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ARMS AND THE MAN
THE COSTS AND BENEFITS OF DEFENSE EXPENDITURE*

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ABSTRACT

The paper surveys the literature on the costs and benefits of defense expenditure with particular reference to developing countries. It uses this to provide a simple cost-benefit framework for assessing the opportunity costs of nuclear proliferation in the Third World.

Introduction

The sponsors of this conference asked me to write a paper on the opportunity costs of nuclear proliferation in the Third World. It is virtually impossible to write a paper on this based on available studies because of two insurmountable problems.

The first concerns the natural secrecy surrounding the nuclear programs of most Third World countries, including those -- China and India -- which have demonstrated a nuclear capability through nuclear explosions, and others who are known as recessed nuclear powers -- Israel, South Africa, Brazil, Pakistan -- with either existing material and technology to manufacture nuclear weapons. This makes it difficult to provide any hard estimates of the costs of nuclear proliferation. A problem that is compounded when the costs of different delivery systems (e.g., missile systems) has to be added to those of producing the bombs. If government budgets did provide a detailed breakdown of these costs in terms of the costs of capital outlays, and labor distinguished by skill levels then standard techniques of cost benefit analysis could be used to compute the real resource costs of the development and deployment of these weapons for particular countries (see Little-Mirrlees; Lal (1980)). No such accounts are available.

Equally problematic is the computation of the benefits from having nuclear weapons. The motives for acquiring these weapons encompass not only considerations of military security but also prestige (see Beaton). When the international pecking order as reflected for instance in the permanent membership of the Security Council is now also coterminous with the existing nuclear powers, other aspirants to a similar status (India and Brazil notably in the Third World) will not ignore this aspect of acquiring prestige despite all the preaching of the existing nuclear powers, for others to desist from acquiring these weapons -- preaching and pressures which they (e.g., India) will see as hypocritical. It is virtually impossible to put a "value" on such national prestige. Attempts through the revealed preferences of particular

countries, on what they are willing to spend in real resource costs to acquire it merely tell us how much particular countries (or more precisely their "elites") are willing to pay for this "non-economic" benefit. That it remains an important motive in international relations is testified by the continuing attempts by the UK and France to maintain independent nuclear deterrent capacities, even though the justifications for them died with the Cold War. It is because as the former UK Secretary of State Douglas Hurd put it, being a nuclear power and a member of the Security Council allows the UK "to punch beyond its weight" in the international arena. Whether the ordinary UK citizen, as opposed to the politicians and bureaucrats desirous of "eating at the top table", derive any utility from such "prestige" is questionable. But it would be rash to predict that these nuclear powers will be forced by their democratic political processes to give up these symbols of past "greatness".

Given the continuing and (as Lawrence Freedman has argued) essentially circular and inconclusive debate in the industrialized West about the strategic and tactical usefulness of nuclear weapons, the benefits in terms of military security provided by nuclear weapons are also problematic. For, despite the axiomatic abhorrence of nuclear weapons in many circles, the fact remains that despite their apocalyptic potential -- apart from the devastation of Hiroshima and Nagasaki by the U.S. -- nuclear weapons have not killed anyone since the end of the Second World War. Also as Freedman notes:

What we do know is that since 1945 Europe has been at peace. This underlines the point that nuclear deterrence maybe a viable policy even if it is not credible.
... The Emperor Deterrence may have no clothes, but he is still Emperor.
(p. 399)

Similarly, it is worth noting that after having fought three bloody wars between themselves till the early 1970s, there has been no such Indo-Pakistan conflict since the Indian "peaceful nuclear explosion" of 1974! Where even military experts and strategic thinkers are seriously divided about the usefulness of nuclear weapons, it would be folly for a mere economist to

tread.

