Defence Spending and Economic Growth in the EU15

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Abstract

Over the last 30 years there has been an impressive amount of empirical work on the defence-growth nexus, using different methodologies, models and econometric techniques and focusing on individual case studies, cross-country studies or panel data studies. Despite the number and the variety of studies, the evidence on the defence-growth relationship is still far from conclusive. Rather surprisingly, very limited work has been published in the relevant literature for the European Union despite the continuous discussions for a Common European Defence Policy that would require an assessment of the economic effects of defence in this region. To fill in the gap in the literature, this paper employs an augmented Solow-Swan model and estimates it both with panel and time series methods to provide empirical evidence on the economic effects of defence spending in the EU15 over the period 1961-2007. Overall, evidence derived from both panel and time series methods is consistent and suggests that military burden does not promote economic growth in this region.

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JEL classification: H56; O40

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INTRODUCTION

The relationship between defence spending and economic growth has been extensively investigated since the seminal study of Benoit (1973, 1978) that suggested a positive relationship between the two variables. The simplistic approach and the various problems associated with this study triggered many researchers to re-examine the same relationship using more sophisticated methods, different theoretical underpinnings, longer time series or larger cross sections. Despite all this, and despite the huge amount of empirical work since the Benoit study, there is still no consensus on the impact of military spending on growth. Of course, there is a wide variety of possible reasons that may lead to different results (ie. different theoretical underpinnings, models and specifications, different estimation methods, different countries, different time periods examined etc) (Dunne and Uye, 2009). This lack of consensus combined with continuous developments in econometrics has led researchers in the area to continue with attempts to identify/establish a more stable/robust relationship.

The purpose of this paper is four-fold. First, it aims to provide empirical evidence on the defence-growth relationship for the EU15, a region that has not attracted much research interest despite its importance in the global economic environment and discussions over the creation of a Common European Defence Area. Secondly, the paper follows Dunne et al. (2005) in employing a growth model that has only recently entered the relevant literature; third, it provides both panel and time series estimates for the fifteen countries in order to compare between them, and finally, it uses longer data series than many previous studies.

The next section provides an overview of the economic development and military expenditure pattern in the EU15, with section three reviewing the existing theoretical and empirical literature. Section four then, discusses the methods used, specifies the model employed and gives the empirical findings. Finally, the last section summarises and concludes the paper.

MILITARY SPENDING AND ECONOMIC GROWTH IN THE EU

As a group, the EU15 has shown an interesting pattern of economic development. As Table 1 shows, it enjoyed high growth rates during the 1960s with the average rate 5.48%. This continued until 1974-5 when the world energy crisis and the recession put most of the countries into negative growth. The relatively poor economic performance continued into the 1980s, before improving slightly in the 1990s, with an average growth rate of 3%. Within this pattern there were some variations as the recession also coincided with the collapse of the dictatorships in three countries, namely Greece, Spain and Portugal and in the case of Greece, 1974 was the year of the conflict with Turkey over Cyprus. The most noticeable improvements in GDP growth during the 1990s occurred in Ireland and Luxembourg (with an average growth rate in the 1990s of 7.84% and 6.22% respectively). The average growth rate of GDP for the 15 EU countries over the years 2001-2007 saw a decline with only four countries (Finland, Greece, Spain and Sweden) experiencing higher rates of growth compared with the previous decade.

Table 1. GDP growth for the EU Countries (%)

