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**DEFENSE SPENDING AND ECONOMIC GROWTH
IN DEVELOPING COUNTRIES**

By

Basudeb Biswas

DEFENSE SPENDING AND ECONOMIC GROWTH IN DEVELOPING COUNTRIES

Economic implications of defense spending can be studied from different perspectives. One basic concept of economics is that given our technical knowledge and endowment of resources, more production of one commodity results in less production of some other commodity. More real spending in the military sphere leads to a reduction of funds for production of civilian goods. This basic fact is reflected in high hopes of receiving a "peace dividend" from less spending on defense following the end of the cold war. According to the *Human Development Report* (United Nations Development Programme, 1992), worldwide military spending has been falling in the late 1980s as shown in Table 1.

Table 1. Trends in global military spending

	Developing Countries	Industrial Countries	World	Developing Countries as % of World
<i>Military expenditures (US\$ billions)</i>				
1960	35	385	420	8.3
1970	75	545	620	12.1
1980	137	618	755	18.1
1984	155	750	905	17.1
1987	132	838	970	13.6
1990	123	762	885	13.9
<i>Annual growth rates (%)</i>				
1960-70	7.9	3.5	4.0	
1970-80	6.2	1.3	2.0	
1980-90	-1.1	2.1	1.6	
1980-84	3.1	5.0	4.6	
1984-87	-5.2	3.8	2.3	
1987-90	-2.3	-3.1	-3.0	

Source: United Nations Development Programme, *Human Development Report*, (New York: Oxford University Press, 1992).

Industrial countries decreased their total military spending from about \$838 billion in 1987 to \$762 billion in 1990 in constant 1988 U.S. dollars. The corresponding figures for the developing countries are \$132 billion in 1987 and \$123 billion in 1990.

The same analysis that applies to the choice between military goods and civilian goods can also be applied to the choice between production for current consumption and production for future consumption. Defense spending cannot contribute to a nation's ability to produce more economic goods and services in the future. More public expenditure in the military sector leads to crowding out of private investment and less investment on public goods like health, education, and scientific research. Thus, from both the short-run and the long-run points of view a decline in military spending will attain the primary objective of development, that is, to benefit people.

A possible beneficial effect of defense expenditure lies in its role in creating effective demand when there is slack in the economy. Within the Keynesian framework of macroeconomic analysis, government expenditure on goods and services including defense is an important force in the determination of output and employment. From this perspective, military spending or any other form of government spending has the potential of achieving full employment output.

The approach of this study about the impact of military expenditures on economic growth is somewhat different from those mentioned above. Treating defense expenditures as autonomous, mainly determined by strategic consideration and threat and security, one can argue that defense expenditures may have developmental side effects. The argument runs in the following manner. The military

is an organized sector and helps building of the infrastructures and contributes to technological progress. The military sector helps in the process of modernization through establishment of allocative efficiency improving institution. The civilian sector gets the benefits of the economic "spin-off" from the military sector. It is also hypothesized that factor productivities may be greater in the military sector than in the civilian sector. In an earlier work, Biswas and Ram (1986) focused on this dimension of the relation between military expenditure and economic growth and estimated parameters within a production function framework. Results obtained in that analysis were compared with those of Rothschild (1977), Benoit (1978), Frederiksen and Looney (1982), Lim (1983), and Deger and Sen (1983), and Leontief and Duchin (1983). The Biswas and Ram study was based on data for the periods 1960-70 and 1970-77, and a sample of 58 less-developed countries was taken. The main objective of this study is replication of the empirical part of the earlier study. The present study is based on a sample of 74 LDCs and covers the period from 1981 to 1989 during the first part of which there was an increase in military spending and a decrease in the second half (Table 1).

The main point emerging from this work is that, in contrast with the results reported in Biswas and Ram (1986), the defense outlays seem to have a positive effect on economic growth for 1981-89.

Evidence in the Conventional Framework

We start with a simple neoclassical production function in which labor (L), capital (K), and military spending (M) enter as "inputs" into a single aggregated output (Y). By taking total derivatives and manipulating the expression, one can derive the following growth equation:

$$\dot{Y} = \beta_0 + \beta_1 \left(\frac{I}{Y} \right) + \beta_2 \dot{L} + \beta_3 \dot{M} + U, \quad (1)$$

where $\dot{Y}$ is the annual rate of growth of total output (GDP), I/Y is the investment-output ratio, $\dot{L}$ and $\dot{M}$ are, respectively, the annual rates of growth of the labor force and the military expenditure variables, and U is the classical stochastic disturbance term. β_1 reflects the marginal product of capital, and β_2 and β_3 are the elasticities of output with respect to labor and military expenditures. Equation (1) is used as the basic empirical equation in this section.

