Revisiting the Nexus between Military Spending and Growth in the European Union

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Abstract
This paper focuses on the influence of military spending on European economic growth. The estimated regressions are based on Barro's (1991) growth model which controls for economic institutional variation across countries. The cross-section and panel data analyses cover the period 1960 - 2000. The empirical findings indicate that military spending has an overall net negative influence on economic growth. Furthermore, the magnitude of this negative impact tends to increase over time as cross-section regression results indicate. Given the development of a Common European Security and Defence Policy (CESDP), these findings suggest that enhanced defence spending may hinder European economic growth.

JEL Classification: O40, H50, C21, C23
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1. Introduction

A recent paper by Kollias *et al.* (2006) examines the causal relationship between defence expenditure and economic growth in the case of the European Union (EU15). The choice of this group of countries is motivated by the recent movement towards the development of a Common European Security and Defence Policy (CESDP), which raises a plethora of complex and multidimensional issues of political, strategic and economic nature.[1] The empirical findings provide evidence for the presence of a positive feedback effect between growth and military expenditure in the long run, and a positive impact of

[1] For a more detailed analysis of the multidimensional issues of CESDP and defence spending in the EU15 see Kollias et al. (2006).

the latter on the former in the short run. On the basis of these results Kollias *et al.* (2006) argue that, in the context of a CEDSP, increases in the defence expenses by the European states, needed to support and develop an independent EU defence capability, may also induce growth. Aggregate demand stimulation, technical progress from military R&D, even earnings from arm exports are cited as possible channels through which such expenditures can stimulate growth, although the authors acknowledge that it is difficult to estimate their precise economic impact.

In this paper I re-examine the impact of defence spending on European economic growth from the perspective of growth literature. The underlying motivation for the present paper is the well known fact that the defence economics literature does not indicate any robust empirical regularity between military spending and economic growth. In addition, it turns out that the relationship in question depends upon the econometric methodology and specification employed, as well as on the time periods covered by the different studies (Dunne (1996) and Dunne *et al.* (2004)).

I conjecture that these diverse findings may be due, among other things, to omitted variable biases. Consequently, the framework for my empirical investigation originates from growth empirics (Barro, 1991). This framework allows for incorporating a variety of variables (commonly referred to as *control* variables) thought to be possible determinants of long-term growth (Sala-i-Martin 1994, 741). The list of control variables includes the country's initial level of real per capita GDP, its long term real average investment share of GDP, its long-term population growth rate, and a measure for its long-term rate of human capital formation. The inclusion of the first base variable permits the testing of the *conditional convergence* (i.e., less developed countries tend to experience higher rates of economic growth than more developed ones, given their individual steady states), whereas the inclusion of the other three base variables is justified, at least partially, by the endogenous growth theory.[2]

Since Barro's (1991) seminal paper, there have been numerous empirical studies that estimate cross-country regressions to examine the possible determinants of long-term economic growth. An almost ignored explanatory variable in the empirical economic growth literature is military spending. This oversight is surprising in view of the substantial attention that the investigation of the impact of military spending on growth has received in the defence economics literature.

Quantifying the extent of the defence burden on economic growth within a neoclassical growth framework has been the focus of five studies. Barro and Sala-i-Martin (1995) examine this question by estimating cross-section regression for 87 countries for the period 1965 – 1975, and 97 countries for the period 1975 –

[2] Typically included in the Barro-*style* regressions is also a set of non-control variables, commonly known as *policy* variables. Nevertheless, the inclusion of these variables is, as Sala-i-Martin (1994) suggests, probably ill-advised because they are usually highly correlated with each other. Hence, I opt for the exclusion of these variables from the subsequent empirical analyses.

