Benoit Revisited:

DEFENSE SPENDING AND ECONOMIC GROWTH IN LDCs

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In the early 1970s, Emile Benoit shocked development economists by presenting *positive* cross-country correlations between military expenditure rates and economic growth rates in less developed countries (LDCs). This article reviews the long debate that has followed. While the studies surveyed here differ widely in method and focus, the empirical results point to similar conclusions. First, efforts at re-estimating Benoit's correlation coefficients for different samples and different time periods all fail to reproduce Benoit's results. Second, while some studies uncover evidence of positive effects of military spending through human capital formation and technological "spin-off" effects, models that allow military spending to affect growth through multiple channels find that, while military spending may stimulate growth through some channels, it retards it through others, and the net effect is negative. The most important negative effect is that higher military spending reduces national saving rates, thereby reducing rates of capital accumulation.

The existence of positive effects of military spending on economic growth, as conjectured by Benoit, still cannot be ruled out. However, the recent econometric evidence points to the conclusion that these positive effects, if they exist, are small relative to the negative effects, and that, overall, military spending has a weak but adverse impact on economic growth in developing countries.

> . . . *Guns kill in more ways than one.*
>
> —*Whynes (1979: 152)*

Emile Benoit shocked development economists when he presented *positive* cross-country correlations between military expenditures and

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economic growth rates in LDCs (Benoit, 1972, 1973, 1978). Skeptics abound, and Benoit's research has been reanalyzed both conceptually and statistically. What is gradually emerging is a consensus that Benoit's findings were aberrant. In reviewing this debate, we suggest that cross-country, macro models generated in the last decade and a half can never fully resolve the issue—country-specific and micro-oriented studies are now needed.

There are four strands to Benoit's argument. First, while Benoit's work has become notorious for its correlations, it begins with a review of the potentially adverse effects that defense expenditures might impose on economic growth. Implicit in this review is a theoretical model of the LDC growth process. This model is explicitly constructed here, and it is shown that Benoit's conclusion—that a one-percentage-point rise in military spending will reduce the GDP growth rate by 0.25 percentage points—is clearly an upper-bound estimate. Second, Benoit then goes on to discuss the potentially favorable growth effects of defense spending. Here, he provides no more than a list—no model, not even implicit, and no numbers, not even illustrative. Most of the interesting tests of Benoit's work that we will later discuss consist essentially of formalizing the workings of these potentially favorable effects. Third, the concepts of growth and defense to be utilized in the empirical work are Benoit's next concern. The conceptualization is inevitably weak: Since Benoit's hypotheses about the possibly favorable influences of military spending are several and vague, it is not clear how to test them. Others have criticized Benoit's definition of external aid. Here, we show that the concept of the "defense burden" is also tricky; it can be captured quantitatively in a number of ways, and the various possible numerical measures may well move in different directions in response to outside forces. Finally, Benoit presents correlations between GDP growth rates and military spending. The correlations are, of course, significantly positive.

The correlations and simple single-equation regressions of other researchers reduce one's confidence in Benoit's positive correlation. But the expected (by most people) significant negative correlation does not emerge. More complex, structural models are clearly needed and several have appeared. While the models are still far from ideal, while the research is still unrelentingly macro-oriented, and while unanimity does not emerge from the cross-country and time-series econometrics, almost

of Michigan for a program of research on economic issues of national defense. We have benefited greatly from the detailed and insightful criticism of the (anonymous) referees.

all of this work points to a net negative effect of military spending on the rate of real economic growth. Military spending reduces saving and investment, and thereby reduces growth.[1]

BENOIT'S HYPOTHESES, DEFINITIONS, AND EVIDENCE

THE ADVERSE GROWTH EFFECTS OF DEFENSE

Benoit suggests three ways in which defense spending can retard growth. Although the numerical estimates of these adverse effects appear arbitrary, Benoit's thinking is actually quite consistent with a basic variation of a Harrod-Domar model of growth. Benoit's picture of LDC growth is formed from capital, capital-output ratios, and exogenous growth rates in productivity. There is one policy choice: the decision to withdraw some part of the GDP (Y) for military use. Thus at any moment the capital stock, K, is apportioned between military production, M, and nonmilitary production, N. The resulting outputs depend upon the capital-output ratio, k.[2] The apportionment of capital between sectors (i.e., between K_m and K_n) is always made to ensure that M is a policy-set fraction, m, of Y.[3] The average productivity of capital in the nonmilitary sector grows at a fixed, exogenous rate, p.[4] And a fixed fraction of nonmilitary output, c, is consumed; the rest is invested.

Formally, the model can be written as five equations in five variables (Y, M, N, K, and K_m):[5]

$$M = mY, \tag{1}$$

$$K_m = kM, \tag{2}$$

$$(K - K_m)e^{pt} = kN, \tag{3}$$

1. This article focuses narrowly on the Benoit controversy. For more general reviews of the motivations for and consequences of military spending in both developed and developing countries, see Chan (1985, 1986).

2. Benoit's capital-output ratio is the same in both military and nonmilitary production.

3. The subscripts refer to sectoral allocation (to M or N).

4. Notice that the average productivity of capital in the military sector does not grow at all.

5. A "dot" over a variable refers to its derivative with respect to time (e.g., $\dot{K} = dK/dt$).

$$Y = M + N, \text{ and} \tag{4}$$

$$\dot{K} = (1 - c)N. \tag{5}$$

Equation 1 shows the policy relation of M to Y. Equation 2 indicates how much of the total capital stock (K) must be allocated to the military sector (i.e., K_m) to implement this military policy. Equation 3 shows the nonmilitary output that is produced by the remaining capital, with the exponential term reflecting the productivity growth there. Equation 4 is the GDP identity. And equation 5 displays the dynamics of the model, whereby net capital formation ($\dot{K}$) consists of a fixed fraction (1 - c) of nonmilitary output. Repeated substitutions yield the differential equations,

$$\dot{K}/K = [(1 - c)(1 - m)]/[km + k(1 - m)e^{-pt}] \tag{6}$$

and

$$\dot{Y}/Y = [(1 - c)(1 - m) + pk(1 - m)e^{-pt}]/[km + k(1 - m)e^{-pt}]. \tag{7}$$

Two aspects of the GDP growth rate of equation 7 should be noted. One, the growth rate grows at a growing rate, owing to the double force of capital accumulation and productivity growth.[6] And two, the initial GDP growth rate can be written simply as

$$(\dot{Y}/Y)_{\text{at } t=0} = [(1 - c + kp)(1 - m)]/k. \tag{8}$$

This, of course, is the familiar Harrod-Domar growth rate, with two changes: There is an exogenous productivity growth (p), and the Harrod-Domar growth rate is proportionately diminished by the relative size of the military allocation (m).

