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THE ECONOMIC EFFECTS OF INDIGENOUS ARMS PRODUCTION IN GREECE: A COMMENT AND FURTHER EMPIRICAL EVIDENCE*

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Abstract

This paper comments on Kollias's (1993) analysis of the economic effects of indigenous arms production in Greece and suggests an alternative model for the estimation of the defence effects on this country. Through a broader consideration of the defence effects on the whole economy for a longer time period, it is shown that military expenditure has been detrimental to economic growth in Greece, contrary to Kollias's findings. (JEL H56)

1. Introduction

In a previous issue of this Journal, Kollias (1993) examined the possible economic spin-offs of domestic arms production in Greece. Concentrating on Kennedy's (1974) "Potential Defence Capacity" (PDC) group of industries, he concluded that domestic arms production has an insignificant effect on Greek industrial output. The purpose of this note is to critically evaluate Kollias's analytical framework and empirical results, and to suggest an alternative model for the estimation of the defence effects on the Greek economy.

Kollias maintains that "the economic spin-offs of military expenditure take essentially two forms: a) Effective demand creation through domestic produc-

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tion of military inputs, and b) increasing productivity through technological progress, i.e. creation of new skills and R & D stimulation" (Kollias, 1993, p. 155). Based on this consideration of the defence effects, he tests the hypothesis as to whether there are such effects from domestic arms production on five PDC manufacturing sectors of the Greek economy in the period 1974-90, through the estimation of a basic sectoral regression model, with sectoral output as the dependent variable and total manufacturing output and military spending as the explanatory variables. The use of military spending in this model is meant to capture the expenditure on domestically produced durables, generated by the defence sector of the economy[1]. In general, his results indicate that "in the case of Greece, spin-off effects are not strong at all. The industries chosen have the best chance of receiving any beneficial effects. Apparently, such effects may be occasionally positive but they are extremely weak and negligible" (Kollias, 1993, pp. 161-162).

A direct implication of the insignificant effects of military expenditure on industrial output is that this expenditure is essentially neutral to output growth rates of the Greek economy. However, broadening the notion of defence implications to include the reallocation of resources effect of defence, and applying this notion to the whole economy for a longer time period, it can be shown that military expenditure is indeed detrimental to growth. Section 2 of this paper critically evaluates Kollias's analytical framework and empirical results. Section 3 provides evidence of the reallocation of resources effect of military expenditure in Greece, and develops a conventional growth model for the estimation of the net value of the combined defence effects on the Greek economy. Section 4 presents some concluding remarks.

2. A Broader Notion of the Defence Effects: The Need for a Whole Economy Study

Kollias attempted to estimate the economic effects of indigenous arms production in Greece, concentrating exclusively on domestic production of military inputs that creates effective demand, and technological progress that increases productivity. Such an approach, however, ignores an important category of defence effects resulting from the reallocation of resources caused by military expenditure. This expenditure diverts resources away from other uses and may have a direct opportunity cost in terms of foregone investment (Deger, 1986). Since military equipment is produced in capital goods industries, one would expect, in the short-run, substantial substitution between military expenditure and investment. Increases in military expenditure cause excess demand. Since capacity in these industries is, in the short-run, relatively inelastic and military demand is unlikely to be very price-elastic, given the prevalence of cost-plus contracts, the adjustment is taken by investment. This happens both through delays in the delivery of equipment and price changes that influence the cost of capital goods and investment demand (Smith, 1980; Antonakis and Karavidas, 1990a). These effects are of great significance at times of war or tension, when military expenditure is increased sharply. If, on the other hand, new technology is embodied in machines of the latest vintage (Hahn and Matthews, 1969), then any reduction in investment from the level it could have attained, not only results in a lowering of the quantity of the economy's capital stock, but also in a depression of technological progress. Thus, domestic production of military imputs, may initially increase the level of effective demand and the rate of productivity, as maintained by Kollias, but these positive effects do not give a complete picture of the defence effects, since, eventually, the reallocation of resources caused by military expenditure is likely to have adverse consequences. What counts, of course, is the net value of the defence effects.