The sample covers 74 countries, and the period extends from 1981 through 1989.¹ Following the World Bank's classification, low-income and middle-income LDCs are treated separately, and pooled sample estimates are also reported.²

The estimates in Table 2 indicate that defense expenditure has a significantly positive effect on economic growth. This is in contrast with the result of the earlier study by Biswas and Ram (1986). However, when one looks at the estimates for the low-income and the middle-income groups separately, the quantitative effect is much less in the low-income countries.³

Table 2. Some Statistical Results on the Relation Between Military Expenditures and Economic Growth in LDCs, 1981-89: Conventional Models

	$\frac{I}{Y}$	$\dot{L}$	$\dot{M}$	R^2
1981-89				
Full sample (N = 74)	0.121** (2.977)	0.568* (1.743)	0.081 (3.036)	.20
Low-income LDCs (N = 30)	0.146** (2.090)	-0.472 (-0.697)	0.052 (2.237)	.26
Middle-income LDCs (N = 44)	0.117* (1.940)	0.526 (1.337)	0.229** (3.074)	.30

Note: Dependent variable is the average annual rate of growth of GDP over the period. A constant term is included in all regressions, but its estimates are not reported. Numbers in parentheses are t-statistics.

*Significant at the 10% level.

**Significant at least at the 5% level.

Military Expenditures and Economic Growth: An Augmented Neoclassical Model

We briefly mentioned some hypotheses about the manner in which increased defense spending may affect growth favorably or unfavorably. Most researchers probably recognize two important mechanisms through which military expenditures may affect economic growth: (a) the military sector may, for a variety of reasons, generate positive or negative externalities for the rest of the economy, and (b) there may be important factor productivity differences. The conventional framework represented in equation (1) can be rationalized in terms of an "external effect," but it

cannot throw light on a possible productivity differential. The model described below was specified by Feder in the context of a study of the role of exports in growth.⁴ The Feder model has been adapted as a two-sector framework to assess the externality effect of military expenditures and the factor productivity variation between the military and the civilian sectors. The model is built on the neoclassical production-function framework and leads to a linear regression equation similar to the conventional specifications. The basic features of the model have been explained in Biswas and Ram (1986) and are briefly mentioned here.

In contrast with a one-sector framework of the conventional model, the economy is now divided into two sectors. The military sector output is designated as M and the civilian sector output is designated as C . Assume that labor (L) and capital (K) are the only inputs in each sector. The relative marginal products of labor and capital may differ across the two sectors and the size of the military sector output may act as an "externality" factor for the civilian sector. The basic equations can be written as follows:

$$Y = C + M \quad (2a)$$

$$C = C(L_c, K_c, M) \quad (2b)$$

$$M = M(L_m, K_m) \quad (2c)$$

where the lowercase subscripts c and m denote sectoral inputs. Postulating that the total input usage is given,

$$L_c + L_m = L \quad (3c)$$

$$\text{and } K_c + K_m = K \quad (3d)$$

Using input subscripts to denote partial derivatives of the production functions with respect to the inputs, let

$$\frac{M_L}{C_L} = \frac{M_K}{C_K} = (1 + \delta) \quad (4)$$

Equation (4) indicates that the ratio of respective marginal factor productivities in the two sectors deviates from unity by a factor δ . $C_m (= \frac{\partial C}{\partial m})$ would represent the marginal externality effect of military output on the civilian sector. If $C_m > 0$ and/or $\delta > 0$, increased military output will imply a higher rate of growth of total output Y , which is the sum of M and C for a given usage of L and K . Taking the total differentials of equations 2a, 2b, 2c, 3c, and 3d one can write the following:

$$dY = dC + dM \quad (5a)$$

$$dC = C_L dL_c + C_K dK_c + C_m dM \quad (5b)$$

$$dM = M_L dL_m + M_K dK_m \quad (5c)$$

$$dL_c + dL_m = dL \quad (6a)$$

$$dK_c + dK_m = dK \quad (6b)$$

As explained by Biswas and Ram (1986), the model yields the following econometric specifications:

$$\frac{dY}{Y} = C_K \frac{I}{Y} + C_L \frac{dL}{Y} + \left(\frac{\delta}{1+\delta} + C_m \right) \frac{dM}{Y} \quad (7)$$

$$\dot{Y} = \alpha \left(\frac{I}{Y} \right) + \beta (\dot{L}) + \left[\frac{\delta}{1+\delta} + C_m \right] \left[\dot{M} \frac{M}{Y} \right] \quad (8)$$