1985, and find no statistically significant effect of military spending on growth.[3] Similar findings are reported by Knight *et al.* (1996) in a cross-section study for 79 countries over the 1971 – 1985 period. However, they report a significant and negative effect when they utilise a panel estimator applied to three non-overlapping five-year periods. Stroup and Heckelman (2001) also apply panel data techniques in a sample of 44 African and Latin America countries during the period 1975 - 1989. They show that the defence burden function (i.e., the influence of military resource use on economic growth) is non-linear and concave. In other words, low levels of military spending can have a positive impact on economic growth, but this positive influence turns negative at higher levels of military spending. Aizenman and Glick (2003) follow a somewhat different approach. Specifically, they estimate cross section regressions for 99 countries to empirically evaluate the ultimate growth effects of military expenditure after controlling for the non-linear interactions between the intensity of threats and defence spending. They suggest that only in the presence of threats above 3.5 (in an efficient scale ranging from 0 to 9) the marginal impact of military expenditures on growth is positive. Finally, Brumm (1997) examines the relationship between military spending and economic growth by estimating cross-section Barro-regressions for 88 developed and developing countries using averages from 1974 to 1989. This study is the only one that reports a statistically robust positive correlation between the growth rate of real GDP per capita and the average military expenditure share of GDP, hence suggesting that enhanced national defence fosters economic growth.

The purpose of the present paper is to shred further light on the growth – military spending relationship by estimating Barro-style regressions for fourteen European Union countries (EU14)[4] using cross-section and panel data techniques for the period 1960 - 2000. In terms of defence spending and economic growth, the EU14 member states present a very diverse pattern. The mean of 5-year averages of the defence burden (i.e., military expenditure as a proportion of GDP) ranges from 1.02% in the case of Austria to as high as 4.59% in the case of Greece. For the same time intervals the average for the whole EU14 is 2.87%. To a large extent, this heterogeneity in defence spending reflects varying degrees of external security needs and significant differences in defence policy among the EU14 member states. In terms of economic growth, the European countries present similar variations. The average EU real growth rate is 2.94% with the UK rate of 2.11% being the lowest among the fourteen members for the whole period, while the highest is that of Ireland with an average of 4.22%. [5] To the best of my knowledge, no previous study has addressed the nexus between military spending

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[3] Barro (1991) also investigates the impact of political instability (proxied by figures on revolutions, coups, and political assassinations) on economic growth by estimating a single cross-section regression for 98 countries in the period 1960 – 1985. He reports a statistically significant inverse relationship between these proxies and economic growth. This finding is justified on the basis of the adverse effects of political instability on property rights, and hence on private investment.

[4] Luxembourg is excluded from the data set due to non-availability of data on education.

[5] See Note 1.

and economic growth in the EU using both cross-section and panel techniques for the specific country and time period sample. Panel data techniques, especially, are acknowledged to offer a better framework for statistical inference *vis-à-vis* other methodological approaches (Dunne and Perlo-Freeman, 2003).

The remainder of the paper is organised as follows: the next section is a brief review of previous theoretical work within the defence economics literature regarding the relationship between military spending and economic growth. Section 3 outlines the data and the empirical estimation results. Finally, Section 4 concludes the paper.

2. Theoretical issues in the defence economics literature

With respect to the theoretical treatment of the defence burden issue, one can identify a list of possible positive effects on economic growth. This list includes a stimulative effect from defence expenditures during periods of unemployment, caused by underconsumption or underinvestment demand[6], as well as technological and managerial spin-off effects transmitted from the defence to the private sector. Regarding the public sector productivity, many developing countries use military resources to provide social infrastructure (e.g., roads, communication networks) and other human capital enhancing activities (e.g., military education and training) that may later impact the private sector. Finally, government activities, such as the provision of national defence, which maintain property rights, can indirectly support growth by increasing citizens' incentive to accumulate capital and to produce (Thompson, 1974).

The list of conceivable opportunity costs to economic activity from military resource use includes lower levels of public and private investment that are more growth enhancing than defence (the *crowding-out effect*), adverse balance of payments in case of arm importing countries, inefficient bureaucracies and a smaller tax base available for providing civilian public sector services. Finally, growth is also inhibited when defence diverts R&D activities and well-educated workforce from the private sector.[7]

Another interesting point raised by Stroup and Heckelman (2001) is how military spending influences growth when assuming diminishing returns to the defence sector. Specifically, if one assumes diminishing marginal productivity in the military sector, the magnitude of the alleged benefits (costs) to growth would increase at a decreasing (increasing) rate as a greater proportion of a nation's available productive resources are diverted to the military sector. Taking into consideration both functions, the authors argue that the net impact of military expenditures on economic growth is a non-linear, concave defence burden

[6] This effect requires a disequilibrium in the economy, and ends once the economy reaches its full employment level.