For these reasons, I have decided to approach the task set me in a more indirect fashion. I first outline what the large literature on military expenditure and economic growth tells us. I then go on to discuss the sparser literature on the determinants of military spending across countries, concentrating on one in particular (by Beenstock) which provides an analytical framework which I believe is the right one to think about the costs and benefits of nuclear proliferation. This leads on in the final section to outlining the type of cost benefit analysis which someone with greater time and resources than those available to me should conduct to determine the true opportunity costs of nuclear proliferation for particular countries or regions.

I. Military Expenditure and Economic Growth

The debate on the effects of military expenditure and economic growth began with an influential study by Benoit (1973, 1978). On the basis of a relationship between military spending and the GDP growth rate of 44 developing countries, between 1950-65, and also the shorter period 1960-65, defense expenditure as a percentage of non-defense GDP was positively correlated with higher growth rates.

Benoit accepted that in developing countries which are chronically short of investible resources increased defense expenditure would crowd out productive investment and output in the civilian sector. He estimated that a rise in defense spending by 1% of GDP would reduce the civilian growth rate by 0.25%.

But offsetting this negative effect, in his view, were a number of indirect benefits to the civilian economy from increased defense spending. These included (a) the imparting of technical skills by the military which could subsequently be utilized by ex-soldiers in the civilian economy; (b) the construction of basic infrastructure such as roads which would also have external benefits for the civilian economy; (c) a whole host of "spinoff" effects

including the role of military R and D in fostering civilian technological progress, and in the modernization of the attitudes and ideas of traditional custom-bound societies; (d) the Keynesian effects of a fuller utilization of domestic resources from an expansionary monetary policy used to finance increased defense expenditure, thus leading to "forced savings". These accounted in his view for the strong positive association between defense spending and growth.

Benoit's conclusions have been fiercely contested, and largely overturned. Without attempting to provide any complete survey of the subsequent literature, a few points are worth noting from the subsequent debate as they are relevant for the cost-benefit framework proposed in the final section of this paper. It is best to set these out in terms of the four broad positive "external effects" of defense spending emphasized by Benoit.

On the effects on education of defense spending the subsequent studies have found both a negative relationship between the share of military expenditure and that of public education expenditure in GNP in 50 developing countries between 1965-73 (Deger (1981)), as well as a positive relationship in 10 Latin American countries, no relationship in 7 and only one negative case for 18 Latin American countries between 1948-79 (Verner (1983)).¹ Attempts have also been made to relate broader social development indicators and defense spending. They, again, find a negative relationship (see e.g., Nabe). However, the link between military expenditure crowding out public social expenditure, which in turn damages growth, is tenuous. The efficiency of public social expenditure can be disputed, as there is evidence that when it declines it is replaced by more effective and efficient private expenditure often in the form of inter-family transfers (see Lal (1995), Lal-Myint (1996)). Nothing in my view, therefore, can be concluded on the basis of the existing studies about the

¹ The Segdet study is based on a cross-section of the countries, whilst Verner is a time series analysis of the respective countries.

effects of military spending on human capital development and thence growth.

The role of the military in the construction of infrastructure , especially roads, must be a positive benefit to the civilian economy, as has been obvious since the construction of the Roman roads which knit Europe. Though in modern times despite the efforts of transport economists, the growth benefits are hard to quantify.

On the spin off effects of military R&D on the civilian economy, though historians (e.g., Braudel) have noted the link between technological advances related to war making as "the midwife of modern times, hastening the establishment of capitalist systems" (p. 57),² Whynes is surely right in emphasizing that this is of little relevance to current developing countries who usually buy their technology, as it is rarely appropriate if it needs to be engineered locally. This is in contrast with developed countries on the technological frontier. Whilst, Deger and Sen's econometric study of India found no evidence to support such a spin-off from defense to development. Furthermore, Gupta in a tart comment on the Indian defence research establishment's achievements to date notes that it would be rash to accept official claims about the viability of its missile development program by "ignoring the consistent failure of the Indian defense research establishment to put into production any significant weapons systems that it develops" (p. 44).

But Deger (1986) does find from her econometric exercises that, "the military establishments may have a modernizing role in an LDC economy and can contribute to a change in structure" (p. 193).³ However, this positive effect is more than offset by the harmful effect on savings, so the net effect on growth is negative.