Apart from its analytical framework, Kollias's paper can also be criticized on the grounds of time coverage of this study. His basic model was estimated over the period 1974-90, given that "since the mid-70s Greece has been engaged in domestic arms production" (Kollias, 1993, p. 156). However, my own research on the development of domestic arms production facilities in Greece came to different conclusions (Antonakis, 1992, 1994). In 1990, the Greek defence industry consisted of six large sized publicly-owned corporations, which were the major defence contractors in this country (the Hellenic Arms Industry S.A., the Greek Powder and Cartridge Company Inc., the Hellenic Shipyards Co. S.A., the Eleusis Shipyards S.A., the Hellenic Aerospace Industry Ltd. and the Hellenic Vehicle Industry S.A.), and thirty eight small to mid-size privately-owned corporations (all being members of the Federation of Greek Defence Industrialists -SEKPY), aimed at securing a minimum share of sub-contracting in total defence business. According to the ICAP S.A. Financial Directories of Greek companies, eighteen defence industrial corporations, including four major defence contractors were founded prior to the mid-70s. Thus, the Greek Powder and Cartridge Company Inc. (production of ammunition and explosives) was founded in 1874, the Hellenic Shipyards Co. S.A. and the Eleusis Shipyards S.A. (shipbuilding, ship repairs and conversions, ship engines repair) in 1956 and 1962, respectively, and the Hellenic Vehicle Industry S.A. (construction of military trucks, armoured vehicles and various accessories) in 1972. Among the major privately-owned defence sub-contractors, ELVIEMEK S.A. (ammunition and explosives) was founded in 1944, ECON OPTICS-MECHANICS CHR. ECONO-

MIDIS & SONS S.A. (metal parts and fittings, mainly for military vehicle engines) in 1953 and ANCO S.A. (electronic and telecommunication equipment and systems) in 1952. Certainly, this evidence casts doubt on the appropriateness of the selected, by Kollias, time period for the estimation of the defence spin-offs in Greece. Furthermore, even if it was the case that the development of the Greek defence industry started after the Turkish invasion of Cyprus in 1974, such a study should not concentrate on the PDC group of industries but should be expanded to comprise the whole economy, since the reduction in investment due to domestic defence production spreads over any sector extensively using capital goods necessary for the operation of the defence sector (Antonakis and Karavidas, 1990b). The empirical analysis of this note refers to the whole economy for a much longer period, from 1958 to 1990, for which comparable data were available for all the variables used in the regressions.

3. Empirical Results

3.1. The Reallocation of Resources Effect of Military Expenditure in Greece

My first task will be to provide evidence of the reallocation of resources effect of military expenditure in Greece. To this purpose, the share of gross domestic fixed capital formation (both private and public) in GDP (I/Y) was made a function of the share of military expenditure (ME/Y), output growth rate (G) and the share of the current-account balance of payments (B/Y). This equation has been adapted for data availability from Smith's (1980) modelling of the reallocation of resources effect elaborated above and an allocation process reflecting consumer substitution between private and public goods. The equation was estimated by the OLS method over the period 1958-90[2]. Time-series used in the regressions were tested for the presence of a unit root based on the augmented Dickey-Fuller (1979) test and the MacKinnon (1991) critical values. Also, the regression equation was tested for normality of the residuals using the Jarque-Bera (1987) test, for heteroskedasticity of the residuals using the Breusch-Pagan (1979) and Engle (1982) ARCH test, and for first-order serial correlation of the error term using the Durbin-Watson (1950) test. The Computer software packages used in the analysis were Micro TSP Version 7.0 and PC-GIVE Version 6.0. To save space, the details of the tests are not reported here, but they are available on request. Since the only problem identified by the diagnostics conducted was the presence of serial correlation of the disturbance term, the equation was re-estimated by the Cochrane-Orcutt (1949) iterative procedure, premised on the postulate of a first-order autoregressive stochastic term, due to the use of annual data. The regression result was

$$\left(\frac{I}{Y}\right)_t = \underset{(1.028)}{23.966} \underset{(-2.532)}{-1.813} \left(\frac{ME}{Y}\right)_t \underset{(-0.021)}{- 0.001G_t} \underset{(-1.902)}{- 0.289} \left(\frac{B}{Y}\right)_t$$

$$\overline{R}^2 = 0.810 \quad SEE = 1.770 \quad F = 34.251 \quad d = 2.044 \quad \underset{(12.311)}{\hat{\rho} = 0.972}$$

