will rise following nuclear acquisition--for empirical analysis. It invites, and urges other scholars to help move the study of nuclear proliferation out of the realm of informed speculation and into the field of testable propositions.

II. THE DOMINANT TYPES OF RESEARCH

The study of nuclear proliferation has been dominated by three types of material--(a) case histories of the decision processes by which a state has decided to "go nuclear" or to refrain from doing so;² (b) speculative efforts to predict future actions of states, either the likelihood of their deciding to join the nuclear club or their probable reaction to a decision of another state to do so;³ and (c) abstract modeling exercises seeking to illuminate future international systems in which nuclear proliferation has already occurred.⁴

Each of these types of research considers the effects of nuclear proliferation. Studies of past decisions about "going nuclear" involve efforts to determine the changes which decision-makers expected to occur in the international system when they decided to develop nuclear weapons capability. Speculations about future decisions seek to establish the expected outcomes from those decisions. These speculations are usually cast in terms of the changes in the national and international arenas which would result and the advantages or disadvantages which are therefore expected. Modeling future international systems involves the study of the characteristics of those systems after proliferation and, directly or indirectly, of the changes brought about by an increase in the number of nuclear powers.

This article does not reject these types of research. Each of them has value, just as each has problems. While the assumptions of modeling exercises are either untested or known to be false, they allow greater rigor than the tortuous process of tracing decision-making history. While the evidence supporting speculations about

future state decisions is incomplete, these studies do provide policy suggestions and evaluations tailored to the specific issues confronting decision-makers at a specific point in time. While decision-making histories lack sweeping generalizability, they are alert to the subtleties of bureaucratic politics and to the situational differences which influence policy choices. Decision-making histories usually focus on the pre-proliferation phase, speculative analyses on the decision itself and the period immediately following, while modeling exercises tend to focus on a period well after proliferation occurs. As a group, these three types of study allow evaluation of nuclear proliferation from a variety of points of view, each of which helps to overcome the inadequacies of the others.

Scholars using these approaches have failed, however, to fully examine the evidence available to them. While there is a great deal of information suggesting the changes which decision-makers and analysts expected to occur following an increase in the number of nuclear states, there are no studies which focus on whether or not those changes actually occurred following nuclear acquisition. Hence, the research is incomplete. Neither advice nor warnings can be offered on the basis that British decision-makers thought they would reduce the costs of defense by going nuclear. Only evidence that costs were increased or decreased will be convincing. Those who would influence policy in this crucial arena must be prepared to go beyond abstract logic and speculation.

III. PROPOSITIONS ABOUT THE EFFECTS OF NUCLEAR PROLIFERATION

A. Expected Effects

Decision-making histories, modeling exercises and speculative analyses have produced a set of folk wisdom about the effects of nuclear proliferation. At the international level, there is virtual unanimity on the conclusion that nuclear proliferation is undesirable. The three arguments most often made in support of this conclusion can be stated as propositions:

Proposition 1: Nuclear proliferation increases the probability of nuclear warfare.⁵

Proposition 2: The acquisition of nuclear weapons by one state will result in their acquisition by others.⁶

Proposition 3: Horizontal nuclear proliferation (an increase in the number of states possessing nuclear weapons) will result in vertical proliferation (an increase in the quantity or quality of nuclear weapons in the hands of existing nuclear states).⁷

Perhaps the most widely researched proposition relating to the effects of nuclear proliferation is its influence on alliances.

Proposition 4: Nuclear proliferation tends to destroy or prevent the formation of alliances.⁸

This may be good or bad depending on the desirability of the alliances involved.

When viewed from the national perspective, there is a great deal of controversy as to whether or not nuclear proliferation will be

advantageous. There are four general propositions which appear in the literature on the effects of nuclear proliferation at the state level. Interestingly, two of these propositions are found in diametrically opposing form--proliferation is expected by some analysts to increase security, by others to reduce it; it is seen as increasing the cost of defense by some authors, while others see it as reducing those costs.

Proposition 5: Nuclear weapons capability results in increased independence of action, particularly in the foreign policy arena.⁹

Proposition 6: Nuclear weapons capability results in increased prestige and influence in foreign relations.¹⁰

Proposition 7: Nuclear weapons capability results in increased (decreased) security.¹¹

Proposition 8: Nuclear weapons capability results in decreased (increased) cost of defense.¹²

Each of these propositions focuses on an issue which decision-makers and analysts concerned with nuclear proliferation consider important. Their evaluation is difficult. Each must be studied if policy makers in potential proliferating countries are to make reasoned choices. Unfortunately, these propositions are seldom stated explicitly and even less frequently examined with rigor.

B. Can the Propositions be Evaluated Without Evidence?

The simplest, most often repeated and, to many, the most convincing argument leading to the conclusion that nuclear proliferation is

"bad" is summed up in Proposition 1, "Nuclear proliferation increases the probability of nuclear warfare." The text of the Treaty on the Non-Proliferation of Nuclear Weapons gives only one reason for the Treaty--that the states concluding it believe "that the proliferation of nuclear weapons would seriously enhance the danger of nuclear war," and that "devastation would be visited upon all mankind by a nuclear war." The 1972 World Armaments and Disarmament Yearbook, published by the Stockholm International Peace Research Institute, argues simply that, "if ever used again, nuclear weapons may lead to an unlimited human catastrophe--and the risks of use by any cause are likely to increase, at least to some degree, the more independent possessor nations there are in the world."¹³

Many analysts have chosen to deal with this issue by assumption and logic. There are, however, three problems with the argument. First, it assumes that nuclear warfare is the worst possible occurrence for mankind. Second, it assumes that the probability of nuclear accident or warfare is dependent solely on the number of weapons possessed and the number of decision structures capable (deliberately or inadvertently) of deciding to use them. Third, it leads toward the conclusion that having decided that the international system would be harmed by nuclear proliferation; political scientists are free to ignore issues relating to national costs and benefits of proliferation.

Is a nuclear accident or even nuclear warfare the worst possible occurrence? It would be difficult indeed to imagine any catastrophe which mankind is capable of visiting upon itself which would be worse than a full-scale nuclear war involving the superpowers and including

the devastation of population centers. If this is what is meant by the term "nuclear warfare" in Proposition 1, as it is apparently meant in the text of the Non-Proliferation Treaty and the SIPRI Yearbook, then there can be little doubt of its inherent evil.

