Economics of the Arms Race

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After reviewing briefly the economic consequences of the arms race, especially in the United States, the author analyses the *dynamics* of arms races, using insights gained from the study of economics. A distinction is drawn between the arms race, which the author defines as an upward adjustment, either quantitative or qualitative, in military stock and personnel, and military spending *per se*; mere spending figures do not recognize the importance of qualitative changes in arms technology. There are powerful forces propelling the arms race and its negative macro-economic consequences are not serious enough to halt it — military spending need not be inflationary, it is not necessarily inversely related to economic growth, it has no decisive causal connection to employment, and it has not altered the industrial structure of our economy in any significant way. Arguments for disarmament must be based, therefore, on a foundation firmer than concerns about the economic consequences of high levels of arms spending. It is here that the tools of economics can prove most useful, by providing insights into the behaviour of rivals, and a means of analyzing the "stability" of the race. By drawing an analogy to the economic experience with cartels, the author concludes that a comprehensive disarmament agreement, even one based initially on mutual trust, would not be sufficient to effect a lasting end to the arms race. After an initial arms limitation is concluded, we will still require a means of legal enforcement, or, as is inevitably the case with cartels, the agreement will collapse and rivalry will spring up once again.

L'auteur décrit brièvement les conséquences économiques de la course aux armements, surtout dans le contexte américain, pour ensuite analyser la *dynamique* du phénomène à l'aide de constatations fournies par les sciences économiques. On distingue entre la course aux armements, que l'auteur définit comme un ajustement ascendant soit quantitatif ou qualitatif de ressources militaires matérielles et humaines, et les dépenses militaires comme telles, l'ampleur desquelles ne refléteraient pas l'importance des développements technologiques. De puissants agents alimentent la course aux armements et ses effets macro-économiques négatifs ne sont pas assez sérieux pour la faire cesser — les dépenses militaires ne sont pas toujours inflationnistes, ne sont pas nécessairement fonction inverse de la croissance économique, n'ont aucun rapport direct avec le chômage, et n'ont aucun impact particulier sur la structure industrielle de notre économie. Les partisans du désarmement doivent donc se fonder sur d'autres motifs que des soucis quant aux conséquences économiques qu'auraient les dépenses militaires élevées. C'est à ce niveau que s'avèrent utiles les aperçus offerts par les sciences économiques, permettant de mieux comprendre le comportement des rivaux et d'analyser la "stabilité" de la course. En traçant une analogie avec l'expérience économique des cartels, l'auteur conclut qu'une entente sur le désarmement, même si fondée sur la confiance mutuelle, ne saurait apporter une fin durable à la course. Après un accord préliminaire sur la limitation des armes, il y aurait toujours les problèmes de mise en application, ou, comme c'est inévitablement le cas avec les cartels, l'effritement de l'entente suivi d'une reprise des rivalités.

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Synopsis

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Introduction

The arms race is a strange and depressing phenomenon. It is a race which is unlikely to produce a winner, a fact which ironically sheds a ray of hope. A "winner" may not avoid taking advantage of its position, while a prospective "loser" may not accept its position graciously. The lack of a winner does not, however, mean that the race ends in a "tie". It could end in nuclear holocaust, in which case all participants, and non-participants too, are losers. Or the race could be "called off", in which case there may be many winners and no losers. Short of these possibilities, the arms race is a race without end, with no well-defined finishing line.

A race without end not only seems pointless; it is tiring, if not exhausting. There would be an obvious gain if each participant were to decide that enough was enough, drop out of the race, and direct its talents and energies elsewhere. Unfortunately, the internal dynamics of an arms race do not produce voluntary drop outs. Unilateral withdrawal by a major participant is not likely to occur even in the unlikely event of "economic exhaustion". Multilateral withdrawal requires rational and collective action by all major

participants in the race. But collective action requires overcoming powerful forces which have so far combined to perpetuate the arms race.

I was asked initially to discuss the economic *consequences* of the arms race. However, as my work proceeded, I found that much of what interested me most went beyond the mere impact of military spending and instead inclined toward an economic analysis of the *dynamics* of the arms race. Another reason for not limiting myself to economic consequences is that it is somewhat unsatisfying simply to render essentially negative judgments about the relation between arms race "cause" and economic "effect". Given the "stagflationary" problems plaguing many nations, and the failure to convince world political leaders of the moral-political degeneracy of the arms race, it is perhaps not surprising that the past decade has produced a growing interest in the economic consequences of the arms race and military spending.[1] It is an old story: if an ethical argument won't suffice, perhaps a "pocket book" one will. Nevertheless, the timing of that interest is curious. Although the decade of the 1970s was characterized by rising inflation and unemployment, by slowing growth and productivity, it was also a decade of decline in military expenditures in relative terms, when taken as a percentage of world Gross National Product [GNP]. This trend has recently, and unhappily, been reversed. On the face of it, the *timing* of events is not favourable to the case that military spending is an important *cause* of current economic problems. As we shall see, economic analysis is not more gentle to this hypothesis. However, economic analysis does yield interesting insights into the forces propelling the arms race, the stability of the arms race and the necessary conditions for a lasting end to the arms race. These insights may be of more lasting value than the simple analysis of economic consequences.

The paper is divided into four Parts. Part I is devoted to the definition of concepts, in which the arms race is distinguished from military spending. It also includes a brief overview of trends in military spending — the chief *economic* indicator of the course of the arms race. Part II contains an examination of the likely impact of the arms race on such macro-economic indicators as inflation, output and productivity growth, and employment, and its impact, if any, on industrial structure. Because military spending is so much more important in the United States than in Canada, the paper focuses on American data and economic conditions.[2] In Part III, the focus is altered. I

[1] The studies I have in mind have been the progeny of international organizations or commissions. See, *e.g.*, U.N. Doc A/32/88/Rev 1., *Economic and Social Consequences of the Arms Race and of Military Expenditures* (1978); C. Sanger, *Safe and Sound* [:] *Disarmament and Development in the Eighties* (1982); and Palme, *et al.*, *Military Spending: The Economic and Social Consequences* [1982] Challenge 4 (September-October).

[2] Because of my lack of knowledge, I will not attempt to discuss the economic consequences of defence spending for the economy of the Soviet Union.

investigate the arms race from an economist's perspective, searching for insights into the behaviour of national military rivals, the factors sustaining that rivalry, and its stability. The final Part suggests, from this economist's view, what are the necessary conditions if collective action is to result in effective measures of arms limitation and disarmament.

I. The Arms Race and Military Spending: Definitions and Measurement

A. *The Concept of the Race*

What is an arms race? Can it be measured? If so, how? Clear thinking on these issues is essential if anything useful is to be said about the economic consequences of arms races. I find it helpful to distinguish between "military spending" and "arms race", even though, for practical purposes, the former is used as a rough *measure* of the latter. Military or defence expenditure is a *flow* of spending *per* unit time, say a year. Thus, spending to procure weapons and military supplies, to pay personnel, and to conduct operations, comprise military or defence expenditure. An arms race is characterized by an upward adjustment in the *stock* of destructive weapons and the necessary personnel to employ them. A simple analogy with a washtub and its contents is helpful in distinguishing the two concepts. In such an analogy, defence spending is represented by the flow of water from the faucet into the tub. The arms race is reflected in the rise or fall in the water level in the tub and sometimes by a change in the temperature of the water. Changes in the water level are analogous to *quantitative* changes in the stock of arms, while changes in water temperature indicate *qualitative* changes in the stock of arms, measured in a hypothetical unit of destructive power. In a similar manner, disarmament is defined as a reduction in the destructive power of the weapons — quantitative or qualitative. The washtub analogy to disarmament is a fall in the temperature and in the level of the water in the tub as it cools and flows down the drain.

Simply because arms races have a *qualitative* as well as a *quantitative* side, dollars of expenditure on arms is not a particularly good measure of the pace of the arms race. For example, Palme notes that, even among the superpowers, less than twenty *per cent* of military expenditure is directed toward the nuclear component of the arsenal.[3] Yet the destructive power of that twenty *per cent* outweighs all else. As another example, the addition of a million rifles or mortars to the United States or Soviet arsenals would involve a large expenditure but would hardly be considered an intensification of the arms race. In the same way, discarding some conventional and outmoded weapons should

[3] *Supra*, note 1, 6.

not be considered a step in the direction of disarmament by either of the nuclear superpowers.

The confusion that can arise in attempting to define and measure an arms race is indicated in an article by a ranking member of the U.S. military establishment:

> "Arms race" — I use the quotation marks because the term is misleading. It is not true that the respective numbers of nuclear weapons deployed by the United States and Soviet Union have both been spiraling upward. America has over the last 15 years, repaired, replaced and improved certain nuclear-weapons systems, but we have not increased the size of our nuclear arsenal. In fact, it is smaller by several thousand nuclear warheads than in 1967. The Soviet arsenal has grown since 1967 by some 6,000 nuclear warheads.[4]

If numbers of weapons were the sole basis for gauging an arms race, one would conclude from the author's remarks that the United States is disarming, which it patently is not, while the Soviet Union is building up rapidly its arms stockpile, which it clearly is. The truth is that during the decade of "detente", the nuclear arms race continued, and both superpowers now appear to be stepping up the pace of the race.

Before turning to military expenditure trends — which can provide only a crude economic measure of the pace of the arms race — it is necessary to clarify at least one more ambiguity about the term "arms race". There are, in reality, at least three arms races in progress. There is the growth in the number, accuracy and destructive power of nuclear weapons and counter-weapons deployed by the superpowers. Then there is the proliferation of nuclear weapons to "third parties". Finally, there is the stockpiling of conventional weapons by both nuclear and non-nuclear states.[5] Military spending best approximates the pace of the last of these arms races.