(t-values in parentheses)

The equation is satisfactorily defined in terms of the standard error of regression and the goodness of fit. The regression F-statistic is significant at the 1% level and the Durbin-Watson statistic does not provide evidence for rejecting the null hypothesis of no autocorrelation. The coefficient of B/Y is significant at the 5% level, while both coefficients of G and B/Y are negatively signed, quite contrary to expectations. Although these results seem, at first glance, unreasonable, in a Keynesian framework of policy activism it is possible to hypothesize a negative causal flow from some measures of aggregate economic activity to government spending, since in such a framework, expansionary or restrictive fiscal measures not merely impact on economic conditions, but also often reflect responses to such conditions (Ram, 1986). Given that, in the estimated model the variables G and B/Y proxy excess demand pressures, and that the dependent variable comprises both private and public investment, the estimated results may well be accepted. However, the most important finding of the regression result is that the coefficient of the defence burden (ME/Y) is negative and significant at the 1% level[3]. Since its value was close to -1, the hypothesis was tested that the actual resource trade-off between the shares of output devoted to defence and investment is equal to -1. The calculated value of the t-statistic was found equal to -1.136, suggesting that the difference from -1 was not even significant at the 10% level (t= 1.313). The results, therefore, not only provide evidence of he reallocation tof resources effect of military expenditure in Greece, but also point to the close substitution between defence and investment for most of the post-war period[4].

The results of the estimated investment equation indicate that the model used by Kollias, with the level of industrial output as the dependent variable, is an inadequate basis for the estimation of the actual economic effects of defence on the Greek economy. Since investment is crucial to growth, a proper method by which the central concept of the reallocation of resources can be examined together with the other categories of defence effects, is to estimate a growth model, whose dependent variable will have absorbed the whole host of defence effects, including the investment crowding-out effect of military expenditure.

3.2. The Defence - Growth Relationship in Greece

The question of the impact of military expenditure on economic growth in less developed countries (LDCs) has attracted a good deal of attention over the past two decades and much controversy exists in the literature over whether military expenditure helps or hurts the developmental process in those countries. While a number of cross-section studies have reported that higher defence budgets stimulate development (Benoit, 1973, 1978; Kennedy, 1974), others have shown that an increase in military burden may hinder economic expansion in LDCs (Deger and Sen, 1983; Deger and Smith, 1983; Leontief and Duchin, 1983; Lim, 1983; Faini, Annez and Taylor, 1984; Deger, 1986; Guimah-Brempong, 1989). A third set of studies, finally, have concluded either that military expenditure helps economic growth in resource-rich but not in resource-constrained LDCs (Frederiksen and Looney, 1982, 1983; Looney and Frederiksen, 1986), or that military expenditure neither helps not hurts economic growth in those countries to any significant extent (Biswas and Ram, 1986; Hess, 1989).

Clearly, the empirical evidence on the subject is ambiguous. The diversity on the conclusions must be mainly attributed to sample variations, differences in specificational choices and time periods examined and the different data bases and definition of variables used across the various studies (Brzoska, 1981; Ball, 1984, 1987; Chan, 1986; Grobar and Porter, 1989). Moreover, most of the aforementioned studies often rest on weak theoretical underpinnings, do not control for third factors, or do not forward a comprehensive model for explaining growth (Cappelen, Gleditsch and Bjerkholt, 1984). Therefore, earlier empirical work on the consequences of military expenditure in developing economies cannot provide full insights into the role and impacts of this expenditure in individual LDCs. Countries differ substantially in the natural environments they face and in socioeconomic structures, hence the need to undertake a longitudinal analysis for the estimation of country-specific defence-growth relationships.