² Also see Keegan's superb history of war from the time man came down from the trees till today.

³ But this does not imply that military or authoritarian regimes are necessarily good for promoting development. See Berg and Berg for a detailed survey of the evidence.

Finally, the supposed beneficial Keynesian effects from defense expenditure are misconceived. It is now generally recognized that except for the exceptional circumstances which generated the Great Depression, most unemployment in developed countries is either cyclical -- associated with the little understood processes of the trade cycle -- or due to classical reasons, when a rigid real wage is too high to maintain full employment. In developing countries where any unemployment -- or more often underemployment -- is due not to a deficiency of demand but to the lack of an adequate supply of the cooperant factors of production, the positive Keynesian effects of increases in defense expenditure are even more dubious (see e.g., Lal (1989)). Benoit based his Keynesian argument on the supposed correlation of an increase in Indian defense expenditure after the Chinese invasion in 1963-64, the rise in inflation which resulted, and the subsequent two year rise in the economy's growth rate. But as Faini et al show, this conclusion is not valid for the longer time series they consider -- though for India there does seem to be some complementarity between defense expenditure and the domestic investment to GDP ratio. Whilst a study of Morocco (Fontanel) found "that the defense burden depressed growth through the inflationary process it generated" (Deger (1986), p. 185). In fact there is no longer any basis for the belief that inflation aids growth (see Lal and Myint). Moreover, as Deger (1986) shows, defense expenditure does significantly depress the savings-income ratio, largely because it displaces publicly funded social expenditures, which are then funded through private channels (ibid, p. 186).

Maizels and Nissanke have produced a useful summary table of various studies of the quantitative effects of defence spending on growth (Table 1). As they conclude:

It seems clear that the impact of military expenditure on economic growth varies widely among the three regions. ... No doubt the same is true as between different countries in the same region, and even in individual countries over time. For developing countries as a group, the estimates also vary widely in magnitude, a resultant in part of differences in model specification, country coverage and data

sources. Nonetheless, there seems little doubt that, taken together, these studies negate the Benoit thesis and that, for probably the majority of developing countries, policy choices involving military versus civilian expenditures are essentially zero-sum, or even negative-sum, games in terms of overall economic growth. (p. 1127)

In a sense this conclusion is hardly surprising. For what these studies have been imperfectly trying to identify is the opportunity cost of defense expenditure, and this must be positive. Though its magnitude will obviously differ from country to country. But this is only one blade of Marshall's famous scissors (the supply curve). We also need to know something about the other blade -- the demand curve. For it would be foolish to suggest that because of its positive resource cost there should be no defence expenditure. For after all defense along with the maintenance of law and order (expenditures on which in countries suffering civil wars often merge with defense expenditures -- see below) is a classical public good. It would be absurd to suggest that, as law or the police absorb real resources which inevitably will reduce those available for investment, growth will be lower than it would otherwise have been. For this is a non sequitur. As without these classical public goods, there would be a Hobbesian state of nature, in which a country's output and growth rate could be much lower -- as private agents sought to protect themselves and their property against the depredations of their neighbors -- pace Somalia! The same is true of defense expenditure. So we need to examine the demand for defense expenditure.

II. The Determinants of Military Expenditure

The simplest way for an economist to understand the demand for defense expenditure is to look upon it as an insurance policy. Beenstock makes this precise. His and Maizel and Nissanke's study are the two major ones for developing countries dealing with this question. We first briefly outline the conclusions of the latter, and then consider the Beenstock study in the next section, which provides the basis for an explicit extension to the costs and benefits

of nuclear proliferation.