B. *The Pace of Military Spending*

World military spending has risen steadily during the past thirty years. Measured in constant 1978 U.S. dollars, military expenditures rose from

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[4] Perle, *A Freeze Means Thin Ice*, The New York Times (7 September 1982) A 23. At the time, Mr Richard Perle was Assistant Secretary of Defense for International Security Policy.

[5] The destructive and lethal power of some conventional weapons is beginning to match that of lower-yield nuclear weapons. See Robinson, "Qualitative Trends in Conventional Munitions: the Vietnam War and After" in Kaldor & Eide, eds, *The World Military Order* (1979) 64. Note that I have not included the horrific race to "perfect" and stockpile the requisite ingredients for biological war.

$134 billion in 1950 to $446 billion in 1979.[6] Currently between 4.5 and 5.5 *per cent* of world Gross National Product is absorbed by the military.[7] More than half of the world total is accounted for by the U.S.A. and the U.S.S.R. However, military expenditures by developing countries are increasing at a more rapid rate than in the developed nations,[8] a fact accounted for in good part by the very large increase in military spending by Middle Eastern states during the last fifteen years.[9]

Despite the rise in world military spending, its relative "economic importance", as a *per cent* of GNP, has been declining, at least until very recently. During the 1970s, world military expenditures fell steadily from 6.1 to 5.3 *per cent* of world GNP.[10] Almost all of the decline was accounted for by the relative decline in military spending among developed countries. In this, the United States led the way, with military expenditures declining, in *real*

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[6] See Stockholm International Peace Research Institute [SIPRI], *Yearbook 1980* [:] *World Armaments and Disarmament* (1980). In 1982, world military spending was expected to reach $650 billion U.S. current dollars or roughly $500 billion constant 1978 dollars. See Palme, *supra*, note 1, 5.

[7] The chief uncertainty revolves around estimates of military spending by the Soviet Union. All major sources of information on world military expenditures reject outright the official Soviet figures which put annual military expenditures at between $20 and $25 billion in current U.S. dollars. However, there are important differences between the estimates which are employed by the United States Arms Control and Disarmament Agency [ACDA] and the International Institute for Strategic Studies [IISS] on the one hand, and the estimates made by SIPRI on the other. R. Sivard, *World Military and Social Expenditures* (1980) presents figures more in line with the SIPRI estimates. In the late 1970s, ACDA and IISS figures were about 50 *per cent* higher than the SIPRI and Sivard estimates that Soviet military expenditures were in the range of U.S. $100 billion *per year*. One of the reasons why the ACDA figures, which are based on CIA estimates, are so much higher than those of SIPRI and Sivard, is that the former base their figures on estimates of what it would cost in the United States to produce the military goods and services it is estimated that the U.S.S.R. has produced in a given year. For a good discussion of the problems of comparing the CIA-ACDA estimates of Soviet military expenditure with figures for NATO countries, or in making comparisons over time, see SIPRI, *Yearbook 1979* [:]*World Armaments and Disarmament* (1979) 28-32.

[8] The income "elasticity" of military spending (which is equal to the percentage change in military expenditure divided by the percentage change in GNP) is much higher for developing than developed countries, but has been declining in both. Using figures from Sivard, *ibid.*, the elasticity was +.49 (1960-70) and +.37 (1970-78) in developed countries compared to +1.77 (1960-70) and +1.19 (1970-78) for developing countries. For the 1970s the ACDA figures for developed countries yield an elasticity of +.39 which is comparable to the Sivard figure, but produces a lower figure for developing countries — +.89.

[9] As a *per cent* of GNP, military expenditures by Middle Eastern countries rose from 10.3 *per cent* in 1970 to 15.1 *per cent* in 1975 and remained at the latter level for the remainder of the 1970s.

[10] In 1960, world military expenditures as a *per cent* of world GNP were about 6.5 *per cent* (ACDA estimates).

terms, by about 14 *per cent* between 1970 Vietnam War levels and 1979.[11] As a result, American military expenditures fell from about 8.0 *per cent* to 5.2 *per cent* of GNP over the decade.[12] The decline in military expenditures [ME] as a proportion of central government expenditures [CGE] was even more dramatic. In 1970, the ratio of ME to CGE was roughly one third in both developed and developing countries. By 1979, the ratio was just above a fifth in both types of countries, with rapidly rising social welfare expenditures on health, education and income maintenance filling much of the gap left by the relative decline in military expenditures. For the United States, the ratio of ME to CGE fell from 50 *per cent* in 1960 to under 25 *per cent* in 1980.

However, as the 1970s came to a close there were signs of a step-up in military spending, particularly among the superpowers — a rise confirmed in the first two years of the 1980s. In the United States, the Reagan Administration's stated objective is a nine *per cent* increase in real spending on the military, which will raise the U.S. ME to GNP ratio from 5.5 in 1981 to 6.8 *per cent* in 1985. Both the U.S. and the U.S.S.R. blame each other for the turn-around, but the real reasons are undoubtedly complex, being at least partly embedded in new technology and in the perceived need to "modernize" existing arms stockpiles. In any event, the sharp rise in the United States defence budget and the heavy commitment of the Soviet Union to its military establishment are beginning to weigh heavily on both economies. In the case of the Soviet Union, the lack of economic slack and a declining rate of growth make all the more obvious the economic drain on the civilian economy caused by a large and growing defence establishment.[13] In the United States, the sharp *change* in the level of defence expenditure and the method of *financing* the current huge federal government budget deficits to which the rise in military spending and Reagan tax cuts have contributed about equally, por-

[11] On this point, ACDA and SIPRI figures agree — with the latter actually indicating a larger decline. During the same period, U.S.S.R. spending on the military is estimated to have risen by 14.3 *per cent* (SIPRI) and 30.4 *per cent* (ACDA). The continued rise in real military spending by the Soviets during "detente" is one of the stated reasons for the current United States military build-up. It should be noted, however, that since 1976, the first year in which the United States was no longer involved in Vietnam fighting, real military spending by the U.S.A. has been rising. Thus much, if not all, of the decline in U.S. real military spending in the 1970s is probably attributable to the phasing down and eventual conclusion of the Vietnam War.

[12] See Table 1 which also includes figures for Canada, the Soviet Union and NATO Europe.

[13] The governments of both the U.S.S.R. and the U.S.A. are well aware of this fact and some experts on both sides suggest, or at least hint at the possibility, that the American build-up is aimed partly at producing economic exhaustion in the U.S.S.R. See United States Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfers 1970-1979* (1982) 19-25; Konobeyev, *The Capitalist Economy and the Arms Race* [1980] Int'l Affairs [Moscow] 192 (No. 8).

TABLE 1
MILITARY EXPENDITURES [ME] AS A PERCENTAGE OF GROSS NATIONAL PRODUCT [GNP]

(1) Year	(2) United States[a]		(3) Canada[b]	(4) Soviet Union[c]		(5) NATO Europe[d]
1950	5.1	—	2.6	—	—	—
1955	10.2	—	6.3	—	—	—
1960	9.0	—	4.2	12.4	—	—
1965	7.6	—	2.9	12.8	—	—
1970	8.0	(7.9)	2.4	12.0	(14.7)	3.7
1971	7.1	(7.0)	2.2	9.7	(14.3)	3.7
1972	6.7	(6.6)	2.1	9.6	(14.4)	3.7
1973	6.0	(6.0)	1.9	9.0	(14.0)	3.6
1974	6.1	(6.1)	1.9	8.7	(14.0)	3.6
1975	6.0	(5.9)	1.9	10.3	(14.1)	3.7
1976	5.4	(5.3)	1.8	9.9	(14.3)	3.6
1977	5.3	(5.3)	1.9	9.5	(14.0)	3.6
1978	5.1	(5.1)	2.0	9.2	(14.1)	3.6
1979	5.2	(5.2)	1.8	9.1	(14.4)	3.6
1980	5.2	—	1.8	—	—	—
1981	5.5	—	1.8	—	—	—
1982	5.9[e]	—	—	—	—	—
1983	6.3[e]	—	—	—	—	—

[a] Figures from two sources are shown. The first column is taken from Stockholm International Peace Research Institute [SIPRI], *Yearbook* (1980) and (1981). The second column in parentheses is from the United States Arms Control and Disarmament Agency [ACDA], *World Military Expenditures and Arms Transfers 1970-1979* (1982) and is provided for fair comparison with the figures in columns (4) and (5).

[b] SIPRI, *ibid.*

[c] SIPRI, *ibid.*, for the figures in the first column. United States ACDA, *supra*, note a, for the figures in parentheses in the second column.

[d] United States ACDA, *ibid.*

[e] Estimates derived from *Budget of the United States Government*, Fiscal Year 1983.

tend a combination of cost-increasing bottlenecks in military-related industries and general deflation, in output as well as prices, in the economy as a whole. This is a subject to which we shall return later.

II. The Impact of the Arms Race on the Economy

There are two major ways in which an arms race affects the economy. First, where arms races involve high levels of defence spending, the way in which that spending is financed can affect such economic aggregates as inflation, output and employment. In addition, if there is a sharp change in the level of defence spending, however financed, it can have dislocating effects on the economy because the additional spending tends to be concentrated in a few industries and sectors of the economy. Second, modern arms races are highly technological in character. As a result, arms races often result in an absorption of highly skilled and specialized resources such as engineers, scientists, computer experts, and Research and Development facilities, which might otherwise have been employed more constructively in civilian industries. While there are undoubted spillovers from military research and development into civilian uses, as for example in aircraft, computer, satellite, and communications technology, the employment in United States defence-related work of 19, 22, 38, 54 and 59 *per cent* of all machinists, electrical engineers, physicists, aircraft mechanics, and aeronautical engineers, respectively, represents a real cost which could affect adversely productivity and economic growth.[14] This said, what are the consequences of the arms race for the economic indicators by which we generally measure the health of the economy?