However, not all nuclear warfare would involve this awesome level of destruction. Situations involving limited or tactical uses of nuclear weapons in preference to other, non-nuclear occurrences can be foreseen. The defense of Western Europe against conventional attack has depended for years on prompt use of tactical nuclear weapons. Smaller states may see limited nuclear capacity as a way of avoiding conventional war by deterring large neighbors. The use of limited nuclear capacity by Israel against conventional forces threatening to overrun population centers might be viewed as preferable to the genocide which could occur in the absence of that nuclear warfare. The point is not that these possible uses of nuclear weapons are good, but rather that there are situations in which the use of some nuclear weapons may be preferable to solutions relying only on conventional capacity. Hence, "nuclear warfare" cannot be presumed to be inherently evil under all circumstances.

Can it be shown through simple application of logic that nuclear proliferation increases the probability of nuclear warfare? The argument may take two forms--(a) the greater the number of nuclear weapons in the world the higher the probability that one will explode and (b) the greater the number of decision structures capable of initiating nuclear warfare, the higher the probability one will do so. The first argument is weak because it can only be linked to nuclear warfare

through complex scenarios which themselves have low probabilities. To result in all out nuclear war, not only must the damage from an accidental detonation be believed to have been caused by a foreign power, but also the isolated detonation must somehow set a process of nuclear escalation in motion.

By far the stronger argument is that nuclear proliferation means, by definition, an increase in the number of decision structures capable of initiating nuclear warfare. If it is the case that the probability of nuclear warfare is dependent only on the number of decision structures capable of initiating it and the probability that any given decision structure would do so is independent of the number of nuclear states, then it would follow that an increase in the number of nuclear states will lead to an increase in the probability of nuclear warfare. It appears reasonable to argue, however, that these two probabilities are not independent. The acquisition of nuclear weapons by a new state may result in a reduction of the willingness of its decision-makers to place themselves in a confrontation with other nuclear states. Similarly, other nuclear states may allow the new nuclear power more freedom of action--be less willing to present threats to its perceived vital interests.

An argument can be made that nuclear proliferation decreases the probability of nuclear warfare. Certainly the United States had a far higher probability of using nuclear weapons during the years in which she possessed nuclear monopoly than at any time since. Is this argument unique to the change from one to two powers? No. The only impediment to nuclear warfare in a two power world is fear of direct

retaliation. Sufficient offensive force would allow first strike capacity and efforts to attain that force level might set off a nuclear holocaust. Add a third nuclear power and two factors change. First, the amount of offensive force necessary to dominate the entire system must increase sufficiently to allow simultaneous destruction of two opponents. Second, the danger inherent in attacking only one other nuclear power increases greatly--the third power could be left as the sole strong survivor. Each addition of a new nuclear power results in further increases in the amount of force needed to dominate the system and the danger involved in attacking a portion of the system.

The point of all this is not that nuclear proliferation is good or even that it can be logically demonstrated that it will change the probability of nuclear warfare. Rather, it is to demonstrate that logic and assumption cannot, by themselves, answer these questions. Even if logic could demonstrate that nuclear proliferation is inherently evil for the international system, however, the obligation of political scientists to examine the effects of nuclear proliferation would not be satisfied. The decision to develop nuclear weapons, or to refrain from doing so, is made by national decision-makers. While knowledge that proliferation is bad for the international system may influence their decisions, domestic factors and the costs and benefits to the state will also play an important role. Situations in which states seek unilateral short run advantage at the risk of serious harm to other parties and even to themselves in the long run are not unfamiliar to political scientists. Empirical research into the effects

of nuclear acquisition on new nuclear states should, therefore, also be carried out.

IV. PROPOSITION EIGHT: A PARTIAL TEST

This section seeks to demonstrate that understanding of the effects of nuclear proliferation can be enhanced through a careful examination of the experience of the nuclear states. Research on this topic must be performed with caution, however. Contextual variables cannot be ignored since the number of cases available is too small to permit the assumption that they are randomly distributed in the data set. Moreover, the cost of erroneous advice or decision in the nuclear proliferation area is high. Research results, particularly at this early stage of analysis, must therefore be interpreted conservatively and understood as tentative and suggestive rather than definitive.

Proposition Eight states, "Nuclear weapons capability results in decreased (increased) costs of defense." In the early 1950's, the British decision to emphasize atomic weapon development was based partially on this idea.¹⁴ The French claim to have reduced defense costs while maintaining nuclear forces.¹⁵ In other contexts, however, the opposite argument has been made. The costs of development, deployment, and maintenance of nuclear forces have, for example, been seen as a major impediment to an Indian decision to develop nuclear weapons capacity,¹⁶ and are asserted as the reason why Britain gave up efforts to maintain an independent nuclear deterrent.¹⁷

The proposition implies that it is possible to substitute nuclear capability for some other types of military capacity. The substitution

may be direct (having nuclear capacity may be expected to make defeat of an opposing state possible with fewer men and less materiel than if conventional weapons were utilized) or indirect (having nuclear weapons may be expected to prevent or deter an attack by an opposing state, thus reducing the level of general military preparedness which is necessary).

The issue of the cost of nuclear weapons is entangled in the purpose for which military forces are maintained. For the powerful states of the world, "defense" seems to be defined more broadly than mere maintenance of territorial integrity. It means maintenance of influence around the world. Hence, conflicts such as Korea, Indo-China, Algeria, the Dominican Republic, Hungary, Viet-Nam, Czechoslovakia and the Suez adventure should be counted as part of the costs of defense for these states. Where these conflicts occurred in the absence of nuclear weapons, they represent part of the cost of maintaining influence. When they occur in spite of nuclear weapons capability, they are a type of influence maintenance which cannot be avoided through possession of those weapons.

B. Measurement of Economic Cost

The analyses which follow focus on direct cost of defense over time. Direct costs are the year to year military expenditures of a state. Four different measures are utilized. The absolute cost of defense, measured in constant value, is the first. Second, the defense expenditure per capita is calculated. This measure views the population of the state as a productive resource, with each individual

representing a capacity to pay a portion of the cost of defense. Hence, the absolute defense burden of each member of the population is one measure which assesses the ability of the society to pay its military bills. Third, the rate of change in defense expenditure is examined. This provides a more precise basis for the evaluation of the cost of proliferation. If a pre-nuclear and a nuclear period each show high and rising defense costs, determining which resulted in the most rapid rise in expenditure will indicate which would lead to a higher cost over time. Finally, the proportion of gross national product which the state devoted to defense is used. This measure takes into account the ability of the economic system to bear the cost of the military establishment.