	1961-70	**1971-80**	**1981-90**	**1991-2000**	**2001-2007**	***1961-2007***
Austria	4.96	3.83	2.39	2.47	1.53	*3.20*
Belgium	5.19	3.56	1.92	2.17	1.47	*3.02*
Denmark	4.76	2.38	2.03	2.51	1.41	*2.76*
Finland	5.11	3.71	3.21	2.25	2.32	*3.43*
France	5.93	3.49	2.40	2.00	1.53	*3.24*
Germany	4.73	2.86	2.35	2.07	0.75	*2.75*
Greece	9.31	5.17	0.76	2.45	4.63	*4.44*
Ireland	4.43	5.02	3.78	7.84	5.47	*5.29*
Italy	6.06	3.82	2.29	1.63	0.65	*3.14*
Luxembourg	3.78	2.87	4.87	6.22	3.38	*4.32*
Portugal	7.00	5.22	3.38	3.03	0.63	*4.21*
Spain	7.91	3.77	3.14	2.84	3.24	*4.28*
Sweden	4.65	1.98	2.02	1.92	2.24	*2.60*
The Netherlands	5.39	3.10	2.28	3.19	0.96	*3.21*
UK	3.02	2.09	2.80	2.51	2.38	*2.58*
EU15 (average)	**5.48**	**3.52**	**2.64**	**3.00**	**2.17**	***3.50***

Source: Eurostat

The variation in growth among the 15 countries is also apparent in the figures for GDP per capita, as the figures in Table 2 show. However, the countries at the top end with the highest average GDP per capita throughout the period - Luxemburg, Germany, Denmark, The Netherlands, Sweden and Austria - remained there as did countries like Greece, Portugal, Spain at the bottom end.

Table 2. GDP per capita for the EU Countries (in 1998 US$)

	1961-70	**1971-80**	**1981-90**	**1991-2000**	**2001-2007**	**1961-2007**
Austria	10194	15605	19681	24365	28120	*18646*
Belgium	10691	15993	19356	23463	26915	*18436*
Denmark	12985	16999	20601	24476	27884	*19779*
Finland	8809	13257	17667	20135	25227	*16107*
France	11032	16053	19388	22446	25284	*18125*
Germany	13757	18847	23056	23201	24886	*20290*
Greece	6185	11755	12914	14327	18149	*12057*
Ireland	5903	8668	11301	19182	31268	*13486*
Italy	9625	14187	18297	22057	24595	*16992*
Luxembourg	14674	19526	25222	40900	54356	*28333*
Portugal	4727	8310	10469	14545	16904	*10334*
Spain	7695	12071	14022	18256	22665	*14084*
Sweden	12903	16774	19788	22081	26542	*18848*
The Netherlands	12389	17361	19743	24814	28795	*19712*
UK	11463	14386	17466	21636	26283	*17354*
EU15 (average)	**10202**	**14653**	**17931**	**22393**	**27192**	***17505***

Source: Eurostat

Military burden over the period also varied across countries, as shown in Table 3. Some differences reflect security issues, but more are likely to reflect internal pressures resulting from the existence of military industries. Among the big defence spenders, the UK and France are the only countries of the European NATO with the status of nuclear powers and with Germany, they all have developed defence industry. Other countries with a relatively developed defence industry are Spain, Sweden, Italy, Austria and the Netherlands. Portugal had a high military burden for the years prior to 1974 and after that it dramatically decreased, with the end of the dictatorship and most importantly with the end of the Colonial Empire. However, the Portuguese defence industry (like the Greek defence industry) is small, inefficient and underdeveloped. For Greece, the end of the dictatorship coincided with the Turkish invasion of Cyprus in 1974 that marked a huge increase in military burden for Greece (reaching an average of 6.5% of GDP during the fifteen years following the conflict), which even after the end of the Cold War it remained high in comparison to other EU countries because of the perceived threat from Turkey (see Nikolaidou, 2008 for more details).