A. *Inflation*

Military spending, *per se*, is not inherently inflationary. A dollar spent on military goods and services is not economically unlike a dollar spent on other goods and services such as education and health. While it is sometimes argued that military expenditures are inflationary because they are contracted on a "cost-plus" basis — with little control over rising costs — such behaviour, if common, produces only once-and-for-all increases in the prices of a subset of all goods and services. By contrast, inflation is a *continuous* increase in the price level, affecting the prices of all goods and services. For inflation to proceed the money supply must expand. This fact implies that it is the method by which military expenditures are *financed* which may make them inflationary. When military expenditures, or other government expenditures, are financed fully by taxes, the withdrawal of spending power from the private sector offsets the increase in spending by government.[15] However, if

[14] See Palme, *supra*, note 1, 10. See also Nelson, *The Impact of Arms Reduction on Research and Development* (1963) 53 Am. Econ. Rev. 435 (Papers and Proceedings).

[15] However, the balanced budget theorem in economics suggests that the increase in taxes may have to exceed the increase in spending if the two are to be economically, as opposed to budgetarily, offsetting.

government expenditures are at least partially *deficit* financed, and the deficit is "monetized", that is, the government bonds issued by the Treasury in order to cover the deficit find their way into the hands of the Central Bank, the government spending will be inflationary. Only if military spending is more likely to be money-financed than are other kinds of government expenditures is it legitimate to say that military expenditures tend to be especially inflationary.

Moreover, under certain circumstances, even deficit financing need not be inflationary. If large deficits are financed by dumping billions of dollars of government bonds into the capital markets, with little or no increase in the money supply, real interest rates will be driven up, and both investment by firms and interest-elastic spending by households and governments will fall as a result. The net effect may be economic contraction of a sufficient magnitude to cause the inflation rate to *fall*. The Reagan Administration's policy of large tax cuts, tight control over the money supply and increased military expenditures is an example of this process in operation. This combination of policies has produced large government budget deficits, unprecedentedly high real rates of interest and severe economic contraction, but the United States inflation rate has fallen from 12 *per cent* annually to under 5 *per cent* in little over a year.[16]

Historically, inflation and wars have often coincided. However, the inflation of the 1970s occurred when government spending was rising, not primarily as a result of military outlays, but because of rapidly rising expenditures on social welfare including health, education and income maintenance programmes. Table 2 shows that despite the relative decline in military spending, the 1970s was — for the United States, as for many other nations — a period of rising government budget deficits and inflation.

B. *Economic Growth*

Sometimes it is suggested that high rates of military spending inhibit growth. This view is based on three arguments. First, it is argued that military spending is "unproductive" — adding nothing to an economy's potential, while absorbing scarce resources. But this view overlooks the fact that, like consumption spending, military spending may give "utility" in the form of added security. In the absence of a supranational police force capable of maintaining international peace, victims of aggression, as well as aggressors, will spend large sums to protect their well-being which, in addition to tangible forms of wealth, includes such intangibles as the nation's "way of life" and "honour".

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[16]The fear is that *eventually* large budget deficits will have to be monetized in order to "stimulate" the economy, and that the result will be increased inflation.

TABLE 2
UNITED STATES DEFENCE SPENDING AND INDICES OF ECONOMIC PERFORMANCE[a]

(1) Year	(2) Defence Outlays as % of GNP[b]	(3) Inflation Rate[c]	(4) Federal Budget Deficit (Surplus)[d]	(5) Deficit (Surplus) as % of GNP[e]	(6) Productivity Growth Rate[f]
1960	9.3	1.6	(0.3)	(0.6)	1.6
1965	7.6	1.7	1.6	0.2	3.8
1966	7.9	2.9	3.8	0.5	3.2
1967	9.1	2.9	8.7	1.1	2.0
1968	9.7	4.2	25.2	3.0	3.3
1969	9.0	5.4	(3.2)	(0.4)	0.2
1970	8.4	5.9	2.8	0.3	0.7
1971	7.7	4.3	23.0	2.2	3.3
1972	7.0	3.3	23.4	2.1	3.5
1973	6.1	6.2	14.8	1.2	1.9
1974	5.8	11.0	4.7	0.3	(3.0)
1975	5.8	9.1	45.2	3.1	2.1
1976	5.5	5.8	66.4	4.0	3.5
1977	5.4	6.5	44.9	2.4	1.9
1978	5.1	7.7	48.8	2.3	0.5
1979	5.1	11.3	27.7	1.2	(0.9)
1980	5.2	13.5	59.6	2.3	(0.3)
1981	5.5	10.3	57.9	2.0	—
1982	5.8[g]	7.6[g]	110.0	3.5[g]	—
1983	6.3[g]	6.0[g]	180.0[g]	5.3[g]	—

[a] Sources: *Economic Report of the President 1980*; *Economic Report of the President 1981*; and United States Congress, *Congressional Quarterly*, 13 February 1982, 228, 230, 234, and 444.
[b] Fiscal year; Outlays = Expenditures + Net Lending.
[c] Percentage change in CPI year over year.
[d] Fiscal year; in billions of dollars.
[e] Fiscal year.
[f] Rate of growth (decline) of output *per* man hour in private business sector.
[g] Estimated.

A second, more convincing, argument is that high levels of government military spending will reduce growth to the extent that resources are absorbed, at least partially, at the expense of capital formation. The issue here is the possible "crowding out" of investments which would otherwise have

been made. Note, however, that the potential for increasing government expenditures to crowd out private sector investment is not limited to military expenditures. In principle it applies to all kinds of government spending, with the *actual* tendency to crowd out depending upon how close the economy is to full employment and on how spending is financed.

A third way in which the level of military spending may affect economic growth, even in cases where there is no "crowding out" of investment, is through its potential impact upon the pace of technological change. If a large portion of a nation's best "brains" and research efforts is devoted to military rather than civilian purposes and if these investments have little or no spillover into non-military uses, the long term rate of economic growth could be reduced. But there is no necessary inverse relationship between military spending and economic growth. The high rates of economic growth experienced by many industrial nations in the 1950s and 1960s occurred in an era when peacetime military spending as a proportion of GNP was at historic heights. Moreover, there were undoubted spillovers from military research and development into civilian uses in such fields as aeronautics, space, telecommunications, and computers. Now that economic growth seems to have slowed down, and there exists an unexplained decline in productivity, some observers have suggested that one explanation may lie in a decline in the spillover potential from current military-related research and development.[17]

While the *level* of defence spending is not inherently growth-reducing or inflationary, a large *change* in the defence budget can pose serious problems. A $25 billion increase in defence and research and development procurement represents only 1 *per cent* of United States GNP, but a very large increase in the output of industries supplying defence, such as manufacturers of aircraft, ordnance and communications equipment. Thus, a rapid rise in military spending requires an abnormally large and rapid expansion of a relatively small set of industries. The likely result is bottleneck cost increases as the prices for particular materials and components and the wages and salaries of persons with required labour skills are bid up. For example, whereas in the Korean and Vietnam War build-ups, much of the additional spending was on personnel as the armed forces expanded rapidly, the current American build-up is concentrated on procurement and research and development. It is estimated that over the five year period 1981-86, the *real* volume of military procurement will rise by 80 *per cent*. This was expected to increase the Pentagon's non-personnel budget from 5.9 to 10.0 *per cent* of goods-producing GNP — defined as GNP minus services, even before taking account of the depressing effect upon GNP of the recent recession in the

[17] See Palme, *supra*, note 1, 14-5. See also, *supra*, Table 2 for figures on the decline in productivity.

United States.[18] By comparison, during the Vietnam build-up, non-personnel outlays as a *per cent* of GNP minus services rose by 2.7 percentage points — from 7.9 to 10.6 *per cent*. If it were not for the recent deep recession, with substantial idle resources, the United States military expansion would be especially prone to bottlenecks, with potential inflationary implications.

C. *Employment*

In a period of high unemployment, there is a natural interest in how the arms race affects employment. Does the arms race raise employment and reduce the unemployment rate? Or does the arms race, in some complex manner, actually reduce employment and raise the rate of unemployment? In other words, were high post-war levels of military spending an important factor in the generally low post-war unemployment picture? Is military spending a curb on investment and long run economic growth and thereby a contributor to *rising* unemployment rates in the past decade? One can find proponents for each of these views, but most economists probably would not be found in either camp.

After World War II brought an end to the Great Depression, some skeptics of capitalism argued that high levels of military spending — even war itself — were *necessary* if capitalist countries were to maintain reasonably full employment. The supposed analytical basis for this view was J. M. Keynes' concern that, without periodic large injections of government expenditures, the inherent economic instability of modern economies, resulting, he thought, from volatile investment demand, would cause periods of substantial unemployment. But even if one accepts the argument that capitalist economies are inherently unstable and most economists today would not, we may ask, why are *military* expenditures necessary? Why not some other form of government expenditure? The answer, which became popular in some circles around the time of the Vietnam War, was that only military expenditures could receive sufficient *political* support as an employment-generating government policy.[19] But this argument lacks cogency because the growth in *government* expenditures on health, welfare and education has far outstripped the growth in government spending on the military.