Benoit's picture of LDC growth is outdated—it was, after all, conceived in the late 1960s. But it is certainly not promilitary. This can be seen through closer examination of the model and its numerical implications. Increased values of m retard nonmilitary growth in three ways:

(a) *income shift effect* (Benoit, 1973: 14). An increase in m requires a once-and-for-all shift of capital from nonmilitary to military production.

6. More precisely, the growth rate of GDP grows if $m < [1 - c]/[1 - c + pk]$, which is satisfied by almost any plausible set of parameter values; and the growth rate of GDP grows at a growing rate until $t > \ln[(1 - m)/m]/p$, which is a long way from now (i.e., $t = 0$) for almost any plausible set of parameter values.

(b) *investment effect* (p. 8). A higher value of m not only lowers the entire future path of nonmilitary output but, since a constant fraction of that output represents investment (1 - c), it lowers the rate of growth of output.

(c) *productivity effect* (p. 11). By assumption, the capital-output ratio (k) is falling only in the nonmilitary sector (at rate p), so that the productivity-growth force on the GDP growth rate is diminished by the increased weight of the military sector when m rises.

Benoit estimates the size of each of these effects, one at a time, approximately, cumbersomely, and with worry that adding up the estimates may involve "some double counting" (p. 15). But his resulting estimate is *exactly* that derived from a full application of his implicit model using his parameter values. His parameter values are (pp. 9, 11, 12)[7]

$$m = 0.024,$$

$$k = 2.8,$$

$$c = 0.836, \quad \text{and}$$

$$p = 0.05.$$

At these values, the per-annum growth rate of nonmilitary output (N) over 14 years, calculated from the solution to differential equation 7, is 12.50%.[8] An increase in m by one percentage point, from .024 to .034, lowers the growth rate of N to 12.25%. Thus the estimated impact of military spending is that a one-percentage-point rise in m will lower the nonmilitary output growth rate by 0.25 percentage points (p. 15).

Benoit recognizes that this "would be a powerful adverse effect" (p. 15) on growth.[9] Critics of Benoit's work generally fail to notice that *his theoretical discussion provides strong ammunition against military spending*. His model generates high growth rates by ignoring productive factors other than capital, by ignoring diminishing returns, and by

7. Such a high value of p is incorporated in Benoit's estimates because he uses the median GDP growth rate of his sample LDCs as a proxy for p (1973: 26). Actually, $p = [\dot{X}/X - \dot{K}/K]/[1 - m]$, which assures that $p < \dot{X}/X$ unless $m > [\dot{K}/K]/[\dot{X}/X]$. This overestimate of p augments the adverse growth effect of increases in m, as Benoit notes (1973: 12-13).

8. Benoit estimates growth rates over such a short period of time (1951-1965), partly because that is the period of his data and partly because the growth rates become incredibly large for longer periods—for these parameter values, it is 23.94% over 50 years.

9. With Benoit's parameters, consumption in A.D. 2000 would be 63% higher with m = .024 than it would be with m = .034.

assuming high rates of exogenous productivity growth in civilian output. To reach the high cost of military spending that Benoit gets—the 0.25 percentage-point estimate of the preceding paragraph—requires double-digit real GDP growth.[10] Were it not for the almost exclusive notice taken of his empirical work, Benoit would have been faulted for constructing a model that exaggerates the adverse influence of defense spending on economic growth.

THE FAVORABLE GROWTH EFFECTS OF DEFENSE

Alongside the quantified (albeit largely implicit) model of the adverse effects of defense on growth, Benoit produces no more than a list of ways in which increased defense spending might stimulate economic growth. The list appears in several places in several variants (1973: xxi, 3-4, 16-20, 85-91, 169-180; 1978: 277-278). The evidence for these "growth-stimulative benefits of defense programs is imprecise, anecdotal, and difficult to evaluate" (1978: 277). Critics usually argue that these beneficial effects are absent in most LDCs, or if present are small (e.g., Ball, 1983a: 508). The following discussion of Benoit's list hints at ways these hypotheses might be tested.

Productivity-enhancing byproducts of military training and experience. This externality is particularly generated through the training and discipline of military personnel, who then take these skills with them to the civilian sector after demobilization. This idea suggests looking at the number of personnel involved in defense as well as, or perhaps instead of, military expenditure. Indeed, the turnover rate of military personnel may be the critical variable. Also, specific hypotheses could be tested concerning the type of skills most likely to be developed in the military, and the industries most likely to employ individuals with those skills. For example, if the military provides training in electronics, the impact of increased military spending on the productivity of industries that make use of electronics technicians could be sought. The macro models reviewed in this article cannot begin to address this hypothesis; and the micro work needed has hardly begun.

Military infrastructure available (at least partly) for civilian use. These quasi-public goods include not only such obvious things as roads and airports, but also disaster rehabilitation, mapping, meteorological

10. For example, with the more modest (and more realistic) assumption that $p = 0.01$, an increase in m by one percentage point lowers the GDP growth rate by only 0.15 percentage points (i.e., from 6.89% at $m = .024$ to 6.74% at $m = .034$).

R&D, and so forth. The difficulty with testing this is that it is hard to conceive of the data that would meaningfully measure such investments in "infrastructure."

Military production of close substitutes for civilian goods, which makes it "possible for the civilian economy to devote a higher share of its total output to investment" (Benoit, 1973: xxi). Note that a possibly higher share of a necessarily lower output, when the military expands, hardly ensures expanded investment. But to the extent that the military produces socially necessary goods and services (e.g., "security") more cheaply than the private sector would, there may be net resource savings from military expansion. Again, the data for testing are unavailable (e.g., nonmilitary expenditures on "security").

A "Keynesian type" of demand creation, promoting a "fuller use of resources than would otherwise have occurred" (p. xxi). No one today, we think, would so naively raise the suggestion that LDC growth rates can be readily elevated by expanded aggregate demand—or that expanded demand, inflation, and growth are so closely and positively related. Certainly, Benoit's own test of this is quite inadequate. He notes that, for his sample of countries, there was a "significant positive simple correlation between the rate of price increase and the rate of growth of real GDP"—once the "hyperinflation countries" were omitted (p. 19). But selectively omitting observations that contribute to negative correlation ensures a positive correlation. A macroeconomic, general equilibrium model is essential here.