[7] Technological spin-offs are considered to be faster if they originate from the private sector.

function. Clearly, this function implies that at low levels of military spending, the net effect on growth may be positive. After a certain maximum influence point, growth declines as military spending continues to expand, and eventually it may turn negative.

3. Empirical analysis

3.1 Data Description

The dependent variable in the estimated Barro-style regressions is the annual rate of growth of real GDP per capita averaged over five-year intervals (*growth*). The set of explanatory variables includes control variables typically used in the empirical growth literature (e.g., Barro and Sala-i-Martin, 1995, Ch. 12), namely, the log of real GDP per capita at levels (*gdp*), the log of the number of years of schooling attained by males and females aged 25 and over at all levels of education (*edu*), population growth (*pop*) and the average real investment/GDP ratio (*inv*). Data on military spending (*mil*) are measured as the ratio of military expenditure to GDP. Hence, *mil* is an indicator of the defence burden imposed on national economies.

Data on the dependent variable is calculated for eight five-year periods, namely 1961 – 1965, 1966 – 1970, 1971 – 1975, 1976 – 1980, 1981 – 1985, 1986 – 1990, 1991 – 1995 and 1996 – 2000. The values of the explanatory variables *pop, inv and mil* represent the averages over the aforementioned growth periods, whereas the values of *gdp* and *edu* correspond to the years preceding the growth periods (i.e., 1960, 1965, 1970, 1975, 1980, 1985, 1990 and 1995).

Data on GDP, population and investment are drawn from the Penn World Tables, version 6.1; education data are taken from the Barro-Lee data set (website: http://www.cid.harvard.edu/ciddata/ciddata.html); and data on military spending are obtained from various SIPRI Yearbooks (Stockholm International Peace Research Institute). Data are analysed for a sample of 14 EU countries (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden and the UK).[8]

3.2 The Empirical Evidence

The empirical specification for the cross-section regressions is:

$$growth = \alpha_0 + \alpha_1 gdp + \alpha_2 edu + \alpha_3 pop + \alpha_4 inv + \alpha_5 mil + \varepsilon \qquad \text{eq. (1)}$$

Accordingly, the empirical specification for the panel data regression is:

$$growth_{t,i} = \alpha_0 + \alpha_1 gdp_{t-1,i} + \alpha_2 edu_{t-1,i} + \alpha_3 pop_{t,i} + \alpha_4 inv_{t,i} + \alpha_5 mil_{t,i} + \varepsilon_{t,i} \qquad \text{eq. (2)}$$

[8] Ram (1995) suggests using at least five-year long growth periods to capture the total influence of defence spending on economic growth.

The signs anticipated for the estimated coefficients of the explanatory variables are those obtained in previous studies. The conditional convergence hypothesis predicts that a higher rate of growth occurs at lower levels of initial GDP per capita (Barro, 1991): $\alpha_1 < 0$. Similarly, an increase in the population growth rate is expected to reduce the rate of economic growth (Mankiw, Romer and Weil, 1992): $\alpha_3 < 0$. On the contrary, an increase in the initial human capital (measured by *edu*) is expected to have a positive impact on the growth rate (Barro, 1991): $\alpha_2 > 0$. Positive impact on growth is also expected with increased investment (Romer, 1990): $\alpha_4 > 0$. The growth effect of military spending is ambiguous.

The *Barro* regressions specified in eq. (1) are estimated for each of the eight five-year intervals by the method of Ordinary Least Squares (OLS) with White robust covariances to account for heteroskedasticity. Table 1 shows the results for the cross-section *Barro* regressions.[9] The goodness of fit measures (adjusted R^2 and *F*-statistic) indicate the relative appropriateness of the specification. The results are for the most part consistent with those reported in earlier studies. The statistically significant negative correlation between *growth* and *gdp* provides support for the conditional convergence hypothesis. The estimated coefficient of *edu* is significantly different from zero in only one time interval (1996-2000) and has the anticipated positive sign. The estimated coefficient of *pop* has the correct (negative) sign in five growth periods but it is statistically insignificant. The estimated coefficient in *inv* is positive in sign and statistically significant in two growth periods (1966-1975).