An alternative view is that high levels of government spending absorb real resources, that the taxes necessary to finance these expenditures have been collected at the expense of investment as well as consumption. More-

[18] See Schultze, *Economic Effects of the Defense Budget* (1981) 18 Brookings Bull. 1, 4.

[19] See Reich, *Does the U.S. Economy Require Military Spending?* (1942) 62 Am. Econ. Rev. 296 (Papers and Proceedings).

over, if spillovers from military research and development into civilian uses are limited, productivity increase may be reduced, and so may a nation's comparative advantage in, and ability to export, high technology items.[20] Accordingly, if the arms race reduces investment and productivity growth, it will tend to reduce the long term rate of economic growth. In turn, a decline in economic growth will tend to raise unemployment, particularly if wages are unable to adjust downward. The unemployment impact will be all the greater during a period of rapid labour supply growth as has been the case in the last decade or two, as the post war "baby boom" came of working age, and married women moved in large numbers from the home into the labour market.

While there is some evidence from cross-national comparisons that high levels of military spending are associated with lower rates of investment and productivity growth,[21] the plausibility of *causal* connection is weakened by the inability to provide a coherent explanation as to why the same effects would not be produced by other forms of government expenditure. One could argue just as plausibly that it is the substantial growth in the relative as well as the absolute size of government in the past two decades that has begun to have an adverse impact on the growth of private sector investment, output and employment. Because it is civilian — particularly social welfare-related expenditures — rather than military expenditures which have accounted for most of the growth in government spending, one might, with greater justification, look to the former rather than the latter as a potential source of drag on the economy.

While the argument that a high level of military spending is *necessary* to the maintenance of full employment, or alternatively, that large military expenditures are inherently employment-reducing, lacks plausibility,[22] it is true nevertheless that employment in a given locale or region may be quite dependent on defence expenditures[23] and that *changes* in defence spending may produce *cyclical* changes in the unemployment rate. The tendency for defence-related employment to be concentrated locally is an important phenomenon which would create obvious adjustment problems if ever a serious programme of disarmament were implemented.[24] But the problems posed

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[20] See Rothschild, *Military Expenditures, Exports and Growth* (1979) 26 Kyklos 804.

[21] See, *e.g.*, Smith, *Military Expenditures and Capitalism* [1977] 1 Cambridge J. Econ. 61; Palme, *supra*, note 1.

[22] The arguments are contradictory as well.

[23] *E.g.*, Nova Scotia, Connecticut, Texas, California, and Massachusetts.

[24] The impact of disarmament on the Canadian economy has been examined in depth by G. Rosenbluth, *The Canadian Economy and Disarmament*, rev'd ed. (1978) and by Bernard & Truchon, *Les retombées économiques de l'effort militaire du Canada dans l'optique du désarmement* (1983) 28 McGill L.J. 684. For the impact of disarmament on the United States

TABLE 3
UNITED STATES DEFENCE EMPLOYMENT LEVELS[a]

(1)	(2)	(3)	(4)	(5)	(6)
Year	Department of Defense Personnel[b]	Defence-Related Civilian Employment in Private Sector[c]	Total Defence-Related Employment[d]	Total Civilian Employment[e]	Unemployment Rate (%)
1965	3.7	2.3	6.0	71.1	4.5
1968	4.8	3.2	8.0	75.9	3.6
1969	4.8	2.9	7.7	77.9	3.5
1970	4.3	2.4	6.7	78.6	4.9
1971	3.8	2.0	5.8	79.1	5.9
1972	3.3	1.9	5.2	81.7	5.6
1973	3.3	1.7	5.0	84.4	4.9
1974	3.2	1.7	4.8	85.9	5.6

[a] Source: Lynch, *Regional Impact of the Vietnam War* (1976) Q.J. Econ. and Bus. 37, 38.
[b] In millions. Includes military personnel and Department of Defense civilian personnel.
[c] In millions. Includes persons employed by prime contractors and sub-contractors and persons providing supplies and services to the contractors.
[d] In millions. Column (2) + Column (3).
[e] In millions.

may be more political than economic. Adjustment to economic change is often rapid. For example, the sudden 44 *per cent* increase in Vietnam War procurement-related employment between 1965 and 1968 was followed just as rapidly by a 40 *per cent* drop between 1968 and 1971, with most of the increase and the subsequent contraction occurring in seven large midwestern industrial states.[25] The adjustment of labour supplies to changing demand seems to have taken place with a minimum of dislocation.

The United States is itself cyclically sensitive to substantial changes in defence spending. Table 3 shows the level of defence-related employment in the United States during the Vietnam War. At the height of the conflict, in 1968, defence-related employment reached 8 million persons, or 9.5 *per cent* of all employed persons. In Canada, the comparable figures for 1974 were 181,300 persons in defence-financed employment, or 2 *per cent* of the

economy, see W. Leontief, *Input-Output Economics* (1966). R. Bolton, *Defense Purchases and Regional Growth* (1966) has estimated the impact of United States defence spending on regional growth.

[25] See Lynch, *Regional Impact of the Vietnam War* (1976) 16 Q.J. Econ. and Bus. 37.

employed labour force.[26] Table 3 also reveals that the Vietnam build-up resulted in a rise in defence-related employment of 2 million persons between 1965 and 1968 and a subsequent decline of 2.2 million persons between 1968 and 1971. As defence-related employment rose, the unemployment rate fell from 4.5 to 3.5 *per cent* during the period 1965-69, and as defence-related employment fell, the unemployment rate rose by 2.4 percentage points. While the defence expansion and contraction obviously contributed to the cyclical movements in the unemployment rate, it would be an error to overstate the direct military impact. The decline in the unemployment rate from 1965 to 1969 was due at least partly to the well-known "Kennedy" tax cut of 1964-65. Likewise, the rise in unemployment between 1969 and 1971 resulted, in good part, from restrictive monetary and fiscal policies put in place after it became clear that the failure to tax-finance the Vietnam War military build-up was producing inflationary strains on the United States, indeed world, economy.

At times of high unemployment, the cyclical sensitivity of employment to large changes in defence spending is sometimes used by proponents of increased defence spending as a means to foster political support for such spending. For example, with the American unemployment rate standing at over 10 *per cent* in the fall of 1982, some Reagan Administration officials saw a "silver lining", or perhaps a gold plated one, in the spiralling military budget. In an attempt to head off Congressional cuts in the defence budget, Caspar Weinberger, the United States Secretary of Defense, is reported to have said that "[y]ou get 35,000 more jobs for every extra $1 billion you spend on national defense".[27] Pentagon economists, tacking on the indirect employment impact of military spending, estimated the total employment effect of a one billion dollar increase in defence spending to be between 50,000 and 60,000 jobs. If the Reagan Administration gets its way, it is estimated by the developers of Pentagon economic models that, by 1987, military spending will account for 3.4 million industrial jobs compared to 2.2 million in 1982.[28]

However, any attempt to justify a step-up of defence spending solely on employment generating grounds is misguided. Unless the increased military hardware is justified in its own right, it obviously would be preferable to stimulate higher employment by producing goods and services that society really demands.[29] Moreover, as a number of analysts have pointed out,

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[26] See Rosenbluth, *supra*, note 24, xii-xiii. Input-output model figures for 1968 in Canada are not available.

[27] Silk, *Military Surge as Spur to Jobs*, The New York Times (17 September 1982) D 2.

[28] See *ibid.* The Pentagon economists used the input-output analysis developed by Professor Wassily Leontief, *supra*, note 24.

[29] Of course, Mr Weinberger stressed that the increase in defence spending was needed in order to respond to the Soviet threat.

defence spending is not a particularly cost-effective method of job creation. It is estimated that an extra $1 billion will create 76,000 jobs if spent on sewer construction, 77,000 jobs if spent on teachers.[30] Finally, if increasing defence expenditures inflate the government's budget deficit while the monetary authorities sharply limit money supply expansion, the likely result is to put upward pressure on real interest rates, further reducing investment demand and extinguishing jobs in the non-defence sector of the economy.

D. *Impact on Industrial Structure*

Has the arms race affected the industrial structure of the economy? It sometimes is argued that because military procurement and research and development expenditures are concentrated on a relatively few large firms, the arms race is contributing to an increase in industrial concentration. It is argued further that the cost plus nature of defence procurement has dulled the efficiency and altered the incentive structure of firms which depend heavily on defence contract work.[31] Moreover, the fact that most defence procurement contracts are negotiated by a single buyer — the United States Department of Defense — rather than awarded on a sealed bid basis, implies that the market mechanism is bypassed and a "cozy" rather than "arms's length" relationship develops between purchaser and supplier. This, in turn, is said to create a community of interest and to reinforce the idea of a military-industrial complex.

The issues raised here are complex and easily subject to distortion. In the short space available, it is difficult to do more than to suggest some general directions of thinking. To begin with, there is no question that defence spending is concentrated on relatively few firms. In the early and mid-1970s, 70 *per cent* of United States defence procurement centred on the 100 largest defence contractors. Less than 20 *per cent* of defence procurement was accounted for by small business.[32] In addition, at the level of specific weapons such as nuclear submarines, fighter aircraft, missile systems, and combat

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[30] See Silk, *Cost-Effective Job Creation*, The New York Times (17 September 1982) D 2. Unfortunately, none of these alternatives directly increases industrial jobs where unemployment is presently most critical.

[31] Cost-plus pricing means that the price established between buyer and seller is equal to an agreed markup over supplier's costs, whatever they may be.