All these measures relate to the direct cost of defense. There are, of course, other costs. Each dollar spent on defense represents a loss of opportunity to spend the same dollar for other societal goals. The economic benefit of a dollar spent on defense may be less than that of a dollar delivered through a social security system or expended to improve schools or housing. This preliminary analysis concentrates on whether direct cost is higher in nuclear eras than others, and leaves the implications of higher costs for the society for later study.

The experience of each nuclear state is evaluated below. Each state's history is divided into three basic phases--(1) pre-nuclear (prior to governmental commitment to develop nuclear weapons), (2) nuclear development (prior to first successful nuclear weapons test) and (3) pursuit of nuclear deterrence. Some variation occurs because

the experience of the states varies--Britain reduces costs through cooperation with and eventual reliance on the United States for weapons research and development; China had nuclear development phases with and without Soviet assistance.

The data set spans 1949 through 1970, again with some variation. These boundaries are selected on the grounds that (a) the costs of defense before 1945 are not comparable to those costs following that year, (b) a combination of the difficulty in obtaining reliable data, the demobilization of states following World War II, and the economic chaos which existed in much of the world during the 1945-48 period make it unwise to extend the analysis into this era and (c) 1970 is long enough after the last case of nuclear proliferation (China, 1964) to establish trends for all countries.

Analyses are performed by the comparison of the experience of each state in different periods of time. These are identified in terms of (1) the nuclear status of the state and (2) important contextual variables, such as overseas conflicts, likely to influence defense costs. To reduce the influence of short term idiosyncracies in year to year spending, analyses focus on examination of trends over time and the averages for periods of years. Direct cross-national comparisons are avoided. There are several reasons for this. First, the quality of available data about military expenditures is uneven, making comparison misleading. Second, no absolute cost for development, deployment or maintenance of nuclear forces can be set. As technology spreads through the world, the cost of a particular achievement declines. Different countries approached the same technological milestones at

different points in time, resulting in different costs. Cost also depends on the scientific and technological community available within the country. Third, not all countries are seeking the same force levels. Differences in strategic position and doctrine result in different costs. France spends considerably less for her forces than the US and USSR do for theirs. Moreover, it is possible to lengthen and shorten the period of time over which costs are spread, thus reducing the burden on societal resources. The French, for example, have several times postponed the date at which they intend to deploy inter-continental ballistic missiles,¹⁸ thus reducing year to year expenditures.

C. Minor Nuclear Powers

1. France: A Clearcut Case

The nuclear experience of France can be divided into three distinct phases. Prior to 1955, though some Frenchmen were working on atomic weapons and an agency had been set up to oversee development of the appropriate technology, no formal government decision had been made to seek nuclear capability and funding for the effort was at relative low levels. A formal decision to develop nuclear weapons was made late in 1954 and funding increases became sizable in 1955.¹⁹ The first French test explosion occurred in February, 1960. Hence, 1949 through 1954 is considered a pre-nuclear era for France. The nuclear development phase is 1955 through 1959. From 1960 on, the French are seen as seeking independent nuclear deterrence capacity and paying the full costs of doing so.

Nuclear weapons are not, however, the only factor influencing French defense costs during the period under study. While 1949 and 1950 were relatively peaceful years, the Korean and Indo-China conflicts were important influences during the 1951 through 1954 period. The costs of the Algerian civil war and the Suez expedition were borne during the 1955-1959 nuclear development era. The end of the Algerian involvement in 1962 marks an opportunity for France to reduce conventional military expenditures. Hence, five analytic periods are defined for France--1949-50, 1951-54, 1955-59, 1960-62 and 1963-70.

Table 1 presents the data on direct economic costs to France aggregated with these five analytic periods. Over time, the absolute cost of defense has increased. Each period, whether peaceful or conflictual, and regardless of nuclear status, has been marked by higher absolute costs of defense than its predecessor. This trend is strong enough to carry over to the measure of absolute defense burden per capita. Military expenditures have increased more rapidly than the French population, so that each member of the society pays an increased price for defense in each era. The nuclear periods, this analysis suggests, are not less costly than the pre-nuclear eras. Indeed, the absolute costs and costs per person are higher after nuclear forces are developed. This is true despite French disengagement from conventional fighting to maintain the empire, a move which would be expected to reduce military expenditures.

Table 1 about here

A different image emerges when the other two cost measures are examined. The rate of increase in defense cost rose more rapidly in

TABLE 1

FRANCE: NUCLEAR STATUS, CONTEXT AND DEFENSE COST^a

Dates	1949-50	1951-54	1955-59	1960-62	1963-70
Nuclear Status	Prenuclear	Prenuclear	Nuclear Development	Seeking Independent Deterrence	Seeking Independent Deterrence
Context	Peaceful	Conflict	Conflict	Conflict	Peaceful
Average Defense Expenditure in Millions of Constant (1960) U.S. Dollars	1928.50	3261.75	3853.75	3907.67	4435.13
Rank Order	5	4	3	2	1
Average Per Capita Expenditure in Constant (1960) U.S. Dollars	46.39	75.03	82.94	86.17	89.88
Rank Order	5	4	3	2	1
Average Change in Defense Expenditure from Previous Year	+5.9% ^b	14.43%	4.14%	3.33%	1.10%
Rank Order	2	1	3	4	5
Average Percentage of Gross National Product for Defense	5.55 ^b	8.05	6.95	6.20	4.91
Rank Order	4	1	2	3	5

a) Defense expenditure data taken from World Armaments and Disarmament, SIPRI Yearbook, 1972, Stockholm International Peace Research Institute (New York: Humanities Press, 1972), supplemented by other volumes in the series. Population data and national product from International Financial Statistics, 1972 Supplement, International Monetary Fund (Washington, D.C.: IMF, 1973).

b) 1950 only.

the two pre-nuclear eras than in any period since. This is surprising, particularly since some of the subsequent periods (1955-59 and 1960-62) contain sizable conventional military efforts (Suez and Algeria) plus the burdens of nuclear force development. Yet, the further the French have advanced down the nuclear road, the more slowly their defense costs have grown. A similar pattern emerges when the proportion of GNP devoted to defense is examined. As with rate of change in military expenditure, the peaceful nuclear era of 1963-70 is the least expensive period for defense, with conflictual pre-nuclear being the most costly.

In summary, then, France is paying more, in absolute terms, for defense in the nuclear era than during any other period analyzed. This is true in spite of reduction of French strategic responsibilities around the world and disengagement from colonial conflicts. On the other hand, going nuclear has permitted France to reduce the rate of growth of military expenditure. This, along with a steady record of economic growth, has resulted in a gradual reduction in the portion of national effort devoted to military purposes. Frenchmen pay more for nuclear defense, but are better able to bear the cost. The French experience suggests that a large developed economy with a steady rate of growth may be able to pay the increased costs of nuclear weapons without making serious sacrifices elsewhere.