Larger amounts of foreign economic (as well as military) aid directed to LDCs that "maintain unusually high defense burdens" (p. xxi). If defense spending attracts foreign aid, the negative growth effect of defense spending may be more than offset by the positive growth effect of the aid it has "helped to attract" (p. 90). Much of Benoit's book is concerned with aid and its correlations with defense and growth. But little emerges because there is no hypothesis to test. What is needed is a political-economic theory of the relation between military spending and foreign aid. Of course, Benoit's faith that foreign aid spurs growth is itself much dated. Currently, the presumption of most economists is that it has little impact, and perhaps even perverse impact.[11]

"Essential security required for economic progress" that is provided more fully by increased defense spending (p. 3). Note that this is differ-

11. A leading textbook on economic development, for example, writes "there is an unusual meeting of the minds between many radical and conservative economists . . . [that] aid may have little impact on growth" (Hogendorn, 1987: 121). But see also Krueger and Ruttan (1983).

ent from the third item listed above. Here, national defense provides something otherwise totally lacking; above, national defense provides something otherwise provided more expensively by the private sector. One seemingly appropriate test would be to proxy the unmeasurable "essential security" by the measurable external conflict and to look at the impact of conflict on growth. If such conflict hurts growth and defense expenditures prevent conflict, a favorable effect is indeed located. Unfortunately for this line of testing, Benoit suggests also the idea that there are "conceivable psychological links between defense and growth" whereby "military tension sometimes" leads nations to "work extra hard" (1978: 278).

THE CONCEPTS OF GROWTH, DEFENSE, AND AID

Since the main thrust of Benoit's case about the relation of growth and military expenditures is to rest on correlations between the two variables, he naturally devotes some time to making a judicious choice of the precise concepts to be incorporated into these variables. Actually, the growth rate concept turns out not to be critical. Benoit worries about whether it should be aggregate growth rate or growth rate per capita, GDP or GNP, and with or without military expenditure included. These are not only the logical alternatives but also the only widely available data series that attempt to capture national output and growth. But they all move together so closely that it rarely matters much which is selected.[12]

The choice of the defense burden variable is much more important, both in its conception and in the magnitude of its empirical impact. Unfortunately, Benoit devoted most of his worry to the empirical side of the problem. He then took as the proper measure of the defense burden the "real resource expenditures" on defense, as measured by "defense expenditure as a percent of GDP" (1973: 29, 30). This defense-to-GDP variable omits expenditures financed by foreign military grant aid on the grounds that they do not involve "real economic costs for the recipient" (p. 29). (For an extensive and careful critique of this choice, see Ball, 1983a.) But many of the possible favorable effects of defense on growth that Benoit suggested do not depend on resource exhaustion by

12. Benoit decided on aggregate real GDP growth rates. He examined GDP growth rates both with the military contribution and without (i.e., the civilian gross domestic output). The correlation between the two growth rates was so high as to make them almost indistinguishable in subsequent work.

the military but on aggregate military spending or on total military presence.

Indeed, many of the arguments about the economic impact of the military on the rest of an LDC economy turn on this very distinction between the volume of domestic resources allocated to the military, the volume of total resources allocated to the military, and the amount of income generated by (or expended on) the military. A simple model is developed below to display the differences between various measures of the "defense burden" and to show that these different measures cannot be counted on to be highly intercorrelated. Thus vague claims that "the military" spurs or retards the civilian sector of the economy may simultaneously be supported and refuted by different measures of military expenditure.

Consider an LDC with given GDP (Y) rationally allocating between nonmilitary goods (N) and military goods (M) so as to maximize its welfare.[13] The nation's welfare function is simply

$$U = M^a N, \tag{9}$$

with $a > 0$. Up to some modest limit (M_0), the LDC can purchase military resources at a subsidized price (P_0); P_0 might be as low as zero if military grant aid is available to it. Beyond M_0, the LDC can purchase further military resources at some higher price, P_1, either by exporting output in order to import military equipment at world prices of P_1 or by diverting domestic resources from civilian to military production at a domestic marginal rate of transformation of P_1.[14]

Substituting this budget constraint for N in equation 9 yields the welfare function to be maximized with respect to M alone:

$$U = M^a [Y - P_0 M_0 - P_1(M - M_0)]. \tag{10}$$

The maximization yields the optimal M:

$$M = [aY + a(P_1 - P_0)M_0]/[(1 + a)P_1], \tag{11}$$

which is greater than M_0 if

13. Both N and M are *flows*—there is neither private nor military capital in this simple model.

14. N is the numeraire good, the price of which is normalized at 1 throughout. Where foreign prices of the military good (M) are considered, the exchange rate is also assumed to be normalized at 1.

$$Y > [(P_1 + aP_0)M_0]/a. \tag{12}$$

We will assume that the optimal M is indeed greater than M_0—that is, that the LDC acquires more M than the subsidized allotment permits.[15]

The actual *expenditure* on M, which we will call M′, is

$$M' = P_0M_0 + P_1(M - M_0), \tag{13}$$

which at the optimal level of M is

$$M' = [aY - (P_1 - P_0)M_0]/[1 + a]. \tag{14}$$

Often, military aid in the form of an opportunity for subsidized purchase is accompanied by loans that permit the postponement of payment. The ultimate payment—whether full or partial, owing to the "softness" of the loans, is irrelevant—may never appear as a military expenditure. In this case, there is a second measure of actual expenditure, which we will call M″:

$$M'' = P_1(M - M_0). \tag{15}$$

At the optimal level of M, this is

$$M'' = [aY - (aP_0 + P_1)M_0]/[1 + a]. \tag{16}$$

Finally, one might calculate the expenditure on M in world prices, which we will call M*:

$$M^* = P_1M. \tag{17}$$

At the optimal level of M, this is[16]

$$M^* = [aY + a(P_1 - P_0)M_0]/[1 + a]. \tag{18}$$

Thus, even in this simplest of models, we have developed four different (each apparently meaningful in some context) concepts of the

15. $M > M_0$ is more likely the higher *a* or the lower P_1, P_0, or M_0. The condition for $M \geqq M_0$ is more modest: $Y \geqq [(1 + a)P_0M_0]/a$. The difference between this inequality and inequality (12) indicates the range of possible solutions at the "kink" in the budget constraint, at the point where $M = M_0$.