In equation (8), as in equation(1), a dot over a variable denotes its rate of growth, and $\frac{I}{Y}$ and $\frac{M}{Y}$ are the conventional notations for the ratios of investment and military spending to the total output.⁵ Equation (8) enables a test of hypothesis that both C_m and δ are zero. In that case, the coefficient of $\dot{M}(\frac{M}{Y})$ is zero and the expression reduces to the standard growth equation. To estimate separately the externality effect C_m and the relative factor productivity differential δ , further manipulation is needed. Making one simplifying assumption that the elasticity of civilian output with respect to military output is constant one gets the following form

$$\dot{Y} = \alpha \left(\frac{I}{Y}\right) + \beta(\dot{L}) + \left(\frac{\delta}{1 + \delta}\right) [\dot{M}(\frac{M}{Y})] + \theta \dot{M} \quad (9)$$

where θ is the elasticity of civilian output with respect to military output, that is,

$\theta = C_m \left(\frac{M}{C}\right)$. Equation (9) allows the externality effect C_m and the relative factor productivity differential δ to be separately identified.

Average variable values for the period 1981-89 are used. Average growth of real military expenditures is derived by fitting an exponential trend function to the constant dollar expenditures given in SIPRI year books. Equations (8) and (9) are estimated to provide information regarding the impact of military expenditures on overall economic growth through the externality effect and/or due to the sectoral factor productivity differential.

Empirical Tests for the Augmented Model

Table 3 presents estimates of equations (8) and (9) for the full sample and also for the subsamples for 1981-89. Estimated coefficients of $\dot{M}(\frac{M}{Y})$ for equation (8) for the full sample and for the subsamples are statistically significant. For equation (9), none of the estimated coefficients of $\dot{M}$ or $\dot{M}(\frac{M}{Y})$ for the full sample or for the subsamples are significant. That is consistent with the estimates in Table 2 that indicate a positive overall effect of military expenditures on growth. However, for the extended equation (9), neither the coefficient of $\dot{M}$ nor that of $\dot{M}(\frac{M}{Y})$ is significant at any reasonable level in any of the samples. Perhaps collinearity between these two variables lowers the precision of the estimates. Therefore, while one may say that the overall effect of military outlays on LDC growth is positive, it is difficult to ascertain whether it is the externality effect or the factor-productivity differential that is more important.

Concluding Remarks

This work was motivated by the consideration of replicating an earlier study by Biswas and Ram (1986) about the impact of military expenditures on economic growth. Econometric results are often fragile. In Leamer's (1983, p. 43) terms, "if we are to make effective use of our scarce data resource, it is therefore important that we study fragility in a much more systematic way." With a view to improving quality of prior research, this work uses the same model but a more recent data set.

Table 3 Some Statistical Results on the Relation Between Military Expenditure and Economic Growth in LDCs, 1981-89: Augmented Growth Model

	$\frac{I}{Y}$	$\dot{L}$	$\dot{M}(\frac{M}{Y})$	$\dot{M}$	R^2
Full sample (N = 74)	0.137** (3.351)	0.573* (1.786)	0.018** (3.413)		.22
	0.136** (3.264)	0.573* (1.773)	0.016 (1.463)	0.008 (0.156)	.22
Low income LDCs (N = 30)	0.184** (2.537)	-0.387 (-0.585)	0.013** (2.617)		.30
	0.189** (2.442)	-0.384 (-0.570)	0.015 (1.235)	-0.010 (-0.193)	0.300
Middle income LDCs (N = 44)	0.129** (2.155)	0.558 (1.426)	0.040** (3.091)		.30
	0.122** (2.031)	0.515 (1.317)	0.023 (1.242)	0.131 (1.27)	.32

Conventional estimates reported in Table 2 indicate a positive effect of military expenditures on economic growth for the full sample and for both subsamples. The augmented model supports that proposition represented in equation (8). However, the extended model of equation (9) indicates no significant externality effect or factor-productivity differential. It is possible that high correlation between $\dot{M}$ and $\dot{M}(\frac{M}{Y})$ lowers the precision of the estimates, and it is difficult to judge whether it is the externality effect or the factor-productivity differential that is more important. On the whole, one may say that, in contrast with the results obtained by Biswas and Ram (1986), the more recent data indicate positive effect of military outlays on LDC growth. However, caution is obviously needed in drawing strong inferences from such results.