Governments spend money on defense for three main reasons according to Maizel and Nissanke (MN). The first is to quell internal rebellions. As Table 2 shows most of the conflicts more recently have involved civil wars.⁴ The second reason "is political tension with, or potential aggression from, neighboring countries. The Arab\Israeli and Iran\Iraq conflicts, and the political tensions between India and Pakistan, and Greece and Turkey, are good examples of such concern" (MN, p. 1129). The third reason which was particularly important during the Cold war was "the degree of involvement in either of the global power blocs" (*ibid*). In addition they also emphasize a number of political and economic variables (degree of internal repression, military dictatorship, level of economic development, size of the government budget, etc.) They estimated cross section regressions for 83 developing countries for 1978-80, with separate regressions for the three regions of Africa, Asia and Latin America for the determinants of the rate of military expenditure in GDP. The results of their regional analysis are summarized in Table 3. They concluded:

The differences among developing countries in the relative size of their military burdens thus appear to reflect a complex of factors -- domestic, regional and global -- which are not easy to disentangle, and which no doubt vary in emphasis from country to country. (p. 1137)

Much more satisfactory is Beenstock's attempt to explain the determinants of military spending in terms of a model where "military spending is incurred to promote security and may be regarded as the insurance premium on a policy that is designed to deter war and to limit the "deductible" in the event that war breaks out. The analogy with insurance is complete" (p. 637). He estimated a cross section regression of 137 countries (including

⁴The study by Grobar and Gnanaselvam provides some estimates of the recent -and continuing-Sri Lankan civil war. They find that the opportunity cost of "the war during 1983-88 was about \$1.5 billion, an amount equal to over 20% of 1988 GDP. Furthermore, the estimated opportunity cost is predicted to increase dramatically (to the range of \$7-\$15 billion) in the event that war continues through 1995" (p. 404).

developed ones) for 1984, incorporating the various variables which emerge as relevant in the reduced form of his model. He finds:

- (i) Defense spending is strictly proportionate to income and does not depend on population.
- (ii) Countries undergoing active internal conflicts typically spend 48% more on defense.
- (iii) Countries undergoing active external conflict typically spend more than four times more on defense.
- (iv) Countries experiencing a latent external threat spend more than five times more on defense.
- (v) NATO countries spend on average 40% more on defense while the WP countries spend 115% more than countries that are not members of NATO or the Warsaw Pact.
- (vi) ...military aid boosts defense spending. (p. 643)

Beenstock provides some indicators for determining country specific norms based on the predicted value from his international regression line for defense spending. He finds for 1984, that:

If countries are ranked by their defense spending as a percentage of GNP it turns out that Iceland is the smallest and Qatar the largest. These countries retain their positions even after normalizing with respect to the international regression line. ... Other countries, however, change their position quite radically. For example Egypt ranked 124 (out of 137) in absolute terms, is only ranked 29 in relative terms, while Uruguay, ranked 63 in absolute terms, is ranked 91 in relative terms. Thus Egypt "underspends" on defense while Uruguay "overspends". Other perhaps interesting cases are the USA (absolute 106, relative 110), the former Soviet Union (absolute 125, relative 22), Pakistan (absolute 101, relative 16), South Korea (absolute 99, relative 14), and Kuwait (absolute 98, relative 121). (p. 646)

Table 4 gives the ratios of military expenditure to GNP for countries in the Middle East, East Asia and South Asia. By determining whether these ratios represent positive or negative deviations from their country specific "norms" derived from Beenstock's regression, some crude empirical content could be given to the question of whether a particular country is "overspending" or "underspending" on defense.

III. A Framework for Analyzing the Costs-Benefits of Nuclear Weapons

The Beenstock model can moreover be extended to examine the question of the costs and benefits of nuclear weapons. Though for the reasons set out in the introduction actual quantification maybe well nigh impossible.

Having seen that the question of the appropriate level of defense expenditure for a particular country is likely to be more complicated than a simple computation of the losses in foregone growth and output as a result of the necessary diversion of resources from civilian issues, the further question of the appropriate composition of this aggregate expenditure will raise even more difficult and country specific issues. But the "insurance" analogy of Beenstock's model allows some illuminating comments on the relevant choices in the development and deployment of nuclear weapons.