[32] See Marfels, *The Structure of the Military-Industrial Complex in the United States and its impact on Industrial Concentration* (1978) 31 Kyklos 409, 416. But Marfels says that only three of the largest ten United States defence contractors are among the very largest industrial corporations. He also says that "the firms which are heavily dependent on military contracting are medium-sized firms only, although they are still in the group of the 50 largest industrial corporations".

vehicles, the four top suppliers of each type of weapon usually accounted for a high proportion of the contracts, often in excess of 90 *per cent*.[33]

It is true also that defence contracts are typically negotiated rather than awarded on a sealed bid basis. Marfels reports that 90 *per cent* of all weapons procurement is done without competitive bidding.[34] When the penchant for negotiated defence contracts is combined with (a) controls over profit *per* sale rather than over cost; (b) the Department of Defense's obsession with "performance"; and (c) typically a high degree of excess capacity in U.S. defence plants, it is not surprising that costs seem inflated, that large cost overruns are common, and that the defence industry gives the appearance of inefficiency. Adams has argued further that defence procurement policies have effectively subsidized and protected large and often inefficient, firms, thereby inhibiting turnover of leading firms and preventing competitive pressures from enforcing the dictates of economic efficiency.[35]

While performance in supplying the Department of Defense often would not pass the more rigorous tests of efficiency confronting firms in the private market place, the lasting effect on industrial structure is not clear. For example, it is difficult to trace changes in the United States industrial structure to defence procurement policies. Industry concentration ratios — the share of industry output accounted for by the largest 4 or 8 firms — have not risen on average. Those specific industries experiencing rising concentration have tended to be consumer-, rather than producer-goods, industries. Moreover, a recent study by Shepherd provides evidence that competition has increased in the United States economy, and that the trend has been particularly marked since 1958.[36] While it is true that "aggregate concentration" (the share of all manufacturing or industrial output accounted for by the 50, 100 or 200 largest firms) has risen in the U.S., most of the increase took place in the first decade after the end of World War II. In addition, the evidence suggests that at least part of the increase in aggregate concentration is attributable to strong motives toward diversification by the largest firms — sometimes by merger. In other words, even absent the arms race, some increase in aggregate concentration was likely.

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[33] See J. Gansler, *The Defense Industry* (1980) 166.

[34] See Marfels, *supra*, note 32. For a comprehensive study of the weapons acquisition process in the United States, see M. Peck & F. Scherer, *The Weapons Acquisition Process: an Economic Analysis* (1962).

[35] See Adams, *The Military-Industrial Complex and the New Industrial State* (1968) 58 Am. Econ. Rev. 652 (Papers and Proceedings); Adams & Adams, *The Military-Industrial Complex: A Market Structure Analysis* (1972) 62 Am. Econ. Rev. 279 (Papers and Proceedings).

[36] See Shepherd, *Causes of Increased Competition in the U.S. Economy, 1939-1980* (1982) 64 Rev. Econ. and Stat. 613.

It is interesting that in recent years, leading military contractors, some of which were noted in the 1960s for their inefficiency and inability to enter the civilian market place, have now become diversified, often through merger, so that they are no longer as dependent on military contracts. One factor operating here is the substantial number of prime contractors acquired by conglomerates.[37] Gansler reports that the percentage of defence-related business of the 25 largest defence contractors fell from 40 *per cent* in 1958 to less than 10 *per cent* in 1975.[38] It would seem that, rather than altering the industrial structure in any marked way, the arms race merely abets a degree of inefficiency. In addition, there may be some tendency, conscious or unconscious, to use defence expenditures as a kind of "industrial policy", to keep afloat large firms who, in the absence of defence contracts, would need some form of market protection or financial bailout to survive. The obvious examples are Lockheed and Chrysler.

III. Economic Analysis of the Arms Race

We now turn away from the specific economic consequences of the arms race to an analysis of arms race "inertia" and "stability". We enter an area which the reader will find more opaque, more subject to assumption and qualification, than that through which he has just passed. It is hoped, however, that the topics are important enough and the insights sufficiently rewarding that the reader will bear with me and the mode of analysis I have adopted in approaching these difficult and complex issues.

A. *Why Does the Arms Race Continue?*

Each year, enormous sums are spent by the superpowers to expand and to modernize arsenals whose lethal power is many times that necessary to obliterate life on earth. Each year, vast sums are spent on arms by poor countries in what often appears to be little more than a boisterous display of new found wealth. Alva Myrdal, a winner of the Nobel Prize for Peace, has stated:

> Every government defends its participation in the arms race as necessary to guard its national security. But this is an illusion. What makes the arms race a global folly is that all countries are now buying greater and greater insecurity at higher and higher costs.[39]

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[37] See Marfels, *supra*, note 32.
[38] See Gansler, *supra*, note 33.
[39] A. Myrdal, *The Game of Disarmament*, rev'd ed. (1982) 7.

The key word is "global". If nations prefer more security to less, it is clearly globally nonoptimal to spend more for less. But the result is quite predictable, even if each of the participants is perfectly rational. An example will help illustrate the point. Suppose there are two nations, A and B, and that, at the outset, the stockpile of arms of A and B are similar. Suppose further that each nation values highly peace and security, but doesn't trust its *neighbour* — a perceived rival. Finally, let us assume that security, which is measured in index number form, is related *negatively* both to the ratio of rival to domestic military capability *and* to the total stock of arms. Under these assumptions, if both A and B increase their military spending, their security indices decline from 1.0 to 0.8 as is indicated by a comparison of the upper left and lower right hand boxes in Figure 1 below.

FIGURE 1

		Nation B	
		No Increase in Expenditure on Arms	Increase in Expenditure on Arms
Nation A	No Increase in Expenditure on Arms	1.0 (A) 1.0 (B)	0.7 (A) 1.2 (B)
	Increase in Expenditure on Arms	1.2 (A) 0.7 (B)	0.8 (A) 0.8 (B)

But if either A or B increases its expenditures on arms while its rival does not, the nation which fails to increase its military capability suffers a perceived decline in security, from 1.0 to 0.7, while its rival's security is enhanced from 1.0 to 1.2. As the numbers in the example suggest, the insecurity produced by a decline in *relative* military power exceeds the insecurity produced by an increase in total world military power. If neither A nor B is certain what its rival will do, and A and B are unwilling or unable to meet together and to agree jointly to limit military spending, the safest strategy is to increase outlay on arms.[40]

[40] The assumption that the two nations begin with armaments which are quantitatively and qualitatively similar is important in the context of deterrence theory. Deterrence theory suggests that the real danger is "imbalance". Thus, if A began with more armaments than B, an increase in arms spending by B, but not by A, might make *both* nations more secure by reducing the chances of a "first strike" for instance. In fact, claims to being behind in an arms race, whether well-justified or not, are often used to promote a step-up in military spending. Of course, one equally could argue that A and B would be even better off if A reduced its arms level to that of B. But if A were willing to do so, would we, in fact, be confronted with an arms race?

We have here an example of the well-known "Prisoner's Dilemma". Each agent acting *on his own* maximizes his gains or minimizes his losses by following a strategy which is clearly inferior to the one he and his rivals would choose if they acted collectively. So long as collective action is not possible, or cannot be trusted because of *sub rosa* cheating, participants prefer strategies which turn out to be *globally* inferior. The type of behaviour reflected in the "Prisoner's Dilemma" is not only rational but occurs in numerous forms. For example, the "Prisoner's Dilemma" explains why rival firms in such consumer products industries as beer or cigarettes may push advertising expenditures to levels which, at the margin, are not globally profitable — where an extra dollar of industry advertising may add less than a dollar to industry revenue. The dilemma faced by each individual firm is that failure to match its rival's advertising campaign threatens to prompt a substantial loss of market share and larger losses than does an imitative strategy. Thus, an action which is collectively non-optimal is individually rational, as long as cooperation, or collusion, is impossible or illegal.[41]

The "Prisoner's Dilemma" analogy is exceedingly apt in the context of the arms race. It provides an explanation for arms race inertia which is not dependent on conspiracy theories or the bogeyman of profiteering interest groups. It does not even require actual aggressors. All that is essential is incomplete information, distrust and the absence of an institution or an organization, such as an international "police force", capable of providing and enforcing collective security.

As powerful as the "Prisoner's Dilemma" analogy is, however, it does not imply necessarily that the rational choice of an individual nation is to increase its arms. Suppose that in the example above, the index of security that would result if each nation were to increase its arms (the lower right hand box) was 0.6 rather than 0.8. In that case, an individual nation's security index is actually lower when both rivals increase their armaments (0.6) than when only the rival nation increases its arms (0.7).[42] The rational action for a nation is to halt any further arms expansion, even though security would be increased if one's own armaments increased while those of one's rival did not.

The existence of a "Prisoner's Dilemma" is not the only factor which can explain arms race inertia making it difficult to stop an arms race short of war.

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[41] None of the ideas are new. They underlie, at least partially, the important work of K. Boulding, *Conflict and Defense: A General Theory* (1962); and T. Schelling, *The Strategy of Conflict* (1960). See also M. Olson, *The Logic of Collective Action; Public Goods and the Theory of Groups* (1971).

[42] Dumas discusses this possibility in detail and provides an analysis of how it might arise. See Dumas, *Armament, Disarmament and National Security: A Theoretical Duopoly Model of the Arms Race* (1979) 6 J. Econ. Stud. 1.