For the purpose of this note, the effects of military expenditure on output growth rates of the Greek economy were estimated on the basis of a conventional growth model, which has the form

$$G_t = a_0 + a_1\, APS_t + a_2\, (ME/Y)_t + a_3\, (Y/P)_t + a_4\, (\dot{P}l)_t + a_5\, \dot{P}_t + u_t$$

where G is the annual rate of growth of GDP, APS is the average propensity to save (the savings to income ratio), ME/Y is the share of military expenditure in DGP, Y/P is the per capita GDP, $\dot{P}l$ is the annual rate of growth of population, $\dot{P}$ is inflation (the annual rate of change of GDPdeflator) and u is the random disturbance term. The military expenditure share was meant to capture the net value of the combined effect of spin-offs and reallocation of resources resulting from defence. The coefficient of this variable was therefore ambiguous, depending on the relative size of the adverse effects of military expenditure. The average propensity to save entered the equation with an expected positive sign, as predicted by almost all conventional growth theories. Per capita GDP with a predicted negative sign would indicate that this country with the post-war experience of continuously rising income per head, would probably be reaching the upper limits of its growth potential (Deger, 1986). Growth of population with a predicted positive sign was a proxy for labour force increase or the "natural" rate of growth. Finally, inflation was included in the model with an ambiguous sign in the light of the potential adverse effects it might have on growth. The relation between growth and inflation is difficult to establish a priori (Thirlwall, 1974). Inflation might lead to a rise in profitability that induces higher investment and hence growth. However, it is also possible that expectations of continuing inflation might cause a spending boom, conspicuous consumption and investment in low-priority sectors that have little growth potential.

The growth equation was estimated over the period 1958-90 by the OLS method. The estimating process involved difficulties attributable to multicollinearity caused by the presence of the population growth, per capita GDP and inflation variables in the model. For this reason, it was decided to estimate the basic equation with various permutations of the explanatory variables. Time series used in the regressions were tested for stationarity, and the estimated equations for normality, serial correlation and heteroskedasticity, using the diagnostics conducted for the investment share equation (the results of the tests are available on request). Since the Durbin-Watson test indicated the presence of serial correlation of the disturbance term, the equations were re-estimated by the Cochrane-Orcutt iterative procedure, premised on the postulate of a first-order autoregressive stochastic term, due to the use of annual data. The results are those of equations la-4a in Table 1 of the Appendix.

Given that the focus of this paper is on the contribution of military expenditure on economic growth and not on a thorough investigation of the growth process of the Greek economy, the estimated equations are reasonably well defined in terms of the standard error of regression and the goodness of fit. In all equations, the regression F-statistic is significant at the 1% level and the Durbin-Watson statistic does not provide evidence for rejecting the null hypothesis of no autocorrelation. With the exception of the growth of population, all explanatory variables seem to be important determinants of the output growth rates in

Greece. The coefficient of the military burden is negative and significant at least at the 5% level in two equations, while in the remaining is significant at the 10% level, indicating that the net value of the spin-off and reallocation of resources effects of defence is negative[5]. The military may have insignificant spin-off effects, as found by Kollias, but the total effect of defence seems to be negative due to the crowding-out of productive civilian investment. The positive coefficient of the GDP per capita is quite surprising, since such a relationship could be mainly generated by the expansionary/ restrictive effect of the rising/declining income per head on savings per head and, hence, on the average propensity to save, assuming a greater than one elasticity of savings with respect to income. However, the average propensity to save was included independently as an explanatory variable in the model and any income cum savings effects on growth should have been captured by the positive coefficient of the average propensity to save. Finally, the insignificance of the population growth variable should be attributed to the fact that in labour surplus economies the natural rate of growth is not a binding constraint.

In addition to a discussion of the estimates summarized in Table 1, some observations seem appropriate in regard to the specificational choice on which the estimates are based. The growth model adopted in this paper is fairly "standard" and has been widely used in the literature[6]. However, an explicit mention of three aspects appears necessary.