Endnotes

I would like to thank Rati Ram for specific comments which I have incorporated in the present version. Of course, the author alone is responsible for any remaining errors or shortcomings. The financial support of the economics department of Utah State University is greatly acknowledged. Competent research assistance was rendered by Sarita Mahapatra and Joon-Ho Lee.

1. Data on military expenditures are taken from Stockholm International Peace Research Institute (SIPRI), *World Armaments and Disarmament, SIPRI Yearbook* (Oxford University Press, New York, 1987, 1991). Data on labor force growth and growth of GDP are from World Bank, *World Development Report 1991*, and all other variables are from World Bank, *World Tables*, 2d ed. (Baltimore: John Hopkins University Press, 1991).
2. Following the terminology in World Bank, *World Development Report 1979*, a low income developing country is defined as one with a per capita GNP of US \$580 or less in 1989 (on the basis of conventional exchange rates); middle-income LDCs are those having per capita GNP of more than \$580 but less than \$6000 in 1989.
3. The coefficient of I/Y is positive and statistically significant. However, its magnitude appears small. Also, as may be expected, the labor coefficient is not significant for low-income LDCs.
4. Feder's methodology is detailed in Gershon Feder, "On Exports and Economic Growth," *Journal of Development Economics* 12 (February-April 1983): 59-73. See also Feder, pp. 61-68.
5. For example, $\dot{Y}$ stand for $\Delta Y/Y$, and similar remarks apply to L and M . Feder's notation in this respect, as in some others, is different. He uses a dot over the variable to denote its absolute increase, not its rate of growth.

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Appendix A

Sample Countries

Argentina, Bangladesh*, Benin*, Bolivia, Botswana, Brazil, Burkina Faso, Burundi, Cameroon, Central Africa, Chad, Chile, Columbia, Congo, Costa Rica, Cote D'Ivoire, Dominican Republic, Ecuador, Egypt, El Salvador, Ethiopia, Gabon, Ghana, Greece, Guatemala, Haiti, Honduras, Hungary, India, Indonesia, Iran, Jamaica, Kenya, Madagascar*, Malawi, Malaysia, Mali*, Mauritania*, Mauritius, Mexico, Morocco, Mozambique*, Nepal*, Nicaragua, Niger*, Nigeria*, Oman, Pakistan*, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Rwanda, Senegal, Sierra Leone*, Somalia*, South Korea, Sri Lanka*, Syria, Tanzania*, Thailand, Togo*, Trinidad and Tobago, Tunisia, Turkey, Uganda*, Uruguay, Venezuela, Yugoslavia, Zaire*, Zambia*, Zimbabwe.

*Low-income LDCs.