Table 3. Defence Spending as share of GDP (%)

	1961-70	1971-80	1981-90	1991-2000	2001-2005	1961-2007
Austria	1.22	1.15	1.17	0.91	0.80	**1.08**
Belgium	3.20	3.05	2.95	1.62	1.30	**2.55**
Denmark	2.73	2.30	2.22	1.74	1.54	**2.17**
Finland	1.73	1.56	1.85	1.61	1.20	**1.63**
France	5.15	3.87	3.90	3.05	2.56	**3.83**
Germany	4.18	3.42	3.14	1.73	1.44	**2.93**
Greece	4.14	5.83	6.11	4.54	4.24	**5.05**
Ireland	1.32	1.52	1.47	0.99	0.72	**1.26**
Italy	3.11	2.52	2.25	1.99	2.04	**2.42**
Luxembourg	1.18	0.92	1.04	0.80	0.86	**0.97**
Portugal	6.76	5.09	3.13	2.42	2.18	**4.11**
Spain	1.94	2.03	2.66	1.48	1.14	**1.93**
Sweden	3.93	3.29	2.62	2.16	1.74	**2.86**
The Netherlands	4.00	3.24	2.99	1.97	1.64	**2.89**
UK	5.74	4.85	4.77	3.09	2.64	**4.39**
EU15 (average)	***3.36***	***2.98***	***2.82***	***2.01***	***1.74***	**2.67**
NATO Europe	***3.86***	***3.48***	***3.26***	***2.39***	***2.1***	**3.1**
US	***8.61***	***6.15***	***6.35***	***3.79***	***3.66***	**3.7**
NATO	***5.22***	***3.85***	***3.89***	***2.56***	***2.30***	**3.7**

Source: SIPRI (various Yearbooks)

Within the EU15 countries there are clearly some interesting variations in military burden and economic performance. There are countries that are economically weak and spend a lot on defence (Greece, Portugal), countries that are economically weak with a very low defence burden (Ireland, Italy, Spain, Finland) but also rich countries that are high defence spenders (France, UK, Germany, Sweden and the Netherlands) and rich countries that are low defence spenders (Luxembourg, Denmark, Austria and Belgium). Estimating the rank correlation coefficient (Spearman correlation) for military burden and growth gave the value -0.27 (see details in the Appendix for the calculation of the Spearman correlation). This suggests that there is a negative association between growth and military burden, so, countries with high military burden have low growth. This variation suggests that the search for some general finding for the group will need to deal with a degree of heterogeneity. It is certainly unlikely that a simple pooling of the data will be adequate.

REVIEW OF THE THEORETICAL AND EMPIRICAL LITERATURE

Defence spending constitutes a significant share of global resources but despite its significant size, its economic impact has only recently been an issue of analysis in economic theory. The theoretical analysis of military expenditure becomes very difficult as it is not a purely economic issue but rather a mixture of economic, political, strategic, psychological, cultural and even moral aspects. Although most economic theory doesn't have an explicit role for military spending as a separate economic activity, there are four basic theoretical approaches (the Keynesian, the Neoclassical, the Liberal and the Marxist) that explain military expenditure from different points of view[1].

In the Keynesian framework, the state appears as proactive and interventionist, using military expenditure to increase output through multiplier effects when aggregate demand is ineffective (Dunne, 1996). Faini, Annez and Taylor (1984) also mention that if aggregate demand is low relative to potential supply, increases in military expenditure can lead to increased capacity utilisation, increased profits and hence, increased investment and economic growth. In the empirical literature, Keynesian demand-side models are widely used to explain the relationship between defence spending and economic growth. Empirical work within this demand-concentrated framework tends to find a negative relationship between military expenditure and economic growth (through the crowding out of savings or investment). The basic disadvantage of this theory is that it focuses on demand-side issues and fails to consider supply-side issues (technology spin-offs and externalities). Smith and Smith (1980) were the first to include explicit production functions in order to overcome this problem of concentrating on the demand side only. A linked liberal or institutional approach regards the Military Industrial Complex (MIC) as the central point in explaining military expenditure. The MIC is a powerful interest group that benefits from defence spending and thus, has an incentive to exaggerate international conflicts and to hinder attempts to settle disputes by non-military means (Dunne, 1990).