First, a problem arising from the estimates of Table 1 is whether these results are valid in the face of a number of omitted variables such as human capital endowments, economic structure, political orientation and historical and cultural factors (Landau, 1986). The omitted variables problem (specification problem in general terms) manifests as bias in the parameter estimates of the included variables. Moreover, their standard errors also tend to be biased and significance tests may lead to wrong inferences. To test for the existence of an, omitted variables problem in the growth model adopted in this paper, we applied the Ramsey and Schmidt's (1976) RESET test. The test procedure involves taking the square of the predicted value of the dependent variable from a given regression equation, adding it as an additional independent variable, re-estimating the regression, and testing for the significance of the new variable. If it is found to be significant, the inference is that the original regression has specification bias. With respect to the four specificational choises in Table 1, it is clear from the t-ratios corresponding to the squared predicted values of the dependent variable (reported in the Table) that the regression equations do not have specification bias.

Second, the question concerning the lagged effects of the income-growth and the military expenditure variables deserves consideration. The number of observations is obviously not large enough to permit a full-scale investigation of distributed lags. However, the importance of not having lagged variables in the growth equation has been explored in many ways, and it does not seem that the broad pattern of results is affected in any major way due to the noninclusion of lagged terms for the income-growth and the military expenditure share variables. For example, inclusion of the lagged income-growth term, as an additional regressor, with the implied Koyck-type distributed lag structure (Koyck, 1954), indicated that the lagged income-growth term is not positive (and below unity) and statistically significant in any of the equations la-4a of Table 1. However, the estimates of this extended growth model gave stronger support for the negative growth effects of defence on the Greek economy, since in this case, the coefficient of the military expenditure share was negative and significant at the 1% level in all equations (detailed regression results of the Koyck-transformed growth models are available on request).

With regard to the growth effects of lagged military expenditure values, although the number of observations is not large enough to enable reliable tests of Granger-type causality (Granger, 1969), some preliminary results did not suggest existence of a major bias. Direct inclusion of one and two-period lags for the military expenditure share showed that the pattern summarized in Table 1 broadly holds. In this case, the estimation of the extended growth model gave a negative sum of the coefficients of the jointly significant current and lagged military expenditure variables in all equations. These values are given in Table 1. It is noticeable that when the flow of causality from military expenditure to income growth was examined, the negative effects of defence on output growth rates became larger, as indicated by the comparison of the absolute values of the sum of coefficients to the coefficient of the current military expenditure share (detailed regression results from which the coefficient sums were derived are available on request).

Third, the structure of the growth equation might not have remained unchanged over the entire time period under consideration. The Turkish invasion of Cyprus in 1974 as well as the disputes between Greece and Turkey over the Aegean Sea's continental shelf, the width of Greek territorial waters and Greece's airspace limits, have created a strategic environment that might have adverse effects on the growth process of the Greek economy in the post-1974 period. On the one hand, the threat of war causes uncertainties and dangers that do not augur well for investment and growth. On the other hand, it is easier to mobilize and harness resources for investment in threat of war-time than in peace-time (Guimah-Brempong, 1989).

To investigate the effects of the threat of war on the output growth rates of the Greek economy, we re-estimated equations la-4a of Table 1 with slope and shift dummies. The results, however, indicated that no parametric change occurred in the coefficients of the explanatory variables in any of the equations. We included only a shift dummy variable, D, which took the value 0 for the 1958-73 period and the value 1 for the 1974-90 period, and estimated equations lb-4b in Table 1. The broad pattern of results was not affected in any major way by the inclusion of the dummy variable. In all equations, the coefficients of the average propensity to save, military expenditure share and inflation rate remained significant and correctly signed (in fact, the significance of the defence term increased in equations 3b and 4b), while the dummy variable appeared positively signed in all equations and significant in the last two of them. Subsequently, we tested the null hypotheses that, in each growth model of Table 1, the slope variables did not contribute to the explanation of variations in output growth rates. The test procedure utilizes the statistic