16. For this calculation to be relevant, we must think of P_1 as the world price, not the domestic MRT.

"defense burden": M, M′, M″, and M* (in equations 11, 14, 16, and 18, respectively).[17] They are quite different from each other. What is more important, they do not all move in the same direction in response to parameter shifts. Partial derivatives permit the construction of the following chart:[18]

	Rise in the Parameter Value		
Effect on	P_0	P_1	M_0
M	–	–	+
M′	+	–	–
M″	–	–	–
M*	–	+	+

For *none* of these three parameters, P_0, P_1, and M_0, is even the direction of the impact the same for all the measures of military spending. The point is, while a variety of measures of "military spending" can be defended for different purposes, care must be taken with the actual choice because these different measures are simply *not* mere monotonic transforms of each other.

A similar problem permeates the discussion of what concept of foreign economic aid is appropriate in a search for the determinants of the growth rate of GDP. Ideally, Benoit says "aid" should comprise the "widest" measures of "receipts of foreign exchange and goods and services obtained from abroad that are not currently 'requited,' in the sense that they do not involve the current surrender of comparable domestic resources in exchange, as would be the case for normal imports" (1973: 35). But, in fact, the variable he selected is quite narrow. Excluded from it are (a) military equipment, on the grounds that "such equipment did not truly substitute for domestic resources that might otherwise have flowed into domestic investment" (p. 35); (b) military transactions receipts, on the grounds that these "require some sacrifice

17. Note the "apparently meaningful" in the text sentence. In the model developed here, the "quantity" of "the military" that maximizes welfare (U) is clearly M—that follows directly from equations 10 and 11. But the expenditure concepts of M′, M″, and M* are much more readily measured and hence tempting to measure. The point is not what is right. The point is that, if there is some mystery in such a simple, explicit model as this, there is likely to be real confusion about the proper measure of "the defense burden" in a complex, implicit model.

18. Increases in the other two parameters, Y and *a*, raise military spending by all four measures.

of domestic resources in the form of additional imports required to provide the services" (p. 36); and (c) private investment and multilateral official aid, on the grounds that they do not provide "true offsets against absorption of domestic resources by defense programs" (p. 36).

What Benoit ends up with is bilateral economic aid (grants or loans). Ball criticized this choice of a particular and partial aid variable as an effort to "stack the deck in favor of the defense burden" as the source of growth (1983a: 510). But the larger criticism concerns neither correlations nor intentions. It is that no formal hypotheses about the aid-military-growth nexus are generated. What aid concept is appropriate is unclear because its role is unclear. Is it seen directly as a source of growth or is it seen as a correlated proxy for military expenditure (which, in turn, may or may not be a source of growth)?

BENOIT'S CORRELATIONS

The bombshell is the correlation evidence. For a sample of 44 LDCs, for data of the 1950s and 1960s, a positive correlation appears between the ratio of military spending to GDP and the rate of growth of real GDP. It is this positive correlation that leads Benoit to suggest that the favorable effects of military spending on growth may outweigh the adverse effects.

Variations of samples and variables did not change these positive correlations. The basic correlations were Spearman rank correlations, but simple linear regressions yielded similar results. Data for the 44 LDCs were used for a shorter period, 1960-1965. The correlations were calculated for the rate of growth of real GDP and for the rate of growth of real civilian GDP (which equals GDP minus military spending).[19] All variations provided positive correlation coefficients—the values of r ranged from +0.52 to +0.60.[20] Such values are of course significant.

Two kinds of questions are raised by skeptics about these correlation coefficients. Are they robust? And, what do they mean? Let us look at the robustness first. Robust means that the same results appear even when different countries, different years, different data sources, and

19. Deger (1986: 179-180) faults Benoit for incorrectly calculating the growth rate of real civilian GDP. Deger is right that what Benoit says he does (in Benoit, 1978: Table 1) is wrong; but what Benoit actually does is right, as a check of his calculations (in Benoit, 1973) confirms.

20. The slopes ranged from +0.30 to +0.34, suggesting that a one-percentage-point rise in defense (i.e., ratio of military spending to GDP) raises the GDP growth rate by one third of a percentage point.

different definitions of variables are incorporated. Benoit's results are *not* robust.

Within Benoit's own sample of 44 LDCs, the significant positive correlations are highly dependent on a few observations. Jordan and Taiwan are particularly critical (Benoit usually refers to Taiwan as China). In both of his samples, 1950-1965 and 1960-1965, their military spending exceeded 10% of GDP (with the average for the complete sample around 3½%) and their real GDP growth rates exceeded 8% (with the average for the complete sample around 5½%). Omission of these two countries drops the correlation coefficients by approximately one half.[21] To a great extent the Benoit correlations really represent a question about these two countries. A superficial answer to that question might be that these two also had the largest total net inflow of all external resources as a percentage of GNP.[22] Indeed, the simple correlation between real GDP growth rates and the total net inflow of all external resources (as a percentage of GNP) is +0.50. The correlation between military spending (as a percentage of GDP) and the inflow of external resources (as a percentage of GNP) is extremely high (+0.79), making it impossible to distinguish the influence of each, separately, on GDP growth through multiple regressions involving the two variables.

Other authors have constructed LDC cross-sections of military spending and GDP growth data, and the resulting correlations are neither positive nor significant. For example, Kaldor's (1976: Table 1) sample of 40 LDCs for 1963-1973 produces a correlation coefficient of −0.18 between military burden (i.e., the share of GNP devoted to defense) and the rate of growth (of real GNP per capita).[23] Deger reestimates Benoit's data for 1965-1973 and finds a rank correlation coefficient between civilian output growth and military burden of +0.00 (1986: 180, 195). Kennedy (1974) amasses data for 48 LDCs from various years of the 1960s and groups them by regions. Although he does not calculate the correlation coefficients, they turn out to be +0.19 for all 48 countries, −0.13 for the African countries, +0.28 for the Asian

21. From +0.52 to +0.25 for the 1960-1965 sample, and from +0.54 to +0.27 for the 1950-1965 sample.

22. See Benoit (1973: Table 3-12, col. 5, p. 128). The percentage exceeded 18% for each of these two countries; the average for the entire sample was under 5%.

23. Only 23 of Kaldor's countries are the same as those in the Benoit sample of 44. Jordan and Taiwan are in her sample, although Jordan's growth rate for this period is negative in her sample. Several other countries in the Kaldor sample had high military burdens and low growth rates: Cambodia, Laos, North Vietnam, South Vietnam, Egypt, and Yemen (Aden). Indeed, several of the included countries were involved in full-scale warfare during the relevant period, and nobody has ever claimed *that* is good for growth.