Marxists consider militarism and military expenditure as a social phenomenon with a historical aspect and they focus on the socio-political and strategic aspects of military expenditure and not so much on the economic ones. They argue that defence spending stimulates economic growth by preventing crises or by acting as an informal industrial policy (Dunne, 1990). Within this school of thought there is one theoretical perspective that has a fundamental role for military expenditure. The underconsumptionist approach developed by Baran and Sweezy (1966), claims that as a capitalist economy grows richer, the available surplus grows beyond that absolutely necessary for consumption and investment. So, within the underconsumptionist framework, military expenditure will be beneficial to growth when the economy is in disequilibrium.

In contrast, Neoclassicals see defence spending as a pure public good supplied by the state, which recognises some well-defined national interest that it seeks to protect. So the state can appear as a rational actor that tries to maximise national interest by balancing opportunity costs and security benefits of military expenditure. In the empirical work, supply-side models of the defence-growth relationship within the neoclassical framework, derive from the aggregate production function. A widely used supply-side model is the one developed by Feder (1982) and further elaborated by Ram (1986) and Biswas and Ram (1986) who considered military expenditure as an exogenous variable and estimated its dynamic real effects on output. However, a recent critique by Dunne et al. (2005) makes the Feder-type model look very problematic both in terms of theoretical underpinnings and in terms of econometric

[1] See also, Smith (1977), Georgiou (1983), and Dunne (1990, 1996).

issues. Other growth models that have been applied in the defence economics literature are the Barro (1990) model (applied by Aizenman and Glick, 2003; Mylonidis, 2008; Pieroni, 2009), the augmented Solow model (introduced by Mankiw *et al.* (1992) and applied by Knight *et al.*(1996)). Furthermore, Halicioglu (2004) following Atesoglou (2002) adopted the new macroeconomic model of Romer (2000) and Taylor (2000) that replaces the standard IS-LM and AD-AS models and provides a more detailed account of fiscal and monetary policies on the national income.

Most of the recent studies avoid a reliance on ad-hoc specifications and tend to be based on well-specified theoretical frameworks - usually the Keynesian or the Neoclassical frameworks- which allow the development of consistent formal models.

Overall, while the empirical results offer no consensus on the economic effects of military spending, the most common finding is that military burden has either no significant effect, or a negative effect on economic growth for developing countries[2]. To our knowledge, there are only three studies that focus on the EU15, to estimate the defence-growth relationship, namely, Kollias et al. (2007), Kollias et al. (2004) and Mylonidis (2008). The first study investigates the causal relationship between growth and milex over the period 1961-2000 by panel data methods and finds evidence of a positive bi-directional causality in the long-run and a positive effect from milex to growth in the short-run. Given these results, the authors argue that increases in defence may promote growth in this region. However, this study has been criticised by Hatzinikolaou (2007) for the econometric analysis employed. Furthermore, the empirical findings of Kollias et al. (2007) study are in contrast to an earlier causality study by Kollias et al. (2004) for the EU15 over the same period of time where the authors provide country by country analysis and they find that growth positively affects milex. It does seem strange that the results of these studies differ although the analysis in both studies is for the same set of countries and over the same period; the only difference is the estimation methods (time series approach for the 2004 study while panel data approach for the 2007 study). Finally, the third study by Mylonidis (2008) that focuses on the EU14[3] employs a Barro-type model to investigate the economic effects of milex using cross-section and panel data methods. The empirical evidence from this study points to a strong negative effect of milex on growth. It becomes obvious then, that among the three studies for the EU15 there is absolutely no common outcome. The present study contributes to the existing literature by providing empirical evidence for the EU15 with more recent data and using the model and estimation methods outlined below.

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[2] Chan (1985) surveying the relevant literature could not find any consistency in the empirical findings while Ram (1995) reviewing 29 studies found little evidence of a positive effect of defence on growth but it was also difficult to say that the evidence supported a negative effect. On the other hand, Dunne (1996) reviewing 54 studies concluded that military spending had at best no effect on growth and was likely to have a negative effect while Smith (2000) suggests that most likely there is a small negative effect in the long run. Furthermore, Dunne and Uye (2009) surveying 103 studies on the defence-growth relationship found 20% with positive effects, 37% with negative and 43% with unclear findings. They also suggest that some of the positive findings should be discounted.