Special interest groups and powerful incentives may play a role too. Modern armed forces are led by well paid and privileged professionals who command forces employing technologically advanced weapons developed by well-rewarded scientists, engineers and skilled technicians, and supplied under cost-plus contracts by firms whose market is guaranteed at taxpayer expense. It would be surprising, almost unnatural, if these circumstances did not generate powerful and varied voices warning sometimes with justification, against "letting down our guard", and advocating supposedly security-enhancing improvements in weaponry. Compounding these forces is the fact that the scientific knowledge on which modern weapons technology is based cannot be destroyed, nor can it be easily turned off or kept secret.

In the United States, this complex of interest groups and incentives is known as the military-industrial complex [MIC].[43] Properly understood, the term "military-industrial complex" is not an unreasonable characterization of at least one of the forces in a modern arms race. Unfortunately, however, there is a tendency in some quarters to embed the MIC concept in some form of conspiracy theory. Doing so is not only simplistic, but overlooks the fact that, at bottom, the problem is one of interest groups and incentives, not unlike those which governments are constantly creating and attempting to cope with in many other domains. The creation of large standing armies and the demand for modern armaments to equip them, created the military-industrial complex, not the other way around. Just as in the regulatory arena,

[43] It would perhaps be preferable to call it the military-industrial-technological complex. That a similar complex set of interests exist in the U.S.S.R. as well, is evident from the paper presented by Seymour Melman, *The Conversion of Military Economy: The USSR*, American Association for the Advancement of Science Annual Meeting (January 1981). An explanation for the arms race that rests on the concept of a military industrial complex is based on a very different model of the government decision-making process than is the deterrence theory-"Prisoner's Dilemma" model. Graham Allison, *Essence of Decision* [:] *Explaining the Cuban Missile Crisis* (1971) distinguishes between three models of government decision-making in his analysis of the Cuban Missile Crisis: the "rational actor"; organizational process; and governmental (bureaucratic) politics models. The "rational actor" model, in which it is assumed that government makes constrained maximizing choices among a given set of alternatives, is the model that underlies the discussion of the "Prisoner's Dilemma". In contrast, the organizational process paradigm emphasizes the role of standard operating procedures, organizational structure and routines, and parochial priorities and perceptions, while the bureaucratic politics paradigm focuses upon the role of diverse interests, bargaining and compromise among officials with unequal influence. Obviously, the military industrial complex concept is much more closely related to the latter two models of government decision-making behaviour than it is to the "rational actor" model. But in my view, and that of Allison too, these decision-making models, although differing among themselves in fundamental ways, are not mutually exclusive. In fact, in an analysis of the arms race, they complement one another nicely. The "rational actor" model is perhaps most useful in analyzing high level strategic decisions while the latter models explain better the day-to-day decision-making behaviour which contributes so much to arms race inertia.

where regulations have begotten regulations,[44] so the growth of large military establishments has engendered its own momentum and self-protecting forces.

An example of the interaction between distrust and institutional incentives that helps to propel the arms race is the apparent decision of both superpowers to extend the competition into outer space.[45] The "costs" in resources and increased insecurity are obvious. Yet, on the other side of the balance sheet, are the higher incomes, prestige and self-importance of the various professionals, from military planners to scientists and engineers, who stand to gain from widening the horizons to which the most advanced technology and planning concepts are applied. Moreover, those who stand to gain most will be able to argue, with some cogency, the historical inevitability that "each time a new medium is opened to man it is exploited to gain a military advantage".[46] In the absence of enforceable cooperation, the costs of the arms race are the costs of avoiding military disadvantage.

Even attempts to limit the budgetary costs of the arms race can produce perverse behaviour.[47] One of the ways in which the budgetary — as opposed to opportunity — costs of new weapons systems can be reduced is to lengthen production runs by selling abroad. Because of the heavy fixed costs associated with weapons development, the average cost of producing *and* developing a weapons system declines over a substantial range. As a result of foreign sales, the cost *per* unit of weapon or weapons system is reduced as is shown in Figure 2, and so is the budgetary outlay for any given quantity, say X_1, purchased at home. If there are no sales abroad, budgetary outlays for X_1 units is $OABX_1$. If production is X_2 with $X_2 - X_1$ units sold abroad, budgetary outlays drop to $ODCX_1$ even though more resources are used up in the production of the weapons system. Thus, sales abroad perpetuate the arms race and use up additional resources while reducing the strain on the most politically sensitive indicator, the supplier government's own budget. Over the decade of the 1970s, when the relative growth in world armament was slowing, the annual value of arms transfers rose from 9 to 20 billion, in

[44] For example, the continued regulation of railroads ultimately required the regulation of trucking, as well as administrative control over technological innovations in transport which threatened to alter existing competitive advantages.

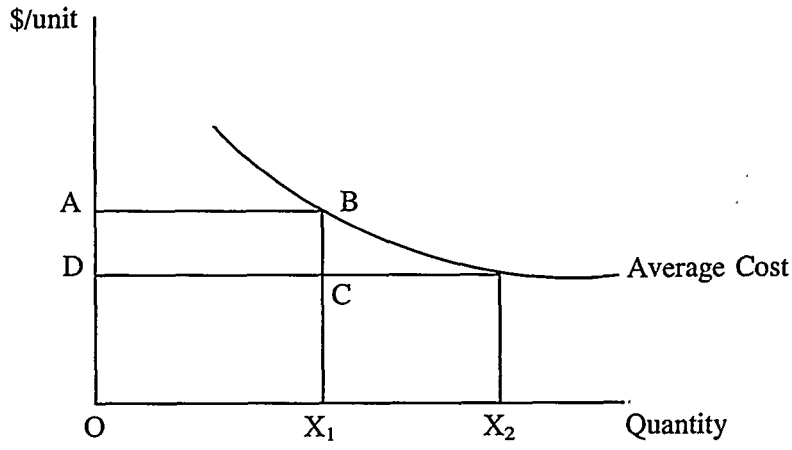
[45] See, *e.g.*, Vlasic, *Disarmament Decade, Outer Space and International Law* (1981) 26 McGill L.J. 135, 147 *et seq.*

[46] Attributed to Robert H. Stivers, Assistant Deputy Secretary of Defense for policy. Reported in Wilford, *Military's Future in Space: A Matter of War or Peace*, The New York Times (19 October 1982) A 1.

[47] Gansler, *supra*, note 33, found the real costs, *i.e.* after deducting for inflation, of military equipment to be rising at a rate of five *per cent per annum*. Thus, for a given budget — even one measured in constant dollars — the amount of weaponry that the military is able to acquire is falling rapidly.

constant 1977 dollars, with over three quarters of the arms imports being absorbed by developing nations.[48]

FIGURE 2



B. *Is the Arms Race "Stable"?*

Historically, most arms races have resulted in war. Is the present arms race any different? If it is, will the arms stockpiles reach an "equilibrium" level at which there is no tendency to increase further? These are difficult questions about which it is not possible to make any definitive statements. However, the existence of weak analogies between international and industrial rivalry suggests, tentatively, that evidence on the latter may yield insights into the former. First, it is necessary to delimit the analysis by making certain distinctions.

Because the analysis will focus on the behaviour of the superpowers, it is useful to distinguish "horizontal" from "vertical" proliferation of weaponry. By "horizontal" proliferation I mean the spread of arms to "third" parties — those not members of one of the two military alliances headed by a superpow-

[48] Note that the budgetary incentive to make sales of arms abroad is unrelated to the argument that one goal of foreign arms sales is to enhance the trade balance (exports of traded items minus imports of traded items). The balance of trade argument seems implausible given the small fraction of total exports: 3.1, 0.3 and 0.7 *per cent* accounted for by arms sales made by the U.S., Canada and NATO Europe respectively, in 1979. See United States Arms Control and Disarmament Agency, *supra*, note 13. The ACDA figure of 16 *per cent* for the U.S.S.R. is probably overstated due to the way in which Soviet arms are valued, while the U.S. figure of 3.1 *per cent* probably understates the real value of arms sales because some are given away and others are sold at "below-market" prices.

er. By "vertical" proliferation, I mean the arms expansion among the superpowers and their close allies. The distinction is important because it seems likely that even if the arms race between the superpowers does not end in war, the horizontal proliferation of non-nuclear arms will almost certainly raise the probability of non-nuclear war occurring somewhere in the world.[49] This fact, plus the likelihood that armed third parties will play one superpower off against the other, virtually assures a feedback from horizontal to vertical proliferation and *vice versa*. Horizontal proliferation is especially destabilizing, while bringing stable third parties into one or the other of the alliances headed by the superpowers may increase stability.[50]

In order to investigate the stability issue, it is necessary to begin with a relatively formal statement of the determinants of a nation's decision to add to its arms stockpile. This is no easy task. Nevertheless, there is some agreement on where to start. The most thorough and influential attempt to present a model of arms races was carried out over a thirty year period by the British mathematician, Lewis Richardson.[51] Richardson hypothesized that the time rate of change of a nation's armaments depends positively on its rival's armaments and negatively on the level of its own armaments, with a constant term whose size depends on the nation's aggression or "grievance". Similarly, the time rate of change in the rival's armaments depends on the same set of factors, so that mathematically we have, in the simplest case of two nations, two differential equations which must be solved simultaneously.[52]

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[49] I deal *infra* with the impact of the horizontal proliferation of nuclear weapons on the probability of war.

[50] See Siljak, *Competitive Analysis of the Arms Race* (1976) 5 Annals Econ. and Social Measurement 283. As noted *supra*, the heavy costs associated with "vertical" proliferation create a budgetary incentive to make foreign arms sales — *i.e.*, for the "horizontal" proliferation of arms.

[51] See L. Richardson, *Arms and Insecurity* [:] *A Mathematical Study of the Causes and Origins of War* (1960).