2. The United Kingdom: A Muddled Case

Aggregating the data on the United Kingdom into useful eras for analysis is somewhat more complex than it was for France. There is no genuine pre-nuclear period within the data set. There was, in fact, no period of time following World War II in which the British government

did not expect to develop and deploy an independent atomic force. Analysts do report that, consistent with the official British policy of assuming no war would begin within ten years following World War II, the pace of nuclear development by the United Kingdom was slower than it might have been in the presence of some immediate threat.²⁰ Hence, annual expenditures in the 1949-52 nuclear development phase were lower than those the society could have afforded. From 1953 through 1957, the United Kingdom sought to develop and deploy an independent nuclear force.

Beginning with the Blue Streak missile in 1958 (which was actually an American rocket with an American guidance system), the British began reducing the cost of nuclear weapons by relying on the United States to carry out important portions of the necessary technological research. This period of "partially dependent deterrence" lasted until the cancellation of the Skybolt program in 1962.²¹ From 1963 through the end of the period being studied, the United Kingdom has sought to maintain deterrent capability but has been heavily dependent on American development of weapon systems.

Contextual variables must also be taken into account. Because of the "no war for ten years" assumption mentioned above, the years prior to the Korean war had artificially low military expenditure. Partially as a consequence of this, the Korean war resulted in radical increases in expenditure. These included not only costs necessary for the maintenance of United Nations forces, but also a number of expenditures seen as essential in light of the increased level of tension between East and West.²² Interestingly, British involvement in Suez (1956-57)

does not seem to have increased defense costs. This permitted creation of a reasonably long analytic period for the evaluation of the cost of seeking nuclear independence (1945-57). Combining these contextual factors with the changes in nuclear status discussed earlier; six analytical periods can be defined for the United Kingdom--1949-50, 1951-52, 1953, 1954-57, 1958-62, and 1963-70.

Since there is no prenuclear era for Britain, analysis is undertaken from a somewhat different perspective than that used in the French case. First, the cost of seeking independent deterrence is compared with partial and total dependency. If maintenance of nuclear forces increases cost of defense, and the United States has taken over some of these costs for the United Kingdom, then the dependent eras should be less costly than the independent deterrence period. Second, the French data suggests that the decision to go nuclear is costly in absolute terms, but may allow a decrease in rate of growth of arms expenditure and a reduction of the proportion of GNP devoted to defense. The nuclear development phase was more costly, in terms of these two indicators, than was the independent pursuit of deterrence. This finding can be checked against the British experience.

Table 2 about here

Table 2 shows the indicators of British defense cost aggregated into the six analytic periods. As might be anticipated, the highest absolute expenditure came in 1953, when the United Kingdom was embarking on an effort for nuclear independence and the Korean war was approaching a climax. There is only a small difference, however, between the absolute cost incurred in seeking nuclear independence during

TABLE 2

UNITED KINGDOM: NUCLEAR STATUS, CONTEXT AND DEFENCE COST^a

Dates	1949-50	1951-52	1953	1954-57	1958-62	1963-70
Nuclear Status	Nuclear Development	Nuclear Development	Seeking Independent Deterrence	Seeking Independent Deterrence	Partial Dependent Deterrence	Seeking Dependent Deterrence
Context	Peaceful	Conflict	Conflict	Peaceful (Suez)	Peaceful	Peaceful
Average Defence Expenditure in Millions of Constant (1960) U.S. Dollars	3461.00	4935.00	5718.00	4966.50	4606.80	4833.38
Rank Order	6	3	1	2	5	4
Average Per Capita Expenditure in Constant (1960) U.S. Dollars	68.57	97.44	112.43	96.79	87.73	88.26
Rank Order	6	2	1	3	4	5
Average Change in Defence Expenditure from Previous Year	+6.40% ^b	+23.90%	+4.40%	-5.08%	+0.10%	-0.25%
Rank Order	2	1	3	6	4	5
Average Percentage of Gross National Product for Defence	6.27	8.81	9.56	7.93	6.48	5.52
Rank Order	5	2	1	3	4	6

a) Defence expenditure data taken from World Armaments and Disarmament, SIPRI Yearbook, 1972, Stockholm International Peace Research Institute (New York: Humanities Press, 1972), supplemented by other volumes in the series. Population data and national product from International Financial Statistics, 1972 Supplement, International Monetary Fund (Washington, D.C.: IMF, 1973).

b) 1950 only.

peace (1954-57) and seeking to maintain international position through conventional conflict while engaging in nuclear development (1951-52). Dependent deterrence (1958-70) is less costly than independent efforts (1954-57), as anticipated. Data on per capita military expenditure are consistent with those for total cost except for some reversals of rank orders (1951-52 and 1954-57, 1958-62 and 1963-70) where the absolute differences are not large on either measure.

The percentage changes in military expenditure from year to year are also consistent with the French experience. The greatest reductions in British defense expenditure occur in 1954-57, when peaceful pursuit of independent nuclear capability occurs. The greatest increases occur in the Korean war period as a result of the low arms level in 1949-50 and the general rearmament which accompanied that conflict. None of the deterrence periods (independent or dependent) results in increases in cost as great as those experienced in the nuclear development phase, including the 1949-50 peaceful period. Dependent deterrence has been maintained with virtually no cost growth and independent deterrence was sought while overall defense spending was reduced rather sharply.

The proportion of gross national product devoted to defense approximates the absolute cost pattern more closely than the rate of change data, reflecting the overall slow rate of growth of the British economy. 1953, which involved substantial overseas military involvement and efforts at independent deterrence, is most costly in these terms. The nuclear development, conflict period (1951-52) is close behind on this cost measure. Even in peacetime, seeking nuclear

independence cost nearly eight percent of GNP, compared with five and one-half to six and one-half percent for dependent deterrence or relaxed nuclear development.

The experience of the United Kingdom does indicated, as did that of France, that nuclear weapons capacity is expensive. When a portion of the costs of maintaining nuclear weapons was passed on to the United States, the UK's total defense costs fell. Three of the four indicators show lower costs for the 1958-70 eras than for the periods in which independent capacity was sought. Only the rate of change in military expenditure shows a different pattern, with large decreases in military spending during peaceful efforts at independence from 1954-57. This is consistent with the French experience that nuclear weapons can be developed and deployed while the rate of increase in defense expenditure declines. There is an important difference, of course, in that France has continued to maintain independent forces, while the British found even the reduced costs too high to pay and have settled for a relatively stable level of expenditure and a nuclear force dependent on American technology.

