MILITARY SPENDING AND BUDGET DEFICITS: THE IMPACT OF US MILITARY SPENDING ON PUBLIC DEBT IN EUROPE (1988-2013).

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Abstract

The aim of this paper is to study the relationship between military spending and sovereign debt in a panel of thirteen European countries. In particular, under the assumption of the interdependence of military spending between US and European countries, we analyse whether US military spending affected European sovereign debt in the period 1988-2013. The empirical estimation is based on different steps: (i) a unit root tests (ii) a set of panel cointegration tests; (iii) an Arellano-Bond panel estimation; (iv) a FMOLS estimation to highlight the long run relationship between debt and relevant variables; (v) a VAR analysis for each country. General results highlight a significant impact of US military spending on European sovereign debt.

Keywords: Military Spending, Public Debt, Interdependence, Fully Modified FMOLS, VAR.

Jel classification: H56; H63; F52;

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INTRODUCTION

The aim of this paper is to study the relationship between US military spending and sovereign debt in a panel of thirteen European countries. In other words, under the assumption of the interdependence of military spending between US and European countries, we analyse whether US military spending affected European public debt in both short and long-run. In the end, the main concern of this work is the impact of increasing debt related to military spending. This may become a crucial issue in the future. In fact, the data provided by SIPRI shows an increasing trend in world military spending in the latest years: between 2001 and 2013 world military spending increased by 49% in constant terms. In this respect US, driven by the war on terror under the Bush Jr. administration (2001-2009), had recorded the crucial increase of 76.4% eventually followed by an overall decrease by 14% in the following years until 2013. Western European countries had increased military spending by 8.5% in the period 2001-2009, whereas in the following years until 2013 they decreased it by 11%.

Needless to say, military spending is financed through taxes or by issuing public debt. The larger is the military spending, the larger could be the expected negative impact on growth, via the increased governmental debt. In fact, military spending is detrimental for growth in the long-run (Dunne and Tian, 2013; Perotti, 2014) and the increased sovereign debt is likely to be a crucial channel of transmission of this impact. For example, Williamson (1984) estimates that in England between 1761 and 1820 the capital formation share would have been almost 5% higher in the absence of war and the national income would have grown by 0.6 per year faster. This evidence is notably surprising because that period is usually refereed as the 'first industrial revolution'. So, in spite of the famous labelling, growth figures were actually rather weak. In fact, Williamson argues that the enormous debt issued to finance the wars had finally crowded-out civilian accumulation. In general, in the past century, the fiscal burden descending from wars was by no means a neglected issue. Pigou (1919) Gottlieb (1919/1924), and Leland (1944), for example, in the aftermath of the WWI and

WWII respectively, discussed the war burden on the future economic growth because of the stock of debt. In very recent years, a growing number of studies on the impact of military spending on public debt has been published[1].

This paper is intended to contribute to this line of research which focuses on the macro-economic impact of military spending on national economies in the long-run. The novelty of this paper is the focus on the impact of US military spending on European fiscal imbalance. Needless to say, the idea behind is that military alliances and relationship between US and Europe constitute a necessary channel of transmission of changes in military expenditures and consequently of their impact. The traditional model of demand for military expenditure developed in Smith (1980) pointed out the role of military alliance in determining the level of military expenditures. In simpler words, military expenditures of allies are associated: In particular, for European countries military spending of the international superpower, the US, does have an impact on choices of military spending of allies.

In the light of that, whenever European countries increase their military spending because of necessary strategic considerations, they have an additional source of pressure on their fiscal sustainability. This is nowadays particularly relevant for some European countries that have been experiencing the sovereign debt crisis since the end of 2009 (Lane, 2012).

To empirically investigate this, we construct a panel of thirteen European countries for the period 1988-2013. The empirical estimation is based on different steps: (i) a panel unit root tests (ii) a set of panel cointegration tests; (iii) an Arellano-Bond panel estimation; (iv) a FMOLS estimation to highlight the long run relationship between debt and relevant variables; (v) a VAR analysis for each country. General results highlight a significant impact of US military spending on European sovereign debt. In particular, we find a long-run relationship between US military spending and sovereign debt in Europe.

This result confirms an implicit question behind this work. Take international political orders characterized by a massive military spending of the

[1] See the next section for a brief survey.

leader country. Are these scenarios sustainable in the long-run? In fact, the ultimate concern behind this work is that the burden emerging because of military spending does affect the very fabric of societal orders, thus increasing the level of vulnerability and insecurity of polities and human beings. In this respect, the structure of international order is a relevant component of the motivation behind this work[2]. The massive military spending of the leader of the international order could depend on ongoing conflicts but it could be interpreted as the latent factor of a long-run process which ends in the economic distress and eventually in the systemic decline. By systemic decline we mean the scenario where the existing institutions are no longer legitimate and therefore they do not function properly anymore. Put differently, the fundamental pillars of the socio-economic system would weaken and eventually would collapse. In other words, the crucial research question is whether US military spending had turned to be into a strong determinant of sovereign debt in Europe so weakening the existing institutional scenario.

In this respect, there are analogies that can be found in the history and precisely: (i) the crisis of the Third Century of the Roman Empire and (ii) the General Crisis of the 17th century. The Roman Empire (henceforth Empire for sake of brevity) reached its greatest extent under Emperor Trajan (98 to 117 CE). Since its very beginning, the main item of Empire budget was the army. Hopkins (1980) estimated that 54% of state revenue would go for the army. Duncan Jones (1994) estimates that in the mid second century, the army accounted for three-quarters of the Empire's budget. Eventually, under Septimius Severus (193-211 CE), the military burden had become unbearable. Lucius Septimius Severus, who was a military himself, took (and consolidated) the power with the support of military. Under his rule, the military spending increased considerably because of the personnel costs. In fact, Severus, increased (almost tripled) the number of troops in Italy and eventually increased their wages (Smith, 1972). Even Severus's successors embraced a similar strategy by raising the military burden.