The results obtained for *mil* are of particular interest. The estimated coefficients are statistically insignificant in five out of eight growth periods. In the remaining three time intervals (1971 – 1975; 1991 – 1995; 1996 – 2000), there is evidence that the opportunity costs of defence expenditures outweigh any benefits, hence resulting in a statistically significant negative correlation between *growth* and *mil*. Furthermore, based on Wald test results, it is evidenced that the magnitude of the negative impact of military spending on growth significantly increases over time (from an estimated coefficient of -0.227 in the 1971-1975 period to -1.229 in the 1996-2000 period).

Next, these standard cross-section estimation results are compared to the panel data estimates (Table 2). The utilization of panel data techniques is well justified in the growth empirics literature. Islam (1995), for example, emphasises the fact that in a cross-country study, it is necessary to control for differences in

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[9] Eq. (1) is also estimated including average real government consumption share (net of public fixed investment) as an additional regressor. The rationale is that the exclusion of this proxy of fiscal policy may downward bias *mil* due to omitted-variable problem. The estimation results (available upon request) indicate that this policy proxy is statistically insignificant in seven out of eight growth periods, and it does not qualitatively alter the estimation results reported in Table 1.

preference and technology, and hence in steady states. *Control* variables on the right-hand side of the regressions only account for the observable part of such differences. Yet, they leave out all these dimensions that are not readily observable. The panel data approach overcomes this limitation by allowing for unmeasurable differences across countries in the form of *country fixed effects*.

Again, the dependent variable is measured as the growth of real GDP per capita over eight five-year intervals. This approach provides a simple way of averaging out short-run cyclical variations in the rate of capacity utilization. The first row of Table 2 reports the estimation results when *mil* is not included in the regression. The second row reports the estimation results after including *mil* as an explanatory variable. Our primary focus is on the second row of Table 2.[10] The adjusted R^2 indicates that this specification explains almost half of the total variation in the dependent variable (R^2=0.436). Furthermore, the DW statistic suggests that the residuals do not suffer from first order correlation (Bhargava *et al*, 1982). Finally, a tacit assumption underlying eq. (2) is that the set of the explanatory variables and the regressand are not simultaneously determined. RESET test is a general test to reveal specification errors due to omitted variables, incorrect functional form, and simultaneity. The large ρ-value of the RESET test statistic suggests that none of the above specification errors is a problem here.

In general, the panel coefficient estimates confirm those reported in Table 1 in the Appendix. The lagged value of GDP per capita is significant and negatively related to the growth rate. On the contrary, the human capital variable and the growth rate of population are not statistically significant. Investment in physical capital exerts a positive effect on growth. Finally, the military spending ratio has a negative and significant effect on growth.[11] This is consistent with the predictions of the endogenous growth theory which suggests that government intervention hinders economic growth through higher taxation and distortion of private sector incentives. However, this finding is in sharp contrast with that reported in Kollias *et al.* (2006) where the empirical results suggest the presence of a positive feedback between European economic growth and military expenditure in the long run. I conjecture that this diversity in the reported results originates from the fact that the present study examines the nexus between defence spending and economic growth after accounting for variables designed to control for differences in cross-country steady states. Furthermore, it is clear from rows 1 and 2 in Table 2 (in the Appendix) that the inclusion of the military spending ratio marginally reduces the absolute size of the estimated coefficient of physical investment (from an estimated coefficient of 0.237 to 0.222). This may indicate the possibility of other channels through which *mil* adversely affects *growth*, namely, through crowding out investment in productive fixed capital. Since growth, investment

[10] Qualitatively similar results (available upon request) are obtained when eq. (2) is estimated with the average real government consumption share as an additional explanatory variable.

[11] The statistically significant negative impact of *mil* on growth suggests that the defence burden hypothesis developed by Stroup and Heckelman (2001) is not applicable in the case of EU14 member states.

and military expenditures in a particular time period are likely to be jointly determined, the aforementioned regression estimates may suffer from endogeneity bias. Dunne *et al.* (2005) argue that using the share of military expenditure in GDP in the growth specification reduces the endogeneity problem, since the share of military expenditure is likely to be less correlated with output shocks than the level of military spending. This argument is confirmed in the present analysis. A formal test of exogeneity (Davidson and MacKinnon, 1989) of *mil* in eq. (2) is performed, and the reported ρ-value = 0.463 suggests that the suspect variable is not endogenously determined with *growth*. Hence, the Panel Least Squares estimates reported in the second row of Table 2 in the Appendix are unbiased and consistent.