[3] Mylonidis (2008) excludes Luxembourg from the sample because of the unavailability of education data for this country.

SPECIFICATION OF THE MODEL AND EMPIRICAL FINDINGS

As mentioned, the various problems associated with the Feder-Ram model have encouraged researchers to develop other more sound models in order to assess the impact of military expenditure on growth. Specifically, Dunne et al. (2005) following the Knight et al (1996) model proposed an augmented Solow growth model with Harrod-neutral technical progress.

$$\ln y(t) = e^{z} \ln y(t-1) + (1-e^{z})\left\{ \ln A_o + \frac{\alpha}{1-\alpha}[\ln s - \ln(n+g+d)] \right\}$$
$$+\theta \ln m(t) - e^{z}\theta \ln m(t-1) + (t-(t-1)e^{z})g$$

Which leads to an estimable model of the form:

$$\ln y_{i,t} = \gamma \ln y_{i,t-1} + \sum_{j=1}^{5} \beta_j \ln x_{j,i,t} + \eta_t + \mu_i + \nu \qquad i=1,2,...,N;\ t=1,2,...T$$

Where:
y = yp = GDP per capita
x_1= iy = gross investment/GDP,
x_2 = my = military expenditure/GDP,
x_4 = ngd = n+g+d = labour force growth rate + 0.05,
x_5 = tr = trend

In this model the key assumption is that *my* (military expenditure as a share of GDP) affects factor productivity via level effects on the efficiency parameter which controls labour-augmenting technical change. Furthermore, g is the exogenous rate of Harrod-neutral technical progress. The simplest specification for the above equation would be to assume homogeneity across countries and over time. However, this would presuppose that all EU15 countries have the same set of coefficients and so, the same transmission mechanism from defence to growth. Given the differences across countries (see section two of this paper) in levels of economic development, size of defence burden and extent of military industry it would seem sensible to allow for unobserved heterogeneity across countries, using fixed or random effects estimation methods.

Time fixed effects can also be allowed for separately or together in a two way fixed effect model. The group fixed effect is estimated consistently for large T, the time fixed effect for large N. Dynamic fixed effect estimates of the slopes in models that contain a lagged dependent variable are consistent for large T, but not for large N, when T fixed. T is large here, so the bias may be small and when computing the long run coefficients the biases are likely to offset each other. If the parameters differ over groups there is a further heterogeneity bias, which can be dealt with by using the mean group estimator, which entails estimating each equation individually and taking an average of the individual estimates (Pesaran and Smith, 1995). When N is small, as in this case, the mean group estimator may be sensitive to outliers.

ESTIMATION RESULTS

Estimating a log linear reparameterised general first order dynamic model form of the above model, with the dependent variable the change in the log of GDP per capita, Δlyp, and using fixed and random effects for the EU15, gives the results in Table 4. Given the different definitions of the labour force across countries, labour force is proxied by population to construct the augmented labour force growth rate (ngd). The variable liy is the share of gross investment in GDP, my is the share of defence spending in GDP and (-1) implies a one period lag. For one way fixed effects and random effects, technology is proxied by the trend (tr).

Table 4. Panel estimates (1961-2007)