TABLE 1
Growth Rate Regressions[a]

Independent Variable	*Benoit's Symbol*	*Regression*[b] *(1)*	*(2)*	*(3)*	*(4)*	*(5)*[g]
constant		4.17*	4.18*	3.24*	0.97	1.12
		(1.56)	(1.56)	(1.42)	(1.20)	(1.12)
defense burden[c]	AB	.30*	.21	.23*	.04	−.07
		(.07)	(.12)	(.11)	(.10)	(.10)
external resources[d]	AR	–	.06	.06	.15*	.10
			(.07)	(.06)	(.06)	(.06)
per capita GNP	Y	–	–	.00*[e]	.00	.00
				(.00)	(.00)	(.00)
investment[f]	AI	–	–	–	.20*	.22*
					(.05)	(.05)
R^2		.29	.30	.44	.61	.56

a. Growth rate of civilian GDP, 1950-1965. The data are all from Benoit (1973).
b. Standard errors in parentheses; – indicates variable excluded; * indicates significance at 5%.
c. Military expenditures as a percentage of GDP.
d. As a percentage of GNP; includes military, private, and multilateral aid, as well as bilateral.
e. This coefficient is 0.0038 with a standard error of 0.0013, small but significant in this regression.
f. As a percentage of GDP.
g. Regression (5) is the same as (4) but with the Jordan and Taiwan observations removed.

countries, and -0.42 for the Latin American countries (Tables 1, 3-5, pp. 178-189).

There is another sense in which the Benoit results are not robust. Slight changes in the regression formulations dramatically change the estimates of the effect of military spending and the significance of those estimates. Consider regression 1 in Table 1. This is Benoit's basic correlation; it shows that a one-percentage-point rise in the defense burden raises the real GDP growth rate by 0.30 percentage points. As other variables that Benoit considers potentially relevant are added, in regressions 2 through 4, the estimate of the coefficient on defense burden falls and becomes insignificant. Relentless, modelless empiricism says that investment and aid overwhelm defense as a propellant of growth. In any case, the simple correlation does not stand up well to additions of other "independent" variables.

Others have constructed large data sets for LDCs in an effort to uncover the determinants of growth. Military spending is often one of the potential determinants. A recent example regressed annual, 4-year, and 7-year rates of growth of real per capita GDP on more than 30 independent variables, with more than 60 countries providing more than 800 annual observations over 1960-1980 (Landau, 1986). The estimated impact of the share of military expenditure in GDP on the GDP growth rate, in the basic regressions, is rarely (and never significantly) positive (pp. 40-43, 60-61). Later regressions, run with interaction terms among the regressors, did produce positive and sometimes significant coefficients (pp. 54-59).[24] Landau does not speculate why the addition of such interaction terms might cause changes of sign.

Another variation on Benoit's correlations has been the division of his sample into different types of countries. Frederiksen and Looney (1983), for example, split Benoit's sample into "resource abundant" and "resource constrained" groups.[25] Basic regressions of the real growth rate of civilian GDP on defense expenditures as a percentage of GDP (and two other independent variables, investment and aid) reveal a significant positive relation in the resource-abundant LDCs (a coefficient of +0.22) and a significant negative relation in the resource constrained LDCs (a coefficient of −1.22). From this they conclude that, while military spending may make some direct positive contribution to growth, it also has a negative impact on growth in resource constrained countries where it diverts scarce resources from more productive opportunities.

It should be noted that, as Frederiksen and Looney have directly employed Benoit's method, their study suffers from the same shortcomings as Benoit's. Their study also uses only bilateral aid as the capital inflow variable. In addition, by splitting Benoit's sample into two groups, they end up with very small samples as the basis for their estimates—the resource constrained group includes only nine countries.

24. The interaction terms were the product of various regressors and the real per capita GDP level. Such interaction terms were not included if they reduced the significance of the basic estimate of the coefficient (p. 65), as they did for military spending.

25. Countries are classified as resource abundant if they have relatively high growth in foreign exchange earnings, high import elasticities, low debt-service ratios, low incremental capital-output ratios, high current account deficit/GDP ratios, and large government spending multipliers. Resource constrained countries display the opposite tendencies. Of Benoit's 44 countries, 7 are removed for lack of data, 4 are removed as atypical (Burma, Iraq, Syria, and Vietnam), 9 are discovered (by cluster analysis) to be resource constrained (Argentina, Brazil, India, Mexico, Morocco, Peru, Philippines, Sudan, and Tanzania—a curious collection), and the other 24 countries fall into the resource abundant category.

Biswas and Ram (1986) reestimate Benoit's equations for 58 countries over the periods 1960-1970 and 1970-1977, separating the sample into low-income and middle-income LDCs. They regress GDP growth on labor force growth, the share of investment in GDP, and the military burden (the ratio of military spending to GDP), and find that the coefficient on military burden for the low-income group is statistically insignificant in both periods. In short, the growing body of correlation evidence is unclear as to sign and significance.

TESTS USING STRUCTURAL MODELS

Going beyond mere correlations, many researchers have built structural models of LDCs that incorporate various direct and indirect linkages between the military variables and growth. The first three papers discussed below focus on just one hypothesized relationship, such as the link between military training and productivity in the civilian sector. The fourth employs an empirical technique associated with the new "atheoretical macroeconomics" to attempt to determine whether military spending should be considered as an exogenous variable in any growth equation. The rest of the papers reviewed below construct models that allow for the military to affect the economy through a number of theoretical channels. What most of the papers have in common is that they offer little support for Benoit's conjecture.

One of the simpler models relating military spending to growth is constructed by Lim (1983). He reexamines Benoit's analysis for a bigger group of LDCs (54) over a later period (1965-1973), within the context of a Harrod-Domar growth model of the form: Real GDP growth is a function of the incremental capital-output ratio and the investment/GDP ratio. He hypothesizes that military spending reduces growth by reducing the resources available for investment. This relation takes the following form: The investment/GDP ratio is a function of the military spending/GDP ratio and the foreign capital inflow/GDP ratio. Lim assumes that both equations have a log-linear form and then estimates the following reduced form equation (with all variables in logarithms):[26]

26. The change in the denominators of the military spending and the capital inflow variables are "preferred" by Lim because they bring out "more directly" the impacts sought. Perhaps Lim's reason is more "singular"; Biswas and Ram (1986: 366) note that Lim's model is essentially a Harrod-Domar identity.

$$\text{Real GDP growth} = a_0 + a_1(\text{marginal output-capital ratio}) + a_2(\text{military spending/total government spending}) + a_3(\text{foreign capital inflow/domestic saving}). \quad (19)$$

The coefficient of the ratio of military spending to total government spending is found to be negative and statistically significant. On the basis of this evidence, Lim concludes that military spending is detrimental to growth in LDCs.