The second issue raised earlier for examination in the British case was whether nuclear development is more or less costly than the pursuit of independent deterrence. Comparison with the French case is complicated by contextual factors. The 1949-50 period reflects a relaxed form of nuclear development, the 1951-52 period an exceptionally fast increase in costs because of the low preceding expenditures. 1953 is affected by the Korean war as well as the change in British

nuclear status. Still, some comparisons can be made. The rate of change in expenditure does show a marked difference between the 1951-52 and 1954-57 periods and this is in the expected direction--nuclear development costs more than efforts at deployment following the first successful test. The other three indicators show only small differences between these periods, though only the absolute cost indicator is in the opposite direction.

The findings for France and the United Kingdom are consistent with the argument that nuclear acquisition is expensive--that it results in increased absolute costs of defense. At the same time, the two countries' experience suggest that nuclear proliferation can be accompanied by a reduction in the rate of growth in arms expenditure of the state. Once a country has experienced its first successful nuclear test, these two cases suggest the proportion of gross national product devoted to defense will decrease over time. Finally, there is some support for the idea that the most costly period is the era in which the state is seeking to maintain its international position with conventional forces which paying the additional costs of nuclear development. Any savings to be incurred, even in relative terms, come after development of nuclear capacity.

3. China: A Different Case

Evaluation of the cost of China's nuclear weapons program is complicated by the poor quality of the available information (both in terms of decision-making histories and in terms of hard indicators such as defense expenditure and GNP) and by the difference between China and the other nuclear states. In this analysis the difference

in level of economic development is emphasized, though cultural and other factors are no doubt also extremely important. The single fact that China is a developing country has profound implications for the analysis. Increased population, regarded as an increase in the capability of a developed society to pay defense costs, may be a liability in the developing country context. Moreover, the indirect costs of defense--diversion of skilled personnel, expenditures deferred in other areas, etc.--are likely to be higher in this case than for France or the United Kingdom.

Chinese nuclear development can be divided into four analytic periods. Prior to 1957 there was little effort or intention to develop nuclear capacity, so the 1949-56 period can be termed pre-nuclear. Discussion of nuclear acquisition began in 1954; efforts to begin serious nuclear development about 1957. Russian cooperation lasted until 1960.²³ This period is termed "dependent nuclear development." From 1961 through the first successful test in 1964, China was involved in independent nuclear development. The 1965 through 1970 period is characterized by pursuit of independent nuclear deterrence.

Contextual variables necessitate some further subdivision of the Chinese experience. The 1949-50 period is a low point for the Chinese economic system and includes great problems of societal reorganization in the wake of the civil war. Chinese intervention in Korea requires that the 1951-53 period be separated. This leaves 1954-55 as a remaining peaceful, pre-nuclear era. Later conflicts, such as the brief war with India, do not appear to have had a great influence on military costs and have been ignored. The increasing tension between China and

the Soviet Union through the 1960's must, however, be remembered as the data are evaluated. The Chinese experience is divided into six analytic periods--1949-50, 1951-53, 1954-56, 1957-60, 1961-64, and 1965-70.

Data on Chinese defense costs, population and gross national product are shown in Table 3. To reduce the chance of erroneous analysis due to data error, two different estimates of the information are used where available. Unfortunately, the United States Arms Control and Disarmament Agency data do not extend back before 1961 and are not presented in constant dollar form. However, where comparisons were possible, the two data sets were quite consistent, suggesting that the longer Stockholm International Peace Research Institute series can be used with some degree of confidence.

Table 3 about here

The patterns observed are very different from those in the previous cases. Independent deterrence costs more in absolute terms than does dependent nuclear development. This, in turn, has a higher cost than either dependent development or any pre-nuclear phase, including the Korean war. Dependent development is no more expensive than the pre-nuclear eras. Per capita expenditure shows a pattern similar to that of total defense cost. Independent deterrence results in a higher per capita defense burden than nuclear development, which is again more expensive than the pre-nuclear periods. Nuclear acquisition is associated with the reversal of a trend toward lower per capita defense costs which had emerged during the 1960's. Sino-Soviet hostilities should be remembered as a partial cause of these increasing costs, since they probably have forced maintenance of high conventional force levels along with accelerated nuclear development.

TABLE 3

CHINA: NUCLEAR STATUS, CONTEXT AND DEFENSE COST^a

Dates	1949-50	1951-53	1954-56	1957-60	1961-64	1965-70	1961-64	1965-70
Source	SIPRI ^a	SIPRI ^a	SIPRI ^a	SIPRI ^a	SIPRI ^a	SIPRI ^a	USACDA ^a	USACDA ^a
Nuclear Status	Prenuclear	Prenuclear	Prenuclear	Dep. Nuclear Development	Ind. Nuclear Development	Seeking Ind. Deterrence	Ind. Nuclear Development	Seeking Ind. Deterrence
Context	Recovery	Conflict	Peaceful	Peaceful	Peaceful	Conflictual	Peaceful	Conflictual
Average Defense Expenditures in Bns. of Constant (1970) Dollars	2.63	3.00	2.50	2.71	4.05	6.92	4.50 ^c	7.50 ^c
Rank Order	5	3	6	4	2	1	2	1
Average Per Capita Expenditures	4.84	5.27	4.09	4.07	5.64	8.69	--	--
Rank Order	4	3	5.5	5.5	2	1	--	--
Average Change in Defense Expenditure	+10.0% ^b	-1.23%	0%	+3.23%	+14.48%	+10.05%	--	--
Rank Order	3	6	5	4	1	2	--	--
Average % GNP Spent for Defense	6.67	5.35	3.49	3.04	4.99	6.52	7.06	7.87
Rank Order	1	3	5	6	4	2	2	1

a) Defense expenditure data taken from World Armaments and Disarmament, SIPRI Yearbook, 1973, Stockholm International Peace Research Institute (New York: Humanities Press, 1973), supplemented by other volumes in the series and from World Military Expenditures, 1971, United States Arms Control and Disarmament Agency (Washington, D.C.: 1973). Population and gross national product from Arthur G. Ashbrook, Jr., "China: Economic Policy and Economic Results, 1948-71," in People's Republic Of China: An Economic Assessment, U.S. Congress, Joint Economic Committee (Washington, D.C.: U.S. Government Printing Office, 1972).

b) 1950 only.

c) Current Dollars

The rate of increase in military costs has been higher during the independent deterrence and independent nuclear development eras than others. On this measure, however, development costs more than the period following the first successful test. Finally, the proportion of national production devoted to the military, which had been declining from 1949 through the dependent nuclear development era, climbed rapidly during the independent development and deterrence periods.