	One way				**Two way**			
	Fixed		**Random**		**Fixed**		**Random**	
Variable	**Coefficient**	**t**	**Coefficient**	**t**	**Coefficient**	**T**	**Coefficient**	**T**
C	-0.260	-6.1	-0.210	-5.5	-0.330	-6.9	-0.219	-5.6
lyp(-1)	-0.008	-1.0	-0.016	-4.6	0.010	0.9	-0.019	-6.5
Δliy	0.163	11.5	0.165	11.8	0.121	6.4	0.144	10.1
liy(-1)	0.016	1.8	0.018	2.9	0.013	1.3	0.021	3.3
Δlmy	-0.066	-5.8	-0.064	-5.7	-0.032	-2.4	-0.046	-4.2
lmy(-1)	-0.011	-2.2	-0.008	-4.6	0.002	0.3	-0.006	-3.2
ngd	-0.097	-11.1	-0.083	-10.1	-0.099	-12.2	-0.082	-10.1
tr	-0.001	-2.2	-0.0003	-3.2	..	..	..	..
Rsq	0.400		0.364		0.575		0.291	
SER	0.022		0.022		0.019		0.020	
DW	1.517		1.451		1.544		1.4116	

We are mainly interested in the cross section fixed effects as we try to model the dynamics, but we also estimate a two way fixed effects model for comparison. Not surprisingly, the two way fixed effects method gives somewhat different results from the others for a dynamic specification. In this case the lagged dependent variable has a positive coefficient, making it explosive and causing all of the long run coefficients to change sign. This means these results should probably be ignored. There are relatively consistent results for the one way fixed and random effects and the two way random effects –most coefficients are significant and have the same signs and similar magnitudes. The log of the investment share has a positive effect on growth in both the difference and level forms while the log of military burden has a consistent negative effect for both difference and level. The reported R-squared is based on the difference between the residual sums of squares from the estimated model, that is from a single constant-only specification, not from a fixed-effects-only specification. As a result, the interpretation of these statistics is that they describe the explanatory power of the entire specification, including the estimated fixed effects. The reported Durbin-Watson statistic is formed simply by computing the first-order residual correlation on the stacked set of residuals. Testing the fixed effects strongly rejects the null that the cross section fixed effects are redundant. Calculating the long run coefficients gave the results in Table 5:

Table 5. Estimated long-run coefficients (1961-2007)

	One way				**Two way**			
	Fixed		**Random**		**Fixed**		**Random**	
c	-32.5		-13.1		33.0		-11.5	
liy	2.0		1.1		-1.3		1.1	
lmy	-1.4		-0.5		-0.2		-0.3	
lngd	-12.1		-5.2		9.9		-4.3	
tr	-0.1		0.02		..		..	

Again apart from the two way fixed effects, these are consistent with expectations across the specifications, with a clear negative impact of military burden in the long run, though the lagged dependent variable in the fixed effects was insignificant. The analysis in the second section suggested that cross country differences would exist and the estimates of the fixed effects did indeed show clear evidence of some serious heterogeneity, with Greece (positive) and Austria (negative) having particularly large coefficients. This suggests some further investigation might be warranted.

Given the available time series 1961-2007 is relatively long, it is possible to estimate the model for each country. The long run coefficients, derived from the short run coefficients estimates for each of the 15 countries are reported in Table 6. To save space, the individual results are not reported here but they are available from the authors on request. As Table 6 shows, there is indeed heterogeneity in the results, though for most of the countries, there is a significant negative effect of military burden on growth. Specifically, military burden has a negative sign for Denmark, France, Greece, Ireland, Luxembourg, Portugal, Spain, Sweden, the Netherlands and the UK. The sign is positive only for five out of the fifteen countries (Austria, Belgium, Finland, Germany, and Italy). There are issues with the significance of the individual coefficients, however, with only France and Spain having significant negative long run coefficients in the sense of both the lagged output per capita and military burden having significant negative coefficients (at 5% significance level). All coefficients on the change in military burden are negative and four significant. Regarding the labour force variable (proxied by population) the estimates are negative and significant for all countries apart from Finland and Luxembourg. The investment variable is positive and significant for all of the countries apart from two (France and Italy).