However, the econometric evidence presented does not justify so strong a conclusion. The negative estimate of a_2 in equation 19 could mean either that military spending has a big negative effect on investment but there is a small positive relation between investment and growth, or that military spending has a small negative effect on investment but there is a big positive relation between investment and growth. Furthermore, Lim's model permits military spending to affect growth through only one channel, namely, by directly affecting investment. If there are the other channels of influence conjectured by Benoit, they could not be located in this procedure, and other positive effects would not be measured.

Biswas and Ram (1986) suggest that "the size of the military sector output may act as an 'externality' factor for the civilian sector" (p. 367) and include military output as an input in their civilian-sector production function. The efficient allocation of given capital and labor between the two sectors then determines the outputs of each. Unfortunately, they then utilize the military output as an independent variable in their regressions, when their explicit model makes it clear that the military output must be endogenous (or one of the other so-called independent variables in the regressions must be endogenous). The ensuing econometrics "suggest absence of any statistically significant impact of military expenditures on growth of total output" (p. 369-370).

Another one-channel study of the effect of defense spending on growth is that of Weede (1983). He argues that military spending encourages economic growth because "the military teaches discipline and creates a useful habit of obeying orders" and "the more capable and disciplined the work force is, the better the economic performance should be" (p. 17). He estimates the following equation for 95 LDCs using data from the period, 1960-1977:

$$\text{GNP growth rate} = a_0 + a_1(\text{log GNP per capita}) + a_2(\text{log GNP per capita})^2 + a_3(\text{investment/GNP}) + \quad (20)$$

a_4(primary school enrollment ratio) + a_5(secondary school enrollment ratio) + a_6(log military participation ratio).

Weede finds that the military participation ratio explains about 10% of the cross-national variance in GNP growth rates. Since variables like "gross domestic investment or school enrollment do no better," he concludes that military participation might contribute to growth.[27] Although Weede's conclusion is the reverse of Lim's, it can be faulted on exactly the same grounds—only one channel of influence is permitted to appear and the outcome must necessarily ignore any other channels, even though they may partly or more than wholly offset the measured influence. Nevertheless, the study is innovative in one very important respect: It does attempt to disaggregate the concept of "the military," and it suggests that such disaggregation may be valuable for assessing the impact of "the military" on economic growth.[28]

Joerding (1986) suggests that previous researchers may have been in error in that they assumed military spending to be econometrically exogenous with respect to economic growth. He applies the Granger test to data on military spending and growth for 57 LDCs between 1962 and 1977. A variable X is said to "Granger-cause" a variable Y if current values of Y can be predicted better by using past values of X than by not using them (when both regressions include all other relevant information). Joerding applies this procedure in turn to military spending and to growth. He finds the hypothesis of Granger noncausality from growth to military spending to be rejected by the data, while the data do not reject the hypothesis of Granger noncausality from military spending to growth.[29] A necessary, albeit not sufficient, condition for military spending to be exogenous with respect to growth is for growth not to Granger-cause military spending. Therefore, the hypothesis that military spending is exogenous with respect to growth is refuted by the Granger test.

Because of this result, Joerding concludes that previous studies (which used OLS to estimate the effect of defense expenditures on

27. Others have reached similar conclusions by distinguishing expenditure and personnel. For example, Dixon and Moon (1986) find that military expenditure has a negative effect on the current standard of living (they do not discuss growth), but that military manpower has a positive effect.

28. Dixon and Moon (1986: 681) also stress the idea that the term, the military, is "multidimensional."

29. Similar results were found by Chan, Hsaio, and Keng (1982). They applied the Granger test to Benoit's data set.

growth in single-equation models) were flawed, since estimation with an independent variable that is endogenous with respect to the dependent variable leads to biased and inconsistent parameter estimates. He suggests the use of simultaneous-equation or dynamic models to seek the relationship between military spending and economic growth.

The Granger tests, however, offer no clue on what form such models should take. That growth helps to predict military spending in a temporal sense—and not the reverse—does not establish that growth causes military spending. While the Joerding study therefore casts doubt on the validity of single-equation models relating military spending to economic growth, it does not provide an alternative model through which such relationships can be analyzed. The Joerding paper is best seen as a critique of, and not a replacement of, the single-equation models described above.

The papers that will be discussed below all involve models that *do* allow for military expenditure to affect economic growth through more than one channel. Some even build into the models multidirectional causality. The first two papers below include time-series studies of the military-to-growth relationship in India. The rest of the papers utilize cross-sectional data or pooled time-series cross-sectional data.

Faini, Annez, and Taylor (1984) test for the effects of military spending on economic performance in the context of a traditional Keynesian model. They hypothesize that, while military spending may have short-run Keynesian stimulative effects, it also has a negative effect on growth owing to the fact that it crowds out investment, straining the "absorptive capacity" of the economy, and putting pressure on available supplies of capital, skilled labor, and foreign exchange. They test this hypothesis by estimating a reduced-form equation that relates the GDP growth rate to the growth rates of exports and population, the change in the share of arms spending in GDP over time, the change in total capital inflows from abroad, the growth rate of the country's capital stock, and the level of GDP per capita. They run this regression using data from India over the period 1950-1972. The coefficient on defense burden is found to be negative and significant.

In addition, to trace through the other possible effects of military spending on the economy, they estimate a series of regressions of the form,

$$X = a_0 + a_1(\log \text{GDP per capita}) + a_2(\log \text{GDP per capita})^2 + a_3(\log \text{population}) + a_4(\log \text{population})^2 + a_5(\text{capital inflow}) + a_6(\text{military spending}/\text{GDP}), \quad (21)$$

where X is the ratio to GDP of, in turn, investment, imports, industrial production, agricultural production, and tax receipts. They find the statistically significant coefficients on the military spending variable to be (1) positive, and close to one, in the investment equation; (2) negative, and greater than one, in the agricultural production equation; (3) positive, and about one half, in the industrial production equation; and (4) positive, and close to one, in the tax receipts equation. These time-series results are interesting. While military spending does not seem to crowd out investment, the results of the first regression suggest that it still has a negative effect on growth. But the structural model that is the basis for that estimation cannot explain how military spending can reduce growth, as the only hypothesized negative link between defense and growth is the negative effect of defense on investment. In short, these time-series results suggest that, at least for the case of India, a different model is needed to explain the defense-to-growth relation.