[52] Formally, Richardson's theory is presented in terms of two linear differential equations expressing the factors that determine the time rate of change $\frac{dA}{dt}$ and $\frac{dS}{dt}$ in the armaments of two nations, A and B:

$$\frac{dA}{dt} = g + aS - bA \qquad \frac{dS}{dt} = h + cA - eS$$

We can denote A and S as measures of American and Soviet military or strategic strength, respectively; a, b, c, e, g, and h are all positive constants, where g and h reflect the degree of "grievance" or "hostility" between the two sides. The negative sign in front of the bA and eS terms is based on the assumption that the greater the size of a country's own armaments stock the less it will feel it necessary or desirable to increase that stock. As Richardson put it, *ibid.*, 15, the negative sign reflects the "fatigue and expense of keeping up defenses". Thus, the bA and eS terms have an economic interpretation: the resource limits upon increased arms procurement.

Richardson tested his model using data on the defence expenditures of belligerents in the years preceding the outbreak of a number of European wars, including the two World Wars. Richardson interpreted his results to support, at least moderately, his basic hypothesis, and contended that a science of arms races was not only possible, but necessary, if war were to be averted in the future. Since Richardson's work appeared, there have been many attempts to refine his model,[53] and a few attempts to test it with data from the current nuclear arms race.[54]

If arming nations behaved in the manner described by the Richardson model, it would be possible to specify the conditions under which the arms race would be "stable" in the sense that armament stockpiles would tend to an equilibrium.[55] In fact, it turns out that the conditions required for stability have significant economic content. Richardson-type arms races are potentially stable because of the existence of what he termed the cost or "fatigue" constraint. This is contained in Richardson's specification that the *rate of change* of a nation's own armaments is related negatively to the *level* of its *own* armaments, and that the larger one's armies, the greater the resources required to maintain them. Now, if the response coefficients of each of the rivals is such that the drag posed by cost or fatigue outweighs the stimulus from the rival's level of armaments, then it can be shown mathematically that a stable equilibrium exists.[56]

There is a catch, however, and this brings us to another economically meaningful factor affecting stability. The mathematically formulated Richardson model assumes implicitly that each nation's armaments are homogeneous, that is, qualitatively similar. Changes in armaments levels are

[53] See Caspary, *Richardson's Model of Arms Races: Description, Critique and an Alternate Model* (1967) 11 Int'l Stud. Q. 63; Brito, *A Dynamic Model of an Armaments Race* (1972) 13 Int'l Econ. Rev. 359; Intriligator, *Strategic Considerations in the Richardson Model of Arms Races* (1975) 83 J. Pol. Econ. 339; Intriligator & Brito, *Formal Models of Arms Races* (1976) 2 J. Peace Sci. 77; Gillespie, *et al.*, *An optimal Control Model of Arms Races* (1977) 71 Am. Pol. Sci. Rev. 226; Sorenson, *Modeling the Nuclear Arms Race: A Search for Bounded Stability* (1980) 4 J. Peace Sci. 169.

[54] See McGuire, *A Quantitative Study of the Strategic Arms Race in the Missile Age* (1977) 59 Rev. Econ. and Stat. 328.

[55] Here equilibrium means a "position of rest". Stability means that a small move away from equilibrium will produce a move back to equilibrium. Incidentally, a stable arms race does not mean that war will not break out, and an unstable arms race, in which armaments stockpiles grow explosively, does not *necessarily* imply that the end result is war. Wars require some "flash point" as well as the existence of armaments. It is perhaps unnecessary to remind the reader that the economic consequence of arms races are nothing by comparison with the economic consequences of a major war.

[56] See Sorenson, *supra*, note 53.

changes in quantities, not qualities.[57] Now the quantitative-qualitative distinction suggests a well-known economic parallel: the differential tendency to equilibrium of homogeneous and differential oligopoly. The argument is as follows. When two, or a very few, rival profit-maximizing firms producing a *homogeneous* product face each other in a market, it is not only possible to specify the equilibrium price and output levels, given demand and cost conditions, but it is likely that the firms will adjust their prices and outputs to these equilibrium levels, given normal specifications on their reaction functions. However, if one introduces product differences, innovation or technological change into the picture, the stability of market equilibrium is eroded, and it is even questionable whether an equilibrium exists. The economic analogy implies that qualitative changes in the arms race, perhaps reflected in technological breakthroughs, will tend to be destabilizing. Qualitative changes pose real threats to arms race stability by producing sudden alterations in the rate of arms build-up, by increasing uncertainty about the rival's military capacity and by increasing the range of military choices. For instance, "first strike" may suddenly modify a strategy of "massive retaliation". It is factors such as these which so disturb many knowledgeable observers of the current arms race, and which probably account for the worldwide increase in concern that the arms race is now entering a new and more perilous phase.[58]

There are other reasons to question Richardson's model and to doubt whether the arms race is headed toward stable equilibrium.[59] The Richardson model is very mechanistic, ignoring learning behaviour, strategic considerations, preferences for international power, and the use of weapons as a

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[57] In Richardson's empirical work this assumption is reflected in the fact that he measured the arms race in terms of defence expenditures. McGuire, *supra*, note 54, uses missiles and warheads as his common unit. Sorensen, *ibid.*, shows that if differences between the accuracy of American and Soviet missiles are taken into account (a qualitative factor), U.S. strategic military strength exceeds that of the Soviets despite the fact that the U.S. has been outstripped in missile numbers and nuclear megatonnage.

[58] In response to the perceived strategic military power of the Soviet Union, the United States is developing a number of new weapon systems such as the MX, Trident II and cruise missiles, some of which are believed to give the U.S. a "first strike" capability. This poses the danger that the Soviet Union, fearing such a first strike, would react by itself striking first. While these conjectures are highly problematic, the mere thought should be enough to start a peace movement.

[59] But see McGuire, *supra*, note 54, who not only found some modest empirical support for the Richardson model, but who also concluded that the model did imply a stable equilibrium albeit *at substantially greater force levels than existed in the mid 1970s*. However, Desai & Blake, *Modelling the Ultimate Absurdity: A Comment on "A Quantitative Study of the Strategic Arms Race in the Missile Age"* (1981) 63 Rev. Econ. and Stat. 619, show that McGuire's data and an alternative model specification only produce stability in the *rate of growth* of armaments.

deterrent.[60] Moreover, the cost or fatigue factor may not be very important. For example, Gillespie *et al.* tested empirically a modified form of the Richardson model,[61] and found evidence that, instead of viewing the arms race in economically negative terms, the U.S.A. and the U.S.S.R. "perceive each other to arm primarily for economic reasons". Moreover, the Gillespie study suggests that neither country seems concerned about "vertical" arms proliferation. If true, we may infer that there is no chance that the "Prisoner's Dilemma" will be broken by an acute feeling of insecurity due to the rise in the total quantity of armaments in existence. Gillespie *et al* concluded that "the USA-USSR confrontation is one that lacks both stability and equilibrium and is leading toward continued increments in arms". However, on the brighter side, when the U.S.A. and U.S.S.R. are included as members of their respective alliances "the armaments race is both stable and equilibrium-seeking".[62]

Up to this point, we have focused on the stability of the arms race between the superpowers and their allies — what was termed earlier "vertical" proliferation. A gnawing problem is the "horizontal" proliferation of *nuclear* weapons. Does the increase in the number of nations with nuclear military capabilities increase the probability of nuclear war? One would think so, by drawing again on an analogy from industrial behaviour. It is believed widely by economists that the likelihood of price competition between firms increases as the number of rival firms rises from 2 to 5 to 10 and so on. The reason is that the larger the number of rivals, the more difficult it is for them to reach and to enforce an agreement among themselves — to collude or cooperate tacitly or explicitly. It is, of course, unclear whether the collusion analogy from economics is apt when, virtually by definition, arms race rivals have no intention of colluding. In fact, if they did collude — or cooperate — there would not be an arms race, certainly not one of such serious proportions as that in which we are now enmeshed.

In an interesting paper, Intriligator and Brito argue that, in certain instances, proliferation may reduce rather than increase the probability of

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[60] See Intriligator & Brito, *supra*, note 53. Richardson, *supra*, note 51, 12, had an interesting response however. After admitting that his "equations are merely a description of what people would do if they did not stop to think", he went on to say that nations "follow their traditions, which are fixtures, and their instincts, which are mechanical ... because they have not yet made a sufficiently strenuous intellectual and moral effort to control the situation". Although Richardson's view lacks the behavioural emphasis of modern social science, one wonders whether he is not pretty close to the mark.

[61] Modified to include an explicit goal or objective function: the achievement of a "balance of power". See Gillespie, *supra*, note 53.

[62] *Ibid.*, 244.

nuclear war.[63] Assuming that the new nuclear nations are responsible and that they acquire nuclear capabilities sufficient to deter a strike by one of the superpowers, then the probability of a *deliberate* initiation of war by one of the first two powers is reduced. The reasoning is that the post-war distribution of power is important to the initiating nation.[64] With additional nuclear nations, the initiator's relative postwar position — if it "survives" — is reduced. Its uncertainty about the reactions of the other nuclear nations is also increased, the larger the number of nuclear nations. This is so whether or not, in a conflict, the latter are belligerents or neutrals. But there is another side to the coin. While nuclear proliferation may reduce the chances of a calculated or "rational" attack, it also increases the probability of an accidental or "irrational" war. And, as the number of nuclear nations increases, the accidental-irrational factor plays an increasingly important role.