The basic question is whether nuclear weapons offer the required degree of security with a lower insurance premium and a lower deductible than conventional weapons?

First, it needs to be noted that the security nuclear weapons provide relates to external conflicts. They are hardly relevant for the more prevalent internal conflicts (see Table 2). For, if a government is seeking to pacify or regain control of parts of its own territory, it would hardly make sense for it to threaten to obliterate that territory in a nuclear holocaust. (I of course rule out those cases -- which regrettably cannot be considered as purely theoretical -- where the government seeks to eliminate some regionally confined section of its population). So what we need to consider is the composition of that part of defense expenditure which seeks to meet external threats.

Analytically, it is simplest to think of what economists call the "expected utility" -- denoted by E -- the government derives in dealing with the external threat in two alternative cases: one when it only has conventional weapons (c), the other when it has nuclear weapons (n). Though of course in the latter case in principle the nuclear weapons need not be a substitute but addition to conventional weapons.

Attached to these alternative cases or "projects" are the respective probabilities of war occurring. It being assumed that the function of these alternative forms of defense expenditure is to deter a foreign aggressor and hence to lower the probability of war denoted by " p ",

with the superscripts c , or n , referring to the conventional and nuclear alternatives.

If a war does occur there will be a loss (L) including the loss of men, material and also possibly political and territorial losses (gains) if the country loses (wins). These losses are likely to differ in the two alternative cases, and in the nuclear case depending upon whether the potential foreign adversary does or does not possess nuclear weapons. As my subject is nuclear proliferation, and to simplify the argument, I will assume for the two polar cases that in one neither party to a possible war possesses nuclear weapons, and in the other that both do.

The costs of the defense expenditure on the two alternative systems will also differ. These will consist of various physical inputs of labor (differentiated by skill), capital goods and land. They need to be priced at their true opportunity costs (by what economists call "shadow prices"), which could be different for well known reasons from market prices. The simplest and most general method of shadow pricing which can readily take account of various distortions in the working of the domestic price mechanism in developing countries (including problems such as un or underemployment, shortage of savings, government budget constraints) are the rules developed by Little-Mirrlees. (For an exposition and derivation of shadow prices for India see Lal (1980)). Valuing each physical input m^i at its shadow price p^i and aggregating will yield the true social cost of the two alternative defense programs denoted by M^C for the conventional and M^N for the nuclear alternatives.

If the level of national income is denoted by Y , and the population by N , then the level of per capita welfare (W) that will prevail in either the nuclear or conventional case will depend upon whether there is war ($W1$) or there is peace ($W2$). Thus:

$$W1 = [Y - L^j - M^i]/N$$

$$W2 = [Y - M^i]/N \tag{1}$$

where $i, j = n, c$.

Whilst the expected utility (E) from the two projects will then just be these two outcomes ($W1, W2$) weighted by their respective probabilities p , so that:

$$E^k = p^k(W1) + (1-p^k)(W2) \quad (2)$$

where $k = n, c$.

We can now readily derive an expression for the difference in expected utility from the nuclear over the conventional option by using (1) and (2) to obtain:⁵

$$E^n - E^c = [(M^c - M^n) + (p^c \cdot L^c - p^n \cdot L^n)]/N \quad (3)$$

This expression succinctly summarizes the relative costs and benefits of the two options. The first expression in brackets is the difference in the costs at shadow prices of the physical inputs of the two alternative "projects". As the costs of the nuclear alternative are likely to be greater than that of the conventional one, we would expect this expression to be negative. The net benefits of the nuclear alternative then turn essentially upon whether or not the second expression within brackets which shows the relative expected "losses" from the conventional and nuclear options is positive enough to outweigh the negative expression for relative costs. Ceteris paribus, the lower are the expected losses from the nuclear option, the more likely it is to produce net benefits. These in turn will depend on the probability of war if a country has nuclear weapons. This in turn will reflect the deterrent effect of these weapons. If one subscribes to the deterrence provided by mutual assured destruction, this probability essentially diminishes to zero. Then irrespective of the loss L^n which could be horrendously large, $p^n \cdot L^n$ will approach zero. But if with Greenpeace you believe that the loss from a nuclear war is infinite, and that there is always a finite possibility that nuclear