Deger and Sen (1983) test the hypothesis that military spending contributes to growth through two types of "spin-off" effects. The first of these is the creation of effective demand for underemployed industrial capital. The second is the contribution of military spending to technological progress that augments the civilian sector's production function. They test this hypothesis on time-series data for India during 1951-1971. They estimate the following equation for the output of five industries (X_i):

$$X_i = a_{0i} + a_{1i}(\text{real military spending}) + a_{2i}(\text{value added in manufacturing}). \quad (22)$$

They also run these five regressions substituting a one-period-lagged value of the military spending variable. For the 10 equations fitted, military spending has a positive, statistically significant coefficient in only one—metal products (with military spending lagged). The coefficients of military spending in all other equations are found to be insignificant. The authors, recognizing the possible endogeneity of the value added variable, also estimate the equations using instrumental variables and a two-stage CORC procedure. None of the coefficients of lagged military spending is found to be significant.

The time-series evidence in both of these studies provides very scant evidence of Benoit's hypothesized growth-enhancing effects of military spending. But India is only one of the LDCs. Only additional research will tell whether the results of the Indian time-series studies can be generalized to other countries.

Faini, Annez, and Taylor (1984) also estimate the equations applied to their Indian time-series study with pooled time-series/cross-sectional data for 69 countries over 1950-1970. They divide their sample into six groups and estimate a regression for each of the six groups using a "fixed-effects" model, which allows for the estimation of a separate intercept for each country. These groups consist of the entire sample, developed countries, developing countries, Latin America, Africa, and Asia. They find the coefficients on defense burden to be consistently negative except for the group of developed countries. All negative coefficients on military burden are statistically significant except in the regression of the Asia group.

The X equations (i.e., equation 21) estimated in their India study are also run using these cross-sectional data. The coefficient of defense burden is negative and statistically significant in the regressions where investment and agriculture (as ratios to GDP) are the dependent variables. The coefficient of defense burden is positive and statistically significant only in the regression where the dependent variable is tax receipts. While it appears that investment may be positively related to defense burden in India, the cross-sectional data reveal a negative relationship between the two variables. This is consistent with the parameter estimates of the reduced form of the structural model, which indicate a negative relationship between defense spending and economic growth for most countries in the sample.

Nabe (1983) looks at the effects of military spending on growth in 26 African countries over the period 1967-1976. He employs the following model:

$$\text{EDF} = a_0 + a_1(\text{military spending}), \tag{23}$$

$$\text{SDF} = b_0 + b_1\text{EDF} + b_2(\text{military spending}), \text{ and} \tag{24}$$

$$\text{GDPM} = c_0 + c_1\text{EDF} + c_2\text{SDF} + c_3(\text{military spending}), \tag{25}$$

where EDF is an "economic development factor" (a composite variable reflecting installed electrical capacity, private expenditures, and government civilian expenditures), SDF is a "social development factor" (another composite variable incorporating government expenditures on health and education and the number of physicians and teachers in the country), and GDPM is GDP generated by manufacturing.

This recursive model is estimated, and military spending is found to reduce manufacturing GDP through the indirect effects of military

spending on both SDF and EDF. The model is estimated both on the basis of pooled data and separately for each year. In all cases, military spending is found to reduce the growth in manufacturing output. But Joerding's criticism of single-equation models of the relationship between military spending and economic growth applies to this recursive model as well. Military spending appears only on the right-hand side of the equations of this model. A more appropriate model would allow economic growth to influence military spending as well. Moreover, as Gyimah-Brempong (1987) has noted, neither saving nor foreign aid appear in any of the equations, even though economic theory suggests that they also affect economic growth.

The three papers below all estimate very similar multiequation models. The papers all hypothesize possible positive direct effects of military expenditure on growth through Keynesian demand stimulation and other "spin-off" effects. They all hypothesize that such expenditure may reduce growth through indirect effects on saving or investment. Finally, they all include a third equation that endogenizes military expenditure. The parameter estimates obtained from these three-equation systems can be used to calculate a multiplier for military expenditure on growth that incorporates all three hypothesized relationships.

One such study is found in the appendix of the paper by Deger and Sen (1983). Their simultaneous model is described by the following equations:

$$\text{GDP growth} = a_0 + a_1(\text{investment}/\text{GDP}) + a_2(\text{military spending}/\text{GDP}) + a_3(\text{GDP}) + a_4(\text{population growth}) + a_5(\text{net foreign capital transfers}); \quad (26)$$

$$\text{Investment}/\text{GDP} = b_0 + b_1(\text{GDP growth}) + b_2(\text{change in GDP}) + b_3(\text{military spending}/\text{GDP}) + b_4(\text{net foreign capital transfers}); \text{ and} \quad (27)$$

$$\text{Military spending}/\text{GDP} = c_0 + c_1(\text{GDP}) + c_2(D) + c_3(\text{population}) + c_4(D_1) + c_5(D_2). \quad (28)$$

In equation 28, D is the difference between per capita incomes measured at purchasing power parity (PPP) and at official exchange rates, D_1 is a dummy for oil-producing countries, and D_2 is a dummy for countries at

war. The variable D attempts to measure the degree of integration of the economy with the rest of the world. The structural parameters of the model are estimated by three-stage least squares (3SLS) on data for 50 LDCs over the period 1965-1973. Parameter estimates are found that imply a growth impact of military spending of –0.16. This equals $(a_2 + a_1b_3)/(1 - a_1b_1)$.

Deger (1986) provides a model that permits interactions of the military and growth through aggregate demand stimulation, technological spin-off effects, withdrawal of resources from potential investment uses, and creation of new resources. Deger estimates three structural equations, using data on 50 LDCs with each data point being the national average for the period 1965-1973. The model consists of:

$$\text{GDP growth rate} = a_0 + a_1(\text{saving/GDP}) + a_2(\text{military spending/GDP}) + a_3(\text{1970 per capita GDP at official exchange rates}) + a_4(\text{foreign capital flow/GDP}); \quad (29)$$

$$\text{Saving/GDP} = b_0 + b_1(\text{GDP growth rate}) + b_2(\text{per capita GDP growth}) + b_3(\text{military spending/GDP}) + b_4(\text{inflation rate}) + b_5(\text{foreign capital flow/GDP}); \text{ and} \quad (30)$$

$$\text{Military spending/GDP} = c_0 + c_1(\text{government spending/GDP}) + c_2(\text{per capita GDP}) + c_3(\text{per capita GDP at official exchange rates minus PPP}) + c_4(\text{war dummy}) + c_5\,(\text{oil-producer dummy}). \quad (31)$$

She estimates the model using 3SLS. In equation 29, she finds that military spending has a positive and significant coefficient. However, in equation 30, military spending has a negative coefficient.