On every measure, then, China's nuclear weapons program is associated with increases in the direct economic costs of defense. For a developing country, the costs of nuclear weapons appear high. It should be stressed, however, that the rate of increase in expenditure and the increasing proportion of the GNP devoted to national defense suggest that the Chinese are seeking to develop nuclear capability more quickly and perhaps further than either the British or French. This means that their strategic goals have increased the price of the development of nuclear forces.

The low costs associated with the 1956-60 dependent nuclear development are also worthy of note. While the pace of this program was undoubtedly slow, the relatively low costs incurred, particularly when compared with the higher costs in the later independent development period or with the French and British development periods, are significant. These low costs underscore the importance of Article I of the Non-Proliferation Treaty, in which nuclear states agree not to aid non-nuclear states to develop nuclear capacity. Apparently the costs of nuclear development can be reduced considerably when assistance is provided.

D. The Superpowers

The United States and the Soviet Union are the other two nuclear states. They are analyzed together because (1) the level of military spending and technology of these two states exceed those of any other country in the world and (2) there is no period within the span of the analysis which can be termed either pre-nuclear or nuclear development for them. The focus of the discussion is, therefore, similar to that utilized for the study of the British experience--the consistency of the data with the findings for other countries.

The evidence from the minor nuclear states suggests that the absolute cost of maintaining nuclear capacity will rise over time. This would seem to be even more true for the superpowers which maintain massive forces and compete at the fringe of known weapons technology. A second issue concerns the trend in military expenditure over time. Have the superpowers experienced declining rates of increase in defense costs (as have France and as did the United Kingdom in the 1954-57 period) or does the rate of increase remain high, as in China? Third, are the American and Soviet cases similar to the other developed nuclear states in that the proportion of gross national product devoted to the military declines over time?

The direct military costs of the Soviet Union are presented in Table 4. Because of differences between accounting systems in the Western countries and the USSR and because of difficulties in establishing currency exchange rates, the Stockholm International Peace Research Institute (utilized as the standard source for defense costs to other countries) does not attempt to produce constant value estimates

of Russian military expenditure. Therefore, a recent article by Stanley Cohn, which presents two alternative estimates of Russian military costs, based on different assumptions about hidden defense costs, has been utilized as the basic source. The time periods utilized to aggregate the data are also based on Cohn's analysis and represent periods in which he sees international tension and arms competition levels as high (1950-52, 1961-63, 1966-69) and low (1953-60, 1964-65).²⁴ Average defense costs for the 20 years of available data are also shown. Unfortunately, Cohn provides data on the percentage of gross national product expended for defense only for selected years.

Table 4 about here

The Soviet experience reflects the familiar pattern of steady increases in the absolute cost of defense. This is true of both total expenditure and per capita expenditure for military purposes. It is true, moreover, despite variations in the level of conflict experienced. The pattern is consistent with the French and Chinese experiences, suggesting that independent nuclear forces have increasing costs over time. The rate of increase in defense costs, however, varies with the level of international conflict. Relatively peaceful eras (1953-60, 1964-65) have the smallest arms cost increases, while conflictual phases have higher rates. The proportion of GNP devoted to defense shows a similar pattern, though these figures are available in only selected years. The last two measures of the Soviet experience somewhat contradict the British and French cases in which independent nuclear forces are associated with decreasing portions of societal resources spend for defense.

TABLE 4

SOVIET UNION: CONTEXT AND DEFENSE COST, 1950-69^a

Dates		1950-52	1953-60	1961-63	1964-65	1966-69	1950-69
Context		Conflictual	Peaceful	Conflictual	Peaceful	Conflictual	Average
Average Defense Expenditure	1) SIPRI \$ Mn. 2) Cohn, A Rubles Bn. 3) Cohn, B Rubles Bn.	22877 8.97 8.90	23495 11.50 10.71	28651 18.40 16.13	31071 20.75 17.70	37069 26.52 17.70	27648 16.08 13.88
Rank Order		5	4	3	2	1	--
Average Per Capita Defense Expenditure	1) Cohn, A Rubles 2) Cohn, B Rubles	48.85 48.47	56.93 53.15	82.94 72.72	90.39 77.11	112.82 86.66	74.14 64.48
Rank Order		5	4	3	2	1	--
Average Change in Defense Expenditure	1) SIPRI 2) Cohn, A 3) Cohn, B	+11.33% +19.45% ^b +21.65% ^b	-1.99% +3.24% +1.11%	+14.53% +14.57% +15.87%	-4.05% +1.25% -0.55%	+8.52% +10.15% +7.37%	+4.38% +7.98% +6.75%
Rank Order		1.5	4	1.5	5	3	--
Average Percentage of Gross National Product for Defense	1) Cohn, A 2) Cohn, B	1950-11.6 1952-14.3 1950-14.3 1952-14.0	1955-12.3 1960- 9.5 1955-12.3 1960- 8.6	1963-12.8 1963-11.4	1965-11.7 1965- 9.9	1969-12.8 1969-10.0	12.14 ^c 11.08 ^c
Rank Order		1	4.5	2	4.5	3	--

a) Defense expenditure data taken from World Armaments and Disarmament, SIPRI Yearbook, 1972, Stockholm International Peace Research Institute (New York: Humanities Press, 1972), supplemented by other volumes in the series and from Stanley H. Cohn, "Economic Burden of Defense Expenditures," Soviet Economic Prospects for the Seventies, U.S. Congress, Joint Economic Committee (Washington, D.C.: U.S. Government Printing Office, 1973) Defense as percentage of gross national product also from Cohn and population data from Frederick A. Leedy, "Demographic Trends in the USSR," in Soviet Economic Prospects

b) 1951 and 1952 only.

c) Includes only years shown in previous columns.

Table 5 about here

The United States data, presented in Table 5 contains few surprises. First, while the absolute cost of defense has risen over time, the increase is irregular and appears to be influenced by conventional military involvement. Second, the rate of increase in military expenditure is much slower than might be expected. If the huge (113%) increase in spending for the first year of the Korean war is ignored, U.S. military spending has increased at an average rate of less than three percent per year, and shrank during relatively peaceful eras. Third, the Viet-Nam conflict has apparently interrupted an irregular, but clear, tendency for the proportion of American GNP devoted to defense to decline. This tendency, which is consistent with the French and British experiences, appears to be reasserting itself in the 1970's.