⁵This can be readily derived from:

$$E^n = [p^n \cdot (Y - L^n - M^n) + (1 - p^n)(Y - M^n)]/N$$

$$E^c = [p^c \cdot (Y - L^c - M^c) + (1 - p^c)(Y - M^c)]/N$$

powers will go to war, then as with Pascal's wager, the expected loss from possessing nuclear weapons will approach infinity!

There is unfortunately no rational basis for assessing these probabilities, and hence for providing any definitive quantification of expression (3), even if we could estimate the relative costs of the nuclear option at shadow prices. But for what it is worth, for one of the currently recessed nuclear powers -- India -- it has been estimated by "retired Air Commodore Jasjit Singh, who heads the Institute of Defence Studies and Analysis ... that India needs to allocate a minimum of 3% of its GDP to ensure credible conventional defence, if geopolitical threats remain unchanged in the next decade. A 2.5% GDP spending would be adequate if India were to deploy its nuclear capability" (Gupta, p. 39). But this comparison rests on assuming that the past costs of developing nuclear weapons and delivery systems are sunk costs, which is correct for countries which have already invested in creating a nuclear capability. For those seeking to acquire it, the capital costs of making the bomb can be considerable (see Beaton). Whether these are worth undertaking must ultimately depend, as expression 3 shows, upon the relative probabilities of war and hence of deterrence under the two alternatives.

I know of no rational way to judge these probabilities. In conclusion, however, I might cite a piece of casual empiricism. When I was a student at Oxford in the early 1960s, a board game called Diplomacy was very popular amongst us. This was based on the map of Europe before the First World War, with players assigned particular countries and their armed forces reflecting the relative strengths of the countries at that time. It was amazing how often the game ended up repeating the pattern of alliances etc., leading to the First World War. Some-time later this board game was overtaken by a new one invented in America, which was based on the Middle East situation in the 1960s. This version also provided nuclear as well as conventional arms to the various players. No matter how often we played the game with different permutations of players and countries, using the rational tactics for a repeated game

of chicken, or the tit for tat strategy of the prisoners dilemma, or no strategy at all, within about half an hour the game usually ended with nuclear bombs having been unleashed on all the major population centers of the Middle East! It is this rather than any rational cost-benefit analysis of nuclear proliferation which at least would give me cause to pause.

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Table 1. Regression coefficients for effect of military expenditure on GDP growth rates of developing countries

	Period	Independent variable*	Africa	Asia†	Latin America‡	Total
Deger (1981)§	1965-73	<i>m</i>	—	—	—	-1.59
Deger and Sen (1983)§	1965-73	<i>m</i>	—	—	—	-0.16
Deger and Smith (1983)§	1965-73	<i>m</i>	-0.09 to -0.39¶	—	0.08 to -0.125¶	-0.20
Lim (1983)	1965-73	<i>m</i> **	-0.10¶	0.17¶†† -0.13¶§§	-0.14‡‡	-0.05¶ -0.001§§‡‡
Frederiksen and Looney (1983)	1950-65	<i>m</i>	—	—	—	0.22 ¶¶ -1.22***¶¶
Faini, Annez and Taylor (1983)	1952-70	Δm	-0.04†††	-0.005¶	-0.02†††	-0.015††† -0.06 to 0.10§
Present authors§	1973-80	<i>m</i> Δm	-0.14‡‡ n.s.	-0.09‡‡ 1.15*	n.s. -3.22‡‡	n.s. -0.034‡‡

**m* = military expenditure as percentage of GDP; Δm = change in *m*.

†Including Middle East and Pacific.

‡Including Caribbean.

§Coefficients include indirect effects calculated from two- or three-stage models.

||Denotes significance not stated.

¶Not significantly different from zero.