Deger argues that Benoit estimated only equation 29, which represents only the demand and spin-off effects of military spending on growth. Benoit does not take into account the resource effects of military spending on growth through its depression of the savings rate. When this is taken into account, the multiplier effect of military spending on growth is found to be –0.22. This equals $(a_1b_3 + a_2)/(1 - a_1b_1 - a_1b_2y)$, where y is per capita income and is evaluated at the sample mean. The negative impact of military spending on growth through the savings rate outweighs the demand and spin-off effects. Deger concludes that Benoit's analysis was not wrong, but rather partial. Benoit captured

only some of the effects that military spending has on growth and thus was wrongly led to conclude that military spending contributes to economic growth.

Deger and Smith (1983) develop an econometric model to test for the effects of military spending on economic growth. They hypothesize that military spending affects growth through three channels: (1) It may raise aggregate demand and contribute to growth by promoting higher capacity utilization rates; (2) it may accelerate modernization through its influence on administration and social structure; and (3) it may reduce growth by lowering the savings rate.

They employ the following simultaneous equation model to represent these effects:

$$\text{GDP growth rate} = a_0 + a_1(\text{saving/GDP}) + a_2(\text{military spending/GDP}) + a_3(\text{population growth rate}) + a_4(\text{net external capital flow/GDP}) + a_5(\text{1970 per capita income at official exchange rate}) + a_6(\text{agricultural output growth}); \tag{32}$$

$$\text{Saving/GDP} = b_0 + b_1(\text{GDP growth rate}) + b_2(\text{per capita GDP growth}) + b_3(\text{military spending/GDP}) + b_4(\text{net external capital flow/GDP}) + b_5(\text{inflation rate}); \text{ and} \tag{33}$$

$$\text{Military spending/GDP} = c_0 + c_1(\text{per capita income at the PPP exchange rate minus per capita income at the official rate}) + c_2(\text{population}) + c_3(\text{oil-producer dummy}) + c_4(\text{war dummy}). \tag{34}$$

This model is estimated for 50 LDCs using national averages for the 1965-1973 period (by 3SLS). The coefficient of military spending in the savings equation is found to be negative and statistically significant. Military spending and saving are both found to have positive and significant coefficients in the growth equation. They use these results to derive a multiplier for military spending on growth of –0.20. Hence, the negative impact of military spending on saving is found to outweigh the positive impact on growth through aggregate demand and the modernization effect.

The authors then test for the sensitivity of their results to the data and sample used. The basic regressions use SIPRI (Stockholm International

Peace Research Institute) data on military spending. For 18 African countries and 12 Latin American countries, the growth effect of military spending is found to be more negative when using ACDA (U.S. Arms Control and Disarmament Agency) data. The 3SLS estimation of the model is also done on subgroups within the sample—looking at high-income, middle-income, and low-income countries separately. In all cases, the growth effect of military spending is found to be negative. A number of other changes in the definition of variables and equations are considered, but the military spending influence on growth remains negative in all cases.

The three papers above avoid the problem of simultaneity bias by using a multi-equation structural model that allows for the potential impact of growth on military spending (as well as the reverse). However, the authors of the papers all choose to estimate their models using 3SLS. One property of 3SLS is that the parameter estimates it yields are highly sensitive to the presence of specification error. Parameter estimates in all equations of a model can be affected by specification error in just one of the model's equations.

While all the models make military spending endogenous, the military spending equations are a likely location of specification error owing to their lack of an adequate "external threat" factor, which surely influences military spending decisions. The three papers include dummy variables for countries at war (and for oil-producing countries), but these are very crude proxies. In the absence of a more reliable index of such threat, one might estimate such models by means other than 3SLS, which would provide confidence that the results found above are not solely the consequence of specification error.

CONCLUSIONS

While the studies surveyed here differ widely in method and focus, the empirical results point to similar conclusions regarding the relationship between military spending and economic growth. First, efforts at reestimating Benoit's correlation coefficients for different samples of LDCs and different time periods all fail to reproduce Benoit's results. In place of Benoit's positive correlations, researchers regularly find negative or statistically insignificant correlation coefficients. Benoit's estimates of correlation coefficients for military spending and economic growth are not robust with respect to the sample or time period examined.

Second, while studies by Weede (1983) and Deger and Sen (1983) find some limited evidence of positive effects of military spending through human capital formation and technological "spin-off" effects, the models that allow military spending to affect growth through multiple channels (such as those of Deger, 1986; Deger and Smith, 1983; and Faini, Annez, and Taylor, 1984) find that, while military spending may stimulate growth through some channels, it retards it through others, and the net effect is negative. The most important negative effect is that higher military spending reduces national saving rates, thereby reducing the rate of capital accumulation.

Most of the more sophisticated structural models relating military spending to growth (and, in some cases, growth to military spending) that find little or negative impact have been estimated using cross-sectional data. Rarely have researchers attempted to test for these relationships using time-series data for individual countries. Studies of this nature—even case studies—might add to our understanding of this relationship since the relationship probably differs, at least in intensity if not in direction, among countries. In addition, further research is possible with more disaggregated data on military spending, which are beginning to appear.[30] The effects of military spending on the economy may very well depend upon how those expenditures are allocated across labor, domestic capital, and import costs.

Although the more complex models are a big improvement over bare correlations, they nevertheless can be further improved. Almost all fail in two basic ways. First, they provide no explicit motivation for government spending on the military.[31] Such spending typically either is exogenous or is pushed by an exogenous propensity to spend out of the growing national output. Threats to national security, both internal and external, need to be more extensively and carefully incorporated. Second, optimizing behavior with respect to security and growth, either by an abstract LDC policymaker or by the actual lobbying interests involved with defense spending, has so far been largely absent from these models. There is a reason for this absence: Such optimizing models will have to be complex. For example, consider a single policymaker

30. Ball (1983b) has published time-series data on military spending broken into operating and capital costs for 40 developing countries. These data are utilized in Porter (1987).

31. An exception is Maizels and Nissanke (1986), which is a study of the determinants of military expenditure. Among wars and various domestic factors, they found "the most important single explanatory variable . . . to be the share of the central government budget in GDP" (p. 1137). For Africa, see Kohler (1988).

facing threats to national security, having a desire to grow, and allocating resources between investment and military expenditure. On the optimized margin, there *must* be a negative relation between defense spending and growth. Much more sophisticated models are needed to generate interesting hypotheses.

In short, the existence of positive effects of military spending on economic growth, such as those conjectured by Benoit, still cannot be ruled out. However, the recent econometric evidence points to the conclusion that these positive effects, if they exist, are small relative to the negative effects, and overall, military spending has a weak but adverse impact on economic growth in developing countries.

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