E. Conclusions about Proposition Eight

Before conclusions are drawn, a word of caution is in order. There are few cases available for analysis on this topic. Moreover, some of the data utilized is, of necessity, based on estimates. As a result, the research performed may be more helpful in clarifying the issues and focusing discussion than in providing a "real" test of the proposition under examination. Conclusions are, therefore, tentative and presented in the hope that they will form the basis for other, more definitive analyses.

The proposition being examined states, "Nuclear weapons capability results in decreased (increased) defense costs." Evidence examined includes two measures of absolute, direct costs of defense (military

TABLE 5

UNITED STATES: CONTEXT AND COST, 1949-70^a

Dates	1949-50	1951-53	1954-60	1961-63	1964-65	1966-70	Average 1949-1970
Context	Peaceful	Conflictual	Peaceful	Conflictual	Peaceful	Conflictual	--
Average Defense Expenditure in Millions of Constant (1960) U.S. Dollars	17201.00	48394.00	46055.70	49688.33	48719.00	63704.00	48499.91
Rank Order	6	4	5	2	3	1	--
Average Per Capita Defense Expenditure	113.37	306.65	266.53	266.36	252.32	317.46	268.34
Rank Order	6	2	3.5	3.5	4	1	--
Average Change in Defense Expenditure	+6.6% ^b	+52.03%	-2.40%	+3.73%	-1.90%	+3.62%	+8.16% +2.77% ^c
Rank Order	2	1	6	3	5	4	--
Average Percentage of Gross National Product for Defense	5.19	12.54	10.12	9.13	7.84	8.81	9.36
Rank Order	6	1	2	3	5	4	--

a) Defense expenditure data taken from World Armaments and Disarmament, SIPRI Yearbook, 1972, Stockholm International Peace Research Institute (New York: Humanities Press, 1972), supplemented by other volumes in the series. Population data and gross national product from International Financial Statistics, 1972 Supplement, International Monetary Fund (Washington, D.C.: IMF, 1973).

b) 1950 only

c) Excludes 1950-51 increase

expenditure and military expenditure per capita), the rate of change in defense spending and the proportion of gross national product devoted to defense. Exploration of the data country by country has resulted in the identification of several intervening variables of potential importance--rate of economic growth, occurrence of conventional conflicts, level of economic and technological development and overall size of economy. The purpose of this section is to review the evidence on a cross-national basis, attempt to evaluate the relationship between nuclear capacity and each measure of defense and, in so far as is possible, determine which intervening variables appear most important in light of the available evidence.

The two measures of absolute defense cost have shown highly similar patterns and can be discussed together. On an absolute cost basis, nuclear acquisition is associated with increased defense costs. France, the United Kingdom and China all experienced their highest levels of military expenditure and military expenditure per capita when attempting to develop, deploy and maintain independent nuclear forces.

The rate of change in defense costs presents a somewhat more complex picture. France and Britain experienced slower growth of military expenditures in their nuclear phases than in earlier eras. China had the opposite experience. The French and British experienced high conventional defense costs immediately prior to going nuclear, and these continued on into the early phases of nuclear independence. Hence, there is a period of time in which they are paying both high conventional defense costs and nuclear costs. When the conventional costs fall, the total military bill falls.

Noting that of the five nuclear powers only the U.S. has gotten involved directly in large scale conventional hostilities since developing nuclear capacity, and remembering the argument that nuclear states will be more cautious about involvements than non-nuclear states and will be given more maneuvering room by others, the generalization that rate of growth in military expenditure declines with nuclear capacity appears to receive some support. The defense costs of the United States and the Soviet Union reflect a pattern in which the rate of change in defense cost is associated with the level of international tension and conflict. The Chinese case, in which the pursuit of independent nuclear capability is associated with both acceleration in the rate of spending on defense and with international conflict (China-India conflict of 1962 and Sino-Soviet hostilities of the late 1960's) is also consistent with this explanation. The experience of the nuclear states suggests, then, that the level of conventional conflict and nuclear status both influence the rate of change in defense cost. The linkage between these two phenomenon should be studied in greater detail.

In addition, the evidence is consistent with the argument that those willing to settle for a minimal deterrent force (France, Britain) may be able to go nuclear while reducing defense expenditure, while those desiring the latest technology and the need to upgrade weapons systems in light of new developments. If a decision to go nuclear is made for purposes of prestige and international influence, it may be possible to reduce defense costs, provided a large economic system with a steady pattern of growth is available.

The proportion of gross national product expended for military purposes is an important variable in the analysis because it measures the cost of defense against the capacity of the society to pay. The results of the analysis for this variable are similar to those for rate of change in defense expenditure. France, the United Kingdom and the United States prior to the beginning of the Viet-Nam war all show a decreasing proportion of GNP for defense while seeking nuclear independence. Given the high military spending of the early 1950's to support conventional conflicts, the disengagement of the French and British from colonial conflicts and the American increase for Viet-Nam, the level of conflict appears to be a plausible explanation. The Soviet expenditure pattern is consistent with this explanation. The lowest portions of GNP for defense coincide with the lowest levels of tension. China, with increasing costs in conflictual, nuclear periods also fits this pattern. Nuclear capacity reduces defense costs, in terms of proportion of GNP, if and only if it is associated with decreased levels of international conflict.

V. SUMMARY

Analysis of nuclear proliferation has failed to focus sufficiently on the experience of the five nuclear powers. As a result, a literature has emerged which is rich in propositions about the effects of nuclear proliferation, but lacking in efforts to evaluate those propositions systematically. This is particularly unfortunate because there are decision makers in the world who are evaluating the advantages and disadvantages of seeking nuclear capability. These people cannot be

influenced by argument or assumption. Greater efforts should be made to evaluate effects of proliferation through the examination of the evidence available from previous cases of proliferation. Moreover, analysis must focus on the effects of nuclear acquisition on the proliferating state as well as on the international system.

As a step in this direction, an examination of the direct economic costs of defense in the five nuclear states between 1949 and 1970 was undertaken. Several tentative conclusions emerge from these analyses. First, pursuit of independent nuclear capability is generally associated with rising defense expenditures, whether measured in terms of total military costs or defense expenditure per capita. Second, China, the only developing country in the analysis, has experienced high rates of increase in defense spending during nuclear development and while seeking to establish a deterrent force. By contrast, the industrialized nuclear states have been able to reduce the rate of increase in their military expenditure while building nuclear forces. Third, both rate of change in defense cost and proportion of gross national product devoted to the military establishment have been reduced in nuclear states if and when conventional military involvement is avoided.