Table 6. Estimated long-run coefficients (1961-2007)

	c	**liy**	**lmy**	**lngd**	**Tr**
Austria	-3.06	0.08	0.004	-1.18	0.02
Belgium	-3.65	0.47	0.005	-1.72	0.01
Denmark	0.87	0.03	-0.21	-0.66	0.01
Finland	0.62	3.29	0.09	4	0.09
France	0.78	-0.51	-0.85	-1.87	-0.01
Germany	15.39	2.1	0.16	-4.29	-0.001
Greece	-5.99	1.5	-0.11	-1.21	0.03
Ireland	-5.37	0.19	-0.44	-2.46	0.05
Italy	0.51	-0.86	0.65	-1.65	0.002
Luxembourg	2.42	0.23	-0.32	0.19	0.03
The Netherlands	-11.2	1.71	-0.35	-3.29	0.004
Portugal	-2.98	0.25	-0.1	-1.65	0.01
Spain	-1.29	0.41	-0.29	-0.98	0.01
Sweden	0.54	0.15	-0.19	-0.67	0.01
UK	1.89	0.08	-0.09	-0.14	0.02

Using these individual country results, Table 7 reports the estimates for mean group estimator, the mean coefficient and the estimated standard error. All variables have the expected signs with the military burden coefficient having the value of -0.14. This is negative but is smaller in absolute value than both the random and fixed effect estimates in Table 5 and insignificant. This may result from the mean group estimator being sensitive to outliers, particularly when N is relatively small as in this study. For fixed effects the construction of the estimator means that as long as an outlier can be considered as counting for a small proportion of the variance it will have little effect, making fixed effects more robust to outliers.

Table 7. Summary of individual country LR estimates for the EU15

	c	**liy**	**lmy**	**lngd**	**Tr**
mean	-0.70	0.61	-0.14	-1.17	0.02
sd	5.76	1.08	0.33	1.84	0.02

As well as being sensitive to outliers, the mean group approach uses the same specification for each country, which can fail to allow for some important country-specific events that were observed to be important for the individual countries. Such heterogeneity will also not be fully picked up in simple fixed effects models. Re-estimating the model for each country with dummies introduced country to account for specific recessions and crises, gave the results in Table 8[4]. These results showed some improvement over those in Table 6, with only two countries, Italy and Portugal, having positive long run coefficient estimates for the military burden variable. France, Germany and Spain have significant negative long run coefficients in the sense of both the lagged output per capita and military burden having significant negative coefficients and five countries have significant coefficients on the changes in military burden variable.The means of the coefficients in Table 9 show a value of -0.38 for military burden, which is larger in absolute terms than that for the model without dummies, but remains insignificant.

Table 8. Estimated long-run coefficients with dummies (1961-2007)

	c	Liy	lmy	ngd	tr	D
Austria	-21.33	5.27	-0.40	-3.27	-0.02	-1.87
Belgium	-22.50	2.25	-2.00	-9.25	-0.12	-4.37
Denmark	0.83	-0.04	-0.37	-0.78	0.01	-0.09
Finland	2.23	-2.73	-0.18	-3.91	-0.09	-1.86
France	3.33	-0.68	-1.18	-1.40	-0.02	-0.33
Germany	0.04	0.52	-0.51	-0.63	0.01	-0.59
Greece	-8.39	1.96	-0.16	-1.58	0.02	-0.89
Ireland	-7.25	0.14	-0.29	-3.29	0.07	-1.14
Italy	-0.79	-1.17	1.33	-2.62	-0.21	-2.17
Luxembourg	2.56	0.23	-0.42	0.19	0.03	-0.59
The Netherlands	-12.59	1.76	-0.43	-3.83	-0.003	-0.40
Portugal	-4.37	0.43	0.32	-1.66	0.02	-1.13
Spain	-1.60	0.37	-0.69	-1.66	-0.14	-0.57
Sweden	1.01	0.19	-0.08	-0.39	0.02	-0.17
UK	1.40	-0.02	-0.60	-0.45	0.19	-0.21

Table 9. Summary of individual country LR estimates for the EU15 with dummies

	c	Liy	lmy	lngd	tr	D
mean	-4.49	0.56	-0.38	-2.30	-0.016	-1.09
sd	8.40	1.79	0.71	2.33	0.10	1.12