**Variables in logs.

††Excluding Middle East.

‡‡Denotes significance at the 5% level.

§§Middle East and Southern Europe.

|||“Resource abundant” countries.

¶¶Denotes significance at the 1% level.

***“Resource constrained” countries.

†††Denotes coefficients with *t*-values exceeding 1.5 (approximately equivalent to significance at the 10% level).

n.s. denotes not statistically significant.

Source: Maizels and Nissanke, Table 1, p. 1128.

Table Two

WARS FROM 1900 THROUGH 1988

Decade ^{b/}	Number of Wars						Estimated			Deaths as a Percentage of World Population
	Industrial Countries ^{a/}			Developing Countries			Number of Deaths (In thousands)			
	Civil Wars	Intl. Wars	Total	Civil Wars	Intl. Wars	Total	Civil Wars	Intl. Wars	Total	
1900-09	3	4	7	4	4	14	279	161	440	0.03
1910-19	2	4	6	7	7	13	766	8,872	9,637	0.60
1920-29	1	2	7	2	2	10	111	83	193	0.01
1930-39	2	6	3	6	6	12	861	1,650	2,510	0.12
1940-49	1	3	10	7	7	17	1,204	15,723	16,926	0.74
1950-59	0	3	19	5	5	24	387	2,025	2,412	0.09
1960-69	3	3	24	7	7	31	2,386	664	3,049	0.09
1970-79	1	2	35	8	8	43	3,924	712	4,636	0.12
1980-89	0	1	28	4	4	38	3,188	631	3,818	0.08

^a The group of Industrialized Countries consists of the OECD countries (excluding Greece, Portugal, and Turkey), and the USSR.

^b When wars cross over decades, rough estimates were made on: (a) how the total number of wars were distributed - wars were counted for every decade in which they occurred; (b) how the casualties were distributed - the average number of deaths per year was calculated for the duration of the war, and then multiplied by the number of years in each decade that the war occurred.

Source: J.M. Hamilton: "War and Development," World Bank, mimeo, September 1990.

Table 3 Regression coefficients for military expenditure ratio to GDP: Regional analysis

	Africa			Asia*		Latin America†	
	Eq.1	Eq.2	Eq.3	Eq.4	Eq.5	Eq.6	Eq.7‡
1. <i>Military activity</i>							
a. Inter-State war or civil war	2.43 (1.63)	1.45 (1.13)	n.s.	1.13 (0.68)	4.30§ (2.81)	1.68 (2.47)	0.95 (1.40)
b. Military government/use of violence	n.s.	0.99§ (3.26)	0.75 (1.47)	0.71 (1.17)	0.59 (1.25)	n.s.	n.s.
2. <i>Internal economic linkage</i>							
a. GDP per capita	1.50 (2.47)	n.s.	n.s.	n.s.	n.s.	-0.37 (-1.02)	n.s.
b. GDP growth rate	n.s.	n.s.	0.47 (2.25)	0.40¶ (1.83)	n.s.	n.s.	-0.18¶ (-1.77)
c. Central government expenditure as ratio of GDP	—	0.22§ (5.45)	0.23§ (4.03)	0.29§ (5.58)	0.23§ (4.79)	n.s.	n.s.
d. Total population	0.38 (0.90)	0.80 (2.45)	-0.38 (-0.92)	-0.50 (-1.15)	n.s.	n.s.	-0.23 (-1.34)
3. <i>External economic linkage</i>							
a. Growth of foreign exchange availability	n.s.	n.s.	—	—	3.84§ (2.79)	n.s.	n.s.
b. Foreign direct investment							
(i) Change in foreign capital stock	n.s.	n.s.	n.s.	n.s.	n.s.	1.20 (1.63)	1.97 (2.58)
(ii) Foreign investor concentration	n.s.	n.s.	-1.66 (-2.55)	-1.41¶ (-1.97)	-0.75 (-0.96)	n.s.	0.53 (1.56)
c. Change in ratio of aid to GDP	2.03 (2.58)	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
4. <i>External political/ strategic alliance</i>							
Arms supplier concentration	0.51 (1.45)	n.s.	0.73 (1.37)	0.91 (1.59)	1.51§ (2.86)	n.s.	n.s.
5. <i>Regional factor</i>							
Middle East	—	—	3.16¶ (1.79)	—	—	—	—
R^2	0.167	0.471	0.815	0.784	0.875	0.197	0.294
D-W	1.97	1.64	2.24	2.23	1.57	2.51	2.29
n	38	38	24	24	19	23	20

*Including the Middle East and Pacific.