Two important implications flow from these findings. It may be possible for a state with a sizable industrialized economy and a steady rate of economic growth to construct a limited nuclear force intended primarily to increase prestige and freedom of action while at the same time holding defense costs at relatively low levels. Empirical analysis to determine whether France, Britain and China have gained in international prestige, influence or independence of action should therefore

Footnotes

¹Stockholm International Peace Research Institute, World Armaments and Disarmament: SIPRI Yearbook 1972 (New York: Humanities Press, Inc., 1972), pp. 283-365.

²There is a voluminous literature relating to nuclear proliferation. Many of the books on the subject contain extensive bibliographies. This is not, therefore, the place to review the literature in detail. This note, and the two which follow are intended simply to indicate the types of literature to which reference is made. Among the typical "decision-making" histories, I would include Mendl, Wolf, Deterrence and Persuasion: French Nuclear Armament in the Context of National, 1949-69 (New York: Praeger, 1970); Pierre, Andrew J., Nuclear Politics: The British Experience with an Independent Strategic Force, 1939-70 (London: Oxford University Press, 1972); Richard N. Rosecrance, Defense of the Realm: British Strategy in the Nuclear Epoch (New York: Columbia University Press, 1968) and Rosecrance, Richard N., The Dispersion of Nuclear Weapons: Strategy and Politics (New York: Columbia University Press, 1964).

³Examples of this type of literature would include Beaton, Leonard and Maddox, John, The Spread of Nuclear Weapons (New York: Frederick A. Praeger, 1962); Boskey, Bennett and Willrich, Mason. Nuclear Proliferation: Prospects for Control (New York: Dunnellen Publishing Company, Inc., 1970); Jabber, Fuad, Israel and Nuclear Weapons: Present Options and Future Strategies (London: Chatto and Windus, Ltd., 1971); Quester, George H., The Politics of Nuclear Proliferation (Baltimore: The Johns Hopkins University Press, 1973) and Williams, Sheldon L., Nuclear

Non-Proliferation in International Politics: The Japanese Case, The Social Science Foundation and Graduate School of International Studies, University of Denver, Monograph Series in World Affairs, Volume 9, (1971-72), No. 3.

⁴Reference is made here to two types of work. One is typified by the discussion of the unit veto system which has resulted from Kaplan, Morton A., System and Process in International Politics (New York: Wiley, 1957). The other is the game theoretic tradition. Both of these types of work are found in Rosecrance, Richard N., The Future of the International Strategic System (Chandler Publishing Co., 1971).

⁵A typical argument is presented in Fischer, Georges, The Non-Proliferation of Nuclear Weapons, translated by David Wiley (London: Europa Publications, 1970) p. 31.

⁶Typical arguments are found in Patil, R.L.M., India: Nuclear Weapons and International Politics (Delhi: National, 1969), p. 24 and Quester, George H., Nuclear Diplomacy: The First Twenty-Five Years (New York: The Dunellen Company, 1970), p. 288.

⁷Among those who make this argument are Raithens, George W., p. 10 in Boskey, Bennett and Willrich, Mason, Nuclear Proliferation: Prospects for Control (New York: Dunellen Publishing Company, 1970) and Gelber, Harry G., "The Impact of Chinese ICBM's on Strategic Deterrence," Orbis XIV (Summer, 1969), pp. 409-10.

⁸A review of relevant hypotheses is presented in Holsti, Ole R., Hopmann, P. Terrence and Sullivan, John D., Unity and Disintegration in International Alliances (New York: John Wiley & Sons, 1973), pp. 25-28.

⁹Hick, Arthur, The Security of China (New York: Columbia University Press, 1970), p. 67; Mendl, (op.cit.), p. 207 and Williams, Sheldon L., The U.S., India and the Bomb (Baltimore: The Johns Hopkins University Press, 1969), p. 70.

¹⁰Beaton and Maddox, (op. cit.), p. 198, Larus, Joel, Nuclear Weapons Safety and the Common Defense (Columbus Ohio State University Press, 1971) pp. 112-114 and Quester, The Politics of Nuclear Proliferation, op. cit., p. 7.

¹¹Coffey, J. I., p. 127 in Boskey and Willrich, op. cit. ; and Jabbar, op. cit., p. 133.

¹²Mendl, op. cit., p. 208 and Beaton and Maddox, op. cit., p. 195.

¹³SIPRI Yearbook, 1972, op. cit., p. 283.

¹⁴Pierre, op. cit., p. 87 and Rosecrance, Defense of the Realm, op. cit., pp. 152-170.

¹⁵Mendl, op. cit., pp. 73-76, 208.

¹⁶Williams, Sheldon L., The U.S., India and the Bomb, op. cit., pp. 74-75 and Quester, George, The Politics of Nuclear Proliferation op. cit., pp. 60-61.

¹⁷DeWeerd, H.A. in Rosecrance, The Dispersion of Nuclear Weapons, op. cit., p. 87, and Pierre, op. cit., pp. 196-201.

¹⁸Mendl, op. cit., pp. 208-09.

¹⁹Zoppo, Ciro, "France as a Nuclear Power," in Rosecrance (ed.) The Dispersion of Nuclear Weapons, op. cit., pp. 116-121 and Mendl, op. cit., pp. 129-152.

²⁰Pierre, op. cit., p. 152; Rosecrance, Defense of the Realm, op. cit., pp. 36-39.

²¹Pierre, op. cit., pp. 196-201.

²²Rosecrance, The Dispersion of Nuclear Weapons, op. cit., p. 78.

²³Hsieh, Alice L., Communist China's Strategy in the Nuclear Era (Englewood Cliffs, N.J.: Prentice Hall, 1962) pp. 15-75 and Harner, Charles, "The Production of Nuclear Weapons," in Whitson, William W., The Military and Political Power in China in the 1970's (New York: Praeger Publishers, 1972), p. 232.

²⁴Cohn, Stanley H., "Economic Burden of Defense Expenditures," pp. 147-162 in U.S. Congress, Joint Economic Committee, Soviet Economic Prospects for the Seventies, 93rd Congress, 1st Session, 1973. Cohn argues (p. 150), "There have been three distinct periods of acceleration of defense spending since 1950. The first period of rapid increase is that of the Korean War, the second the era of sputnik and the Berlin Wall, and the third the years of the late sixties of accelerated production and development of aerospace and nuclear weaponry. The long period of relaxation in the middle and late fifties is that of detente after the Korean War and the second corresponds to the era of the nuclear test ban treaty of the mid-sixties."