Overall, these results do provide a predominance of negative coefficients for the short and long run effects of military spending on growth, but many of these estimates are insignificant. Certainly, while there is heterogeneity across countries, there is no

[4] Dummies were introduced to capture major economic crises. Specifically, a dummy for the year 1975 was introduced for Belgium, Denmark, Italy, Luxembourg, the Netherlands, Portugal; a dummy for the year 1992 for France, a dummy for the year 1993 for Austria, for 1991 for Finland, 1974 for Greece and the UK, 1983 for Ireland, 1991 to 1993 for Sweden, 1975 to 1981 for Spain while a dummy for the period after 1992 was introduced in the case of Germany to account for the reunification.

evidence to suggest that military expenditure might have a positive effect on growth in the EU 15. These results are not inconsistent with Mylonidis (2008), which found negative effects of military spending using a Barro-style growth model, but are in contrast to two Granger causality studies by Kollias et al. (2004; 2007), for the same region. Dunne and Smith (2010) do warn against surmising the sign of a relationship when using the Granger causality methods without an identified structural model and the evidence of the importance of the non-military variables in the growth models used here underlines that concern.

CONCLUSIONS

This paper makes a contribution to the growing literature on the economic effects of military spending, by using a long data set on a group of related countries, the EU15, that have been little studied. The data set is both long and relatively up to date capturing the impact of post Cold War changes in the security environment and taking account of the Dunne et al. (2005) critique, the paper employed the augmented Solow-Swan model to provide a dynamic estimable growth model. The initial analysis of the experience of the countries over the period suggested a negative association between military spending and growth, but also identified unobserved heterogeneity. This was dealt with using fixed and random effects models on a general dynamic model. Some large fixed effects suggested it might be worthwhile investigating the degree of heterogeneity further. As there was adequate time series, a mean group estimator was used, which gave results that were in line with the panel estimates. There were insignificant coefficients for a number of countries that suggest caution in interpreting the results too strongly, but when dummy variables were introduced into the equations to deal with specific economic shocks in individual countries, while the individual country results were improved the mean coefficients were still close to the panel data estimates.

Overall, this extensive test of different panel data specifications, leads to the conclusion that military burden, does not have a positive impact on the economies of the EU15 and that it either has a negative effect or no effect at all. This is not inconsistent with the findings of Mylonidis (2008), but is weaker. It is inconsistent with the positive effects surmised in the Granger causality tests of Kollias et al. (2004; 2007), but the Dunne and Smith (2010) warning over the interpretation of such tests in the absence of a structural model does reduce concern over this inconsistency.

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APPENDIX

TABLE A1 Spearman rank correlation for military burden and growth

COUNTRY	RANK MILITARY BURDEN	Military burden (%)	RANK GROWTH	GDP growth (%)	d	d^2
Luxembourg	**1**	0.97	**13**	4.32	-12	144
Austria	**2**	1.08	**7**	3.20	-5	25
Ireland	**3**	1.26	**15**	5.29	-12	144
Finland	**4**	1.63	**10**	3.43	-6	36
Spain	**5**	1.93	**12**	4.28	-7	49
Denmark	**6**	2.17	**4**	2.76	2	4
Italy	**7**	2.42	**6**	3.14	1	1
Belgium	**8**	2.55	**5**	3.02	3	9
Sweden	**9**	2.86	**2**	2.60	7	49
The Netherlands	**10**	2.89	**8**	3.21	2	4
Germany	**11**	2.93	**3**	2.75	8	64
France	**12**	3.83	**9**	3.24	3	9
Portugal	**13**	4.11	**11**	4.21	2	4
UK	**14**	4.39	**1**	2.58	13	169
Greece	**15**	5.05	**14**	4.44	1	1
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Spearman Correlation (ρ) = $1 - [6\sum d_i^2 / (n(n^2 - 1))] = -0.27$