Appendix B

Country Name	$\dot{M}$	$\frac{M}{Y}$	$\frac{I}{Y}$	$\dot{L}$	$\dot{Y}$
Argentina	-7.429	4.688888	18.37777	1.4	-0.3
Bangladesh*	5.464	1.466666	14.98888	2.6	3.5
Benin*	-0.283	1.957142	17.73333	3.2	1.8
Bolivia	-4.405	3.7	15.37777	2.7	-0.9
Botswana	11.688	2.955555	29.12222	3.4	11.3
Brazil	1.13	1.23333	24.47777	2.2	3
Burkina Faso*	4.357	2.911111	23.65555	2.6	5
Burundi*	-2.372	3	17.29999	2.9	4.3
Cameron	2.558	1.866666	27.75555	3.2	3.2
Central Africa*	-1.398	2	13.8	2.7	1.4
Chad*	58.932	6.06	8.128568	2.4	6.5
Chile	0.5454	7.933333	20.44444	1.7	2.7
Colombia	9.283	2.055555	24.81111	2	3.5
Congo	1.495	2.7	36.93333	3.4	3.9
Costa Rica	-0.302	0.577777	30.41111	2.4	2.8
Cote D'Ivoire	0.44	1.111111	11.42333	4.1	1.2
Dominican Republic	-5.976	1.444444	27.51111	2.3	2.4
Ecuador	3.694	1.744444	26.4	2.7	1.9
Egypt	-4.422	6.255555	36.2555	2.5	5.4
E. Salvador	-5.36	4.077777	31.3333	1.4	0.6
Ethiopia*	5.8503	9.188888	13.17777	3	1.9
Gabon	2.056	3.022222	38.37777	3.7	1.2
Ghana*	7.0474	0.688888	18.67777	3.4	2.8
Greece	-0.907	6.533333	24.65555	0.4	1.6
Guatemala	3.052	2.577777	14.64999	2.9	0.4
Haiti*	1.1143	1.285714	14.72222	1.9	-0.5
Honduras	13.255	4.588888	18.85555	3.5	2.3
Hungary	5.33	2.9	30.76666	-0.2	1.6
India*	7.3082	3.311111	24.38888	2.1	5.3
Indonesia*	-44.124	3.3	30.21111	2.1	5.3
Iran	-6.613	3.457142	21.66666	3.5	3.4
Jamaica	-8.537	1.2375	26.34999	1.3	1.2
Kenya*	-0.835	3.177777	24.5	3.9	4.1
Madagascar*	-7.003	2.311111	12.5	2.9	0.8
Malawi*	-4.853	2.244444	18.33333	3.4	2.7
Malaysia	-2.299	6.522222	21.66666	2.6	4.9
Mali*	6.052	2.528571	22.74444	2.5	3.8
Mauritania*	-16.082	7.475	29.01111	2.4	1.4
Mauritius	2.587	2.77777	27.4	1	5.9
Mexico	-7.578	0.575	27.7	2.1	0.7
Morocco	0.053	5.411111	31.28888	2.6	4.1
Mozambique*	7.153	9.983333	20.61111	2.7	-1.4
Nepal*	13.924	1.366666	21.83333	2.6	4.6
Nicaragua	1.121	15.94444	29.41427	3.4	-1.6
Niger*	3.7436	0.722222	14.66666	3.4	-1.6
Nigeria*	-14.794	1.533333	16.25555	3.4	-0.4

Country Name	$\dot{M}$	$\frac{M}{Y}$	$\frac{I}{Y}$	$\dot{L}$	$\dot{Y}$
Oman	4.384	21.34444	29.925	4.7	12.8
Pakistan*	7.986	6.622222	19.55555	3.2	6.4
Panama	9.743	1.711111	24.44444	2.2	0.5
Paraguay	0.135	1.266666	31.13333	3.2	2.2
Peru	-0.064	6	31.97777	2.3	0.4
Philippines	-5.5	1.744444	27.65555	2.5	0.7
Poland	3.0848	3.111111	31.52222	0.7	2.5
Portugal	2.846	3.3	36.36666	0.6	2.5
Rwanda*	-1.237	1.825	16.66666	3.2	1.5
Senegal	9.296	2.6	23.06666	3	3.1
Sierra Leone*	-19.834	0.8	13.88888	2.4	0.6
Somalia*	-12.827	3.055555	27.4	3	3
South Korea	6.3171	5.177777	22.05555	1.2	9.7
Sri Lanka*	23.302	2.5	26.36666	1.5	4
Syria	-10.646	14.16666	31.06249	3.6	1.6
Tanzania*	3.981	4.288888	21.21249	3.1	2.6
Thailand	2.064	4.755555	33.87777	1.9	7
Togo*	10.657	2.477777	25.28888	3.5	1.4
Trinidad & Tobago	-9.05	2.571428	12.60555	1.7	-5.5
Tunisia	5.517	4.88888	34.76666	2.5	3.4
Turkey	2.107	4.544444	30.53333	2.4	5.1
Uganda*	-5.448	3.511111	12.04444	3.2	2.5
Uruguay	-6.647	2.833333	19.08888	0.6	0.1
Venezuela	-3.952	2.511111	29.4	2.8	1
Yugoslavia	-1.284	3.944444	45.57777	0.7	1.3
Zaire*	-1.687	1.666666	11.67777	3.1	1.9
Zambia*	-7.254	3.488888	17.95555	3.7	0.8
Zimbabwe	5.244	6.311111	23.24444	3.5	2.7

$\dot{M}$ -- Annual rate of growth of military expenditure.

$\dot{L}$ -- Annual rate of growth of labor force.

$\dot{Y}$ -- Annual rate of growth of gross domestic product.

$\frac{I}{Y}$ -- Investment output ratio.

$\frac{M}{Y}$ -- Military expenditure output ratio.