According to Intriligator and Brito, the major policy implication flowing from their analysis is that more attention should be paid to preventing accidental or irrational war than to non-proliferation *per se*. But one could argue the opposite, namely, that the best way to prevent accidents is to prevent proliferation. Again, an analogy can be drawn from economics. The best assurance against an outbreak of price competition in an industry with two, or very few, rivals who are avoiding a price-competitive attack on each other, is to promote high barriers to the entry of new firms into the industry. Nevertheless, even blocked entry is not sufficient to prevent an "irrational" outbreak of price competition between the established rivals. In addition to non-proliferation — of firms or weapons — cooperation seems necessary.[65]

However, another analogy from economics forces us to scrutinize the side effects of cooperation carefully. The literature on cartels, and on industries whose price and output-entry conditions are publicly regulated, suggests that limitation of price competition often stimulates non-price forms of competition.[66] Restricted by agreement or law from competing in one manner,

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[63] Intriligator and Brito note that the only time nuclear weapons were used was when only one nation had nuclear capabilities. See *Nuclear Proliferation and the Probability of Nuclear War* (1981) 37(2) Public Choice 247. Now that there are two nuclear superpowers, the probability of use is reduced because of a balance of nuclear terror caused by the ability to strike back.

[64] This reasoning assumes that there is something left to distribute after a war. An unfortunate characteristic of much of the theoretical literature on nuclear war is its failure to integrate explicitly what doctors and other scientists, knowledgeable about the effects of nuclear war, have had to say about life — or what's left of life — after a thermonuclear war. See Bates, *The Medical and Ecological Effects of Nuclear War* (1983) 28 McGill L.J. 716 and Wolfe, *Chemical and Biological Warfare: Medical Effects and Consequences* (1983) 28 McGill L.J. 732.

[65] While as consumers we generally lose from cooperation (collusion) among firms, as human beings we could gain from cooperation among the nuclear superpowers.

[66] A classic example was the United States airline industry prior to deregulation in 1978.

rivals find other means — and the necessary incentives — to compete. This analysis implies that even if participants in an arms race are prepared to agree on some issues, it is important to consider the side effects.

Some economists have argued, for example, that the SALT I agreement which produced limits on the *quantities* of certain strategic armaments and reduced somewhat the level of military spending, may have accelerated the *qualitative* arms race.[67] Given the bureaucratic nature of the military establishments in both the U.S. and the U.S.S.R., it would not be surprising if agreements to limit specific weapons resulted in a shift of effort and resources toward weapons systems not covered by the agreement, for instance, cruise missiles or increased accuracy of strategic nuclear weapons. Because the qualitative arms race can be more destabilizing than a quantitative one, there is a certain irony in the idea that the SALT I agreement, however well-intentioned, may have reduced, rather than increased, long term security. In any event, economic analysis suggests that regulating only one or some dimensions of competition can be welfare- or security-reducing. Moreover, defusing the arms race requires not only control over the "outputs" but altering of the incentive structure of the "inputs".

IV. Halting the Arms Race

The economic analysis employed in this paper suggests that there are powerful forces propelling the arms race, but that the economic consequences are not, on the whole, serious enough to do more than slow down somewhat the growth of military spending. As I see it, an objective evaluation of the economic issues suggests that if arguments for disarmament are to be persuasive, they will have to be built on something firmer than the economic effects of the arms race, at least those short of war.[68] However, economics does

[67] See, *e.g.*, Brito & Intriligator, *Strategic Arms Limitations Treaties and Innovations in Weapons Technology* (1981) 37(1) Public Choice 41; MacKay, *Strategic Arms Limitation Treaties and Innovations in Weapons Technology* [:] *A Comment* (1981) 37(1) Public Choice 61.

[68] Some readers will angrily, and perhaps justifiably, object that I have overlooked totally the economic impact of the arms race on the less developed countries [LDCs]. It is true, of course, that I have said almost nothing about the LDCs — space would not permit. However, unless one assumes that the resources that are currently being poured into the arms race would otherwise be diverted to aid the "Third World", it is not at all clear that the *economic* impact of the arms race has been so disturbing to LDCs — unless of course it has embroiled them in war. Incidentally, I suspect that the *political* consequences of the arms race are much more serious for the LDCs because a large portion of the arms acquired are used to maintain internal "order", which usually means existing autocrats. It is interesting to note that E. Benoit, *Defense and Economic Growth in Developing Countries* (1973) found — unexpectedly, he claimed — a

provide some powerful tools for analyzing the arms race, its intransigence, its lack of stability, and, as I will attempt to show in this final section of the paper, what will be required ultimately to put an end to the race.

What will terminate the arms race between the superpowers? Trust? Cooperation? I have already noted some problems with partial agreements. But even a comprehensive arms agreement, covering all aspects, present and future, of the arms race, although a highly desirable step in the right direction, would not be *sufficient* to ensure *enduring* arms limitation and peace. Why not? An economic analogy can explain why comprehensive agreements between rivals are not sufficient, or perhaps even necessary, to ensure peace. Again, we can call on the cartel literature for a simple explanation. Even the most full-blown cartel agreement, covering all conceivable aspects of competition between its members, can, and probably will, break down eventually unless its provisions are enforceable in law.[69] Moreover, the likelihood of breakdown increases with the number of members.

The implications of the cartel analogy for putting a *lasting* end to the arms race are clear. Something more than agreement — or even trust which can so easily turn to distrust — is needed. Eventually, limits on armaments and their use must be made *legally enforceable*. The legal imperative implies some form of "constitutional" agreements establishing broad rules on the development, deployment and use of arms. Enforceability implies a body — a

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positive correlation between defence burden and growth in developing countries. However, the work of at least one economist has called into question Benoit's findings. See Palme, *supra*, note 1, 21, fn. 15.

A quick scan of the data contained in Sivard, *supra*, note 7 seems to indicate a high rank correlation between military spending *per capita* and health and education spending *per capita*, in Third World countries. I suspect that as the real incomes of Third World countries rise, they will continue to buy more of both security (armaments) and social welfare. Given that so many of the LDCs are new nations whose borders often conflict with those delineated by ancient tribal custom, and given the quite normal desire to increase protection of "property" as its value rises, at least some of the demand by LDCs for armaments must be considered quite natural, even if it is undesirable from the standpoint of world stability. Of course, these statements are not intended to justify the transfer of arms to the Third World by the superpowers in an attempt to win or keep allies, nor can they explain or justify the appalling arms race going on in the Middle East.

[69] Of course, because of the antimonopoly and antitrust traditions of most western nations, they have not only refused to enforce cartel agreements, or other contracts in restraint of trade, but have, in many cases prosecuted such arrangements as criminal conspiracies. But this, of course, is beside the point. The real issue involves the behaviour of individual members of a group. For a theory of group behaviour and an explanation of why, left to themselves, self-interested individuals will not act to achieve common or group interests, see Olson, *supra*, note 41.

"police force" — to ensure compliance with those rules.[70] Reaching such a "constitutional" agreement is, no doubt, a tall order. And, no doubt, some readers will feel uncomfortable about any proposition that infringes on national sovereignty. Let me attempt, then, to place these difficult issues in a different light.

It is no coincidence, I believe, that military spending has grown enormously during a period of unparalleled economic growth.[71] As wealth increases, there is a tendency to spend more to defend and secure that wealth. In economic parlance, the income elasticity of military spending is greater than zero, although not necessarily greater than one.[72] This statement applies to individuals as well as to nations. However, in the case of individuals, certain institutions have evolved which allow them to economize on the resources required to protect themselves. These institutions include a police force and a court system which not only prosecutes offenders but enforces contracts and property rights. In fact, without a means of enforcing contracts and property rights, and a degree of internal order, national income and welfare would be much lower than it is today. In economic terms again, the roles played by the police force and court system make them "public goods". Once they are made available to one person they are available to all. Take them away, and the share of resources required to provide individual protection will rise dramatically.[73]

Let us push the analogy with individuals a little further. Economists like to think of individuals as "sovereign consumers". Yet these same individuals are expected to relinquish their "sovereignty" so far as appropriating property and settling disputes is concerned — at least those disputes for which mutual agreement among the parties involved is not possible. The same reasoning, it would seem, must apply to nations, if they are to economize on the resources needed for security and are to minimize the probability that defensive or protective weapons will be used in war.[74] It may not be easy to get national

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[70] Some economists, drawing on the "Coase theorem", might argue that, in principle, the rival parties should be able to reach through negotiations a mutually advantageous self-enforcing arms control agreement; that no "police force" is needed. See Coase, *The Problem of Social Cost* (1960) 3 J. Law and Econ. 1. However, in my view, the informational, transaction cost and distributional problems which often make the "Coase theorem" difficult to apply in practice, also plague its practical application to the arms race. Incidentally, a world police force would provide at least one "market" for the "munitions makers" and their sidekicks, the weapons technologists.

[71] This is not to say that all of the growth in military spending is related to economic growth.

[72] See *supra*, note 8.

[73] One only need think of feudal lords and their armies of vassals who in a period of national disintegration provided virtually the only means of protection — if not order.

[74] The issue is even more clear when an individual or nation is hostile and aggressive.

leaders to think as individuals, but it does seem that this will be necessary if a future arms limitation or disarmament agreement is not to become a cruel hoax on an unsuspecting humanity.

In concluding, it would be fair to say that in this paper more issues have been raised than questions answered. This result, however, is a common malady in economics. Yet, economic "science" does have some useful contribution to make to understanding the arms race. Its contribution may lie less in providing *economic* arguments against the arms race than in offering insights into why the race is run and in suggesting what institutional arrangements are required to bring the arms race under control.