†Including the Caribbean.

‡Excluding Chile, Costa Rica and Panama.

§Denotes significance at the 1% level.

||Denotes significance at the 5% level.

¶Denotes significance at the 10% level.

Figures in brackets are *t*-values.

Source: Maizels and Nissanke, Table 4, p. 1135.

Table 4(a)

Percent Ratio of Military Expenditure to GNP Middle East									
Year	Egypt	Iran	Iraq	Israel	Kuwait	Oman	Saudi Arabia	Syria	U.A.E.
81	9.1	6.8	25.4	22.9	2.8	23.0	13.1	14.6	6.0
82	15.2	6.4	44.7	20.7	4.2	24.0	17.0	15.8	6.0
83	13.4	6.3	39.1	22.2	5.4	27.6	22.0	21.8	6.7
84	13.7	7.2	44.3	24.5	5.3	27.0	19.7	22.7	6.7
85	12.8	7.7	37.9	20.3	5.7	24.4	22.7	21.8	6.7
86	11.7	10.7	47.4	17.3	5.2	27.0	20.9	18.0	7.0
87	11.2	8.8	43.1	14.0	4.8	21.4	19.4	11.7	6.4
88	8.6	8.2	40.2	12.7	4.9	20.6	15.8	12.5	6.3
89	4.9	6.4	32.0	12.5	6.1	21.1	15.9	14.3	5.5
90	4.7	6.0	48.0	12.6	53.1	18.1	20.6	14.6	7.3
91	4.1	5.0	74.9	8.0	101.8	16.0	29.1	na	13.6
92	4.2	2.9	na	10.0	80.9	17.7	27.2	na	5.7
93	4.3	3.5	na	9.1	13.3	21.5	15.8	na	4.8

Source: Derived from: World Military and Social Expenditures 1991 by R.L. Siraed
World Military Expenditures and Arms Transfers (1991-92 and 1993-94),
 U.S. Arms Control and Disarmament Agency.

Table 4(b)

Percent Ratio of Military Expenditure to GNP East Asia				
Year	China	Japan	North Korea	South Korea
81	8.2	0.9	20.0	6.2
82	7.6	1.0	20.0	6.1
83	6.8	1.0	20.0	5.5
84	5.8	1.0	20.0	5.1
85	5.1	1.0	20.0	5.0
86	4.6	1.0	20.0	4.7
87	4.2	1.0	20.0	4.2
88	3.8	1.0	20.0	4.0
89	3.6	1.0	20.0	4.1
90	3.7	1.0	20.0	4.2
91	3.3	1.0	20.0	3.7
92	3.0	1.0	25.0	3.7
93	2.7	1.0	na	3.6

Table 4(c)

Percent Ratio of Military Expenditure to GNP

South Asia

Year	Bangladesh	India	Pakistan	Sri Lanka
81	1.5	3.3	5.5	1.3
82	1.7	3.5	5.8	1.2
83	2.1	3.5	6.2	1.5
84	1.9	3.6	5.9	1.6
85	1.7	3.5	6.3	2.9
86	1.7	3.6	6.5	2.4
87	1.8	3.8	7.4	3.1
88	1.7	3.4	6.9	4.6
89	1.6	3.0	6.4	4.3
90	1.5	3.0	6.9	4.8
91	1.4	2.7	6.1	4.8
92	1.3	3.1	6.2	3.8
93	1.5	3.3	6.4	4.8