$$F_{(Q-L,\ N-Q)} = \frac{(SSR_Q - SSR_L) / (Q - L)}{SSE_Q / (N - Q)}$$

where Q is the number of the extended set of explanatory variables (the initial set of explanatory variables plus the set of shift and slope dummies, including the constant term), L is the number of explanatory variables in equations lb-4b, SSR is the regression sum of squares and SSE is the sum of squares of the least squares residuals. The estimated value of this statistic for each growth model as well as the tabulated value of F at the 5% level are given in Table 1. In each model, the null hypothesis was accepted, that is, no parametric change occured in the coefficients of the explanatory variables. Furthermore, since, contrary to expectations, the coefficient of GDP per capita was positive in all specificational choices of the growth equation, and became insignificant with the inclusion of the dummy variable, it was reasonable to conclude that this variable does not contribute to the explanation of variations in output growth rates in Greece. Excluding GDP per capita from the regressions, we were left with equations 3a-4a and 3b-4b. The results therefore indicate that, in the post-1974 period, there has been an upward shift in the growth equation, giving support for the hypothesis that countries experiencing war threats are able to mobilize resources for investment more easily than countries at peace. What is more important, however, is that, even after the upward shift, the growth effect of the military expenditure share has remained negative and significant[7].

4. Conclusion

The main objective of this paper has been to re-examine Kollias's (1993) findings on the insignificant economic effects of indigenous arms production in Greece. To this purpose, it was maintained that the spin-off effects estimated by Kollias, namely the effective demand creation through domestic production of military inputs, and the increasing productivity through technological progress, should be examined together with the reallocation of resources (investment crowding-out) effect of military expenditure in Greece, for which this note provided evidence on the basis of data over the period 1958-90. Furthermore, since investment is crucial to growth, a proper method by which the whole host of defence effects could be jointly investigated, would be to estimate a defence-growth relationship for the Greek economy, instead of estimating defence-sectoral industrial output models, as was done by Kollias.

The estimation of a conventional growth model for the Greek economy over the period 1958-90, indicated that the net value of the spin-off and reallocation of resources effects of defence is negative. The military may have insignificant spin-off effects, as found by Kollias, but the total effect of defence seems to be negative due to the crowding-out of productive civilian investment. This conclusion is fairly "robust", since the broad pattern of results was not affected in any major way due to the noninclusion of lagged terms for the income-growth and the military expenditure share variables. Finally, the results indicated that there has been an upward shift in the growth equation in the post-1974 period, without any parametric change in the coefficients of the military expendidure share or the other determinants of the growth process in Greece. Essentially the evidence confirms that military expenditure has been detrimental to economic growth in Greece, contrary to Kollias's findings.

Appendix

TABLE 1

Determinants of the Output Growth Rates in Greece, 1958-90

Dependent Variable	Coefficients of: Constant	APS	ME/Y	Y/P	$\dot{Pl}$	$\dot{P}$	D	$\overline{R}^2$	SEE	F	d	$\hat{\rho}$	RESET t	(ME/Y)+ +(ME/Y)-1+ +(ME/Y)-2	SSR_L (SSR_Q)	Q - L (N-Q)	SSE_Q	F(Q-L, N-Q) ($F_{0.05}$)
1a.G	5.418**	0.286***	-0.830*	0.084*	-0.041	-0.313***		0.651	2.082	10.639	2.306	-0.444		-1.008				
	(1.877)	(5.626)	(-1.488)	(1.678)	(-0.037)	(-3.945)						(-2.364)	-0.863					
2a.G	5.467**	0.285***	-0.844**	0.084**		-0.313***		0.664	2.042	13.277	2.306	-0.444		-1.121				
	(2.232)	(5.807)	(-2.188)	(1.722)		(-4.037)						(-2.445)	-0.868					
3a.G	7.392***	0.274***	-0.836*		-0.223	-0.202***		0.626	2.155	11.385	2.248	-0.427		-1.021				
	(2.687)	(5.188)	(-1.410)		(-0.194)	(-4.551)						(-2.273)	0.270					
4a.G	7.699***	0.272***	-0.915**			-0.200***		0.639	2.117	14.745	2.249	-0.425		-1.146				
	(3.545)	(5.306)	(-2.254)			(-4.774)						(-2.360)	0.269					
1b.G	8.120**	0.335***	-1.240*	0.032	-0.252	-0.349***	2.192	0.645	2.099	9.067	2.400	-0.474			279.663	5	80.369	1.262
	(1.815)	(4.152)	(-1.621)	(0.395)	(-0.227)	(-3.840)	(0.795)					(-2.507)			(305.037)	(20)		(2.71)
2b.G	8.221**	0.330***	-1.294**	0.037		-0.346***	2.036	0.659	2.058	10.986	2.392	-0.469			279.428	4	88.924	1.054
	(1.889)	(4.318)	(-1.832)	(0.475)		(-3.935)	(0.770)					(-2.545)			(296.483)	(22)		(2.82)
3b.G	9.451***	0.354***	-1.400**		-0.369	-0.348***	3.063**	0.657	2.063	10.919	2.430	-0.481			278.964	4	92.156	0.852
	(3.443)	(5.459)	(-2.275)		(-0.349)	(-3.922)	(1.867)					(-2.655)			(293.250)	(22)		(2.82)
4b.G	9.941***	0.350***	-1.526***			-0.342***	3.023**	0.669	2.028	13.534	2.427	-0.470			278.432	3	102.318	0.364
	(4.242)	(5.521)	(-3.077)			(-3.963)	(1.861)					(-2.661)			(283.089)	(24)		(3.01)