4. Concluding Remarks

The European Union Military Staff Organisation, the Military Committee of the European Union and the establishment of the European Defence Agency in 2004 are the current culmination of the efforts for the creation of a European defence pillar. The present study is motivated by, and focused on, the economic dimension of a common European defence within Barro's (1991) model specification.

The cross-section and panel data analyses cover eight non-overlapping five-year growth periods over 1960 – 2000. In the case of the panel data analysis the statistical results are based on a fixed, country-specific effects model using observations from a sample of fourteen EU member states. The empirical findings indicate that military spending has an overall net negative influence on economic growth during the periods considered. Furthermore, the magnitude of this negative impact tends to increase over time as evidenced by the cross-section regression results.

On the basis of these results one may argue that, in the context of a CEDSP, increases in the defence budgets by the European states, needed to support and develop an independent EU defence capability, are likely to hinder European economic growth performance. This may originate from the possibility that, other things equal, a rise in military spending exerts a negative impact on the rate of investment in productive fixed capital (crowding-out effect).

Finally, the results reported in the present paper contradict those reported in the work by Kollias *et al.*, 2006 which investigates the empirical bivariate relation between military spending and economic growth in the EU15. I conjecture that this contradiction results from the fact that the latter empirical work is subject to omitted variable biases.

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APPENDIX

Table 1. Estimated *Barro-style* Cross – Section Regressions

Intervals	gdp	edu	pop	inv	mil	Adj. R^2	F-statistic (ρ-value)	Wald-test (ρ-value)
1961-1965	-5.146*	1.682	1.853	0.093	-0.068	0.252	0.229	-
1966-1970	-3.017***	-0.166	0.669	0.186***	-0.014	0.860	0.001	-
1971-1975	-3.468**	-0.124	-0.580	0.085*	-0.227*	0.565	0.032	-
1976-1980	-5.501*	0.568	-1.569*	0.104	0.001	0.267	0.191	-
1981-1985	0.111	1.085	-0.424	-0.027	-0.231	0.006	0.466	-
1986-1990	-2.041	-1.671	-0.655	-0.021	-0.488	0.492	0.055	-
1991-1995	-5.229***	2.367	-1.043	-0.041	-0.794***	0.256	0.200	0.014
1996-2000	-10.392***	4.904***	3.615***	-0.156	-1.229***	0.789	0.002	0.000

Notes : The dependent variable is the five-year period average annual change in real GDP per-capita. All cross section regressions are estimated by Ordinary Least Squares with White robust covariances to account for heteroskedasticity in each cross-section equation. The null hypothesis of the Wald test is that the estimated coefficient of *mil* in the last two growth periods equals -0.227. Rejection of the null indicates a statistically significant increase in the negative impact of *mil* on *growth*. *** denotes statistically significant coefficients at the 1% significance level; ** denotes statistically significant coefficients at the 5% significance level; * statistically significant coefficients at the 10% significance level.

Table 2. Estimated *Barro-style* Panel Regressions

gdp	edu	pop	inv	mil	Adj. R^2	F-statistic (ρ-value)	DW	RESET (ρ-value)	Exogeneity (ρ-value)
-3.093***	2.050	-0.691*	0.237***	-	0.418	0.000	2.036	0.911	-
-3.376***	1.119	-0.659	0.222***	-0.408***	0.436	0.000	2.055	0.385	0.463

Notes : The dependent variable is the five-year period average annual change in real GDP per-capita. Panel regressions in rows 1, 2 and 3 are estimated by Panel Least Squares. White robust covariances to account for cross-equation (contemporaneous) correlation, as well as for different error variances in each cross-section equation. Fixed country effects are not reported to save space. DW is the Durbin-Watson statistic for the presence of 1st order serial correlation. The upper 5% critical value for the DW statistic (T=10 and H=50) is 1.8769 (Bhargava *et al.* 1982). RESET tests the hypothesis that the coefficients on the powers (up to the 4th power) of fitted values are all zero. Exogeneity statistic tests the null hypothesis that *mil* is an exogenous variable (Davidson and MacKinnon, 1989). *** denotes statistically significant coefficients at the 1% significance levels; ** denotes statistically significance at the 5% significance level; * denotes statistically significance at the 10% significance level.