Notes:

(i) G = annual rate of growth of GDP, APS = average propensity to save (the savings to income ratio), ME/Y = the share of military expenditure in GDP, Y/P = per capita GDP, $\dot{Pl}$ = annual rate of growth of population, $\dot{P}$ = inflation (annual rate of change of GDP deflator).

(ii) $\overline{R}^2$ = the coefficient of multiple determination adjusted for degrees of freedom, SEE = the standard error of the regression, F = the regression F-statistic, d = the Durbin-Watson statistic, $\hat{\rho}$ = the autoregressive parameter estimate, RESET t = the t-statistic of the square of the predicted value of the dependent variable, SSR = the regression sum of squares, SEE = the sum of squares of the last squares residuals, Q = the number of the extended set of explanatory variables in the corresponding equation (the initial set of explanatory variables plus the set of shift and slope dummies, including the constant term), L = the number of explanatory variables in the corresponding equation, $F_{(Q-L, N-Q)}$ = the value of the statistic for the test of the significance of change in the slope variables, $F_{0.05}$ = the tabulated value of the F-statistic at the 5% level.

(iii) t-values in parentheses; (*) denotes significance at the 10% level, (**) at the 5% level and (***) at the 1% level.

Footnotes

1. Given the availability of data on "military equipment and construction expenditure" in Greece (source: *National Accounts of Greece,* Ministry of National Economy and National Statistical Service of Greece), total military expenditure (including the "pay and allowances of the Armed Forces") cannot be regarded as the best indicator of the expenditure on domestic defence durables. However, for the sake of comparison of my conclusions to Kollias's findings, I will maintain the same explanatory variable in the approach to be elaborated in this paper.

2. All variables are derived from data in constant 1970 prices. Data from the National Accounts of Greece, 1958-75, No 23, and the Provisional National Accounts of Greece, 1983,1984, 1987, 1988 and 1991, Ministry of National Economy and National Statistical Service of Greece.

3. It might be argued that there is a simultaneity problem in this equation, since it is likely that the share of investment may influence the rate of growth and the share of the balance of payments, though it is more likely that military expenditure is not influenced by investment (see Antonakis, 1985, 1989, 1994). The negative relationship between investment and military expenditure, however, does not depend on the coefficients of the endogenous variables (G and B/Y) and it is these that are most likely to be biased.

4. The hypothesis of close substitution between military expenditure and investment was first tested by Smith (1977, 1980). Using cross-section data for large OECD countries, he found a clear negative effect of military expenditure on investment, with a coefficient on military expenditure not significantly different from -1. A theoretical mechanism producing such a close substitution was developed in Smith (1977).

5. As in note 3 above, it has been shown elsewhere that military expenditure does not depend on output growth rate. Thus, the possible existence of a simultaneity problem is not likely to affect the unbiasedness of the military expenditure coefficient.

6. For example, Deger ans Sen (1983), Faini, Annez and Taylor (1984), Deger (1986), Hess (1989).

7. This conclusion seems to be fairly robust in the case of the Greek economy. Within a Harrod-Domar growth framework, it has been shown elsewhere that military expenditure is inversely related to growth rates (see Antonakis and Karavidas, 1990b).

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