[2] Albeit indirectly, this could be considered also a test of the Hegemonic Stability theory which has been the paramount approach among political scientists.

Caracalla increased the soldier's normal pay by a half in the midst of the crises of the third century Maximinus Thrax doubled the soldiers' pay (Speidel, 1992). Such a policy in the long run turned to be unsustainable. In fact, at the time of political crises the third century a tremendous monetary and financial crises took shape in 238 CE. At that time, the Crisis of the Third Century (235-284 CE) had already taken shape after the assassination of Emperor Alexander Severus.

A second analogy has to be found in the financial troubles of Spanish empire under the Habsburgs. In particular, since the reign of Philip II (1556-1598) until Philipp IV (1621-1665) the Spanish empire experienced severe budget deficits because of massive military spending. Kindleberger (1991) pointed out the Spain "*…experienced financial crises at the level of the monarchy in 1557, 1575, 1596, 1607, 1627, and 1647-though not, on this showing, in 1619 to 1623…*"[3]. The main reason of such financial imbalances has to be found into the military commitments of Habsburgs. Philip II had already inherited a massive debt from Charles V. But, in particular, he led Spain into a number of conflicts. Such a policy has been financed by issuing state bonds (*Juros* and *Asientos*) and by levying new taxes. This massively increased the public debt and depressed the economy. In spite of the severe economic crises, the relationship between military spending and fiscal imbalance of kingdom did not stop. It was the *leit motiv* of Spanish policy until the re-structuring of international order implemented after the Westphalia treaty.

The paper proceeds as follows: in the next section a brief survey of the related literature is presented; eventually the data and test for unit roots are presented; in the fourth section we propose an Arellano-Bond Panel estimation and in the fifth section a Fully Modified OLS estimation. In the sixth section we present a VAR analysis in order to highlight the impact on each country. Conclusions summarize and discuss.

[3] Kindleberger (1991), p. 152.

II. MILITARY SPENDING AND DEBT

The literature on the nexus between military spending and debt has been rapidly increasing for recent years, thanks to a growing availability of data and to the recent developments in estimation methodologies of panel data. In seminal papers of Brzoska (1983), Looney and Frederiksen (1986) and Looney (1989), the focus was on the Third World and low-income countries contexts. Eventually a superior attention has been paid to other regional areas: the Arab countries have been the focus in Alami (2002); South American countries in Dunne et al., (2004a); Middle Eastern countries in Smyth and Narayan, (2009), Far Eastern countries in Dunne et. al., (2004b) and Sub-Saharan African in countries Ahmed(2012). More recently, the analysis has been extended to high income economies, such as European and NATO countries [Paleologou (2013), Alexander (2013)]. The estimation strategies and methodological approaches differ depending on the nature of dataset employed: single country time series, cross country panels or both.

Focusing on panel data approaches, the aim of empirical evidence investigations was primarily focused on the relationship between national military spending and debt. Dunne et al. (2004b) found a positive and significant effect of military burden on external debt in eleven small industrialized economies; they used static and dynamic panel estimators, with fixed and random effects, including as control variables, the net international reserves and growth of GDP. Smith and Narayan (2009), analyse six middle eastern countries to highlight long and short run effect of military spending on external debt. After controlling for unit roots and cointegrating relationships, they used Fully Modified OLS (FMOLS), Dynamic OLS (DOLS) and Dynamic Fixed Effect (DFE) techniques and found a positive (and elastic) and significant effect of military expenditure on debt in the long run, and positive (but inelastic) effect in the short run. The same econometric approach has been used by Ahmed (2012) to analyse the effect of military expenditure on external debt burden for 25 Sub-Saharan countries. Results show that military expenditures exhibit a positive impact on external debt, both in the short and in the long run. With respect to large economies, Alexander (2013) investigated the empirical evidence from high-income members of NATO using a partial auto regressive distributed lag (ARDL) equation to evaluate the effect of national military spending and growth on debt. After controlling for the stationarity of series, he employed the Arellano-Bond technique to estimate the short run relationships among them. He found a strong persistence over time of the dependent variable (the share of government debt on GDP), together with a positive effect of the variation of military spending (from 1.85 in larger sample to 2.72 in smaller sample) and a negative effect of the change in GDP per capita (from -0.79 in larger sample to -1.19 in smaller sample). The same techniques were used by Paleologou (2013) in the empirical investigation on 25 European countries for the period 1996-2009. The author obtained similar results: a positive and elastic (1.4) relationship between the first difference of military expenditure and first difference of government debt, and a negative (-0.5) effect of the first difference of GDP per capita growth on debt (first difference). All the mentioned studies, adopt a traditional approach studying the impact of national military spending on gross public debt. This paper is an attempt to go beyond this approach by considering the necessary interdependence of military spending between allies in the international community.

III. THE RELEVANT DATA AND THE UNIT ROOT TESTS

The empirical analysis is run exploiting a panel of thirteen European countries: Belgium, Finland, Denmark, France, Germany, Greece, Ireland, Italy, Norway, Portugal, Spain, Sweden and United Kingdom. The sample selection was driven by the quality of available data together with the economic and military association of the observed countries with United States. With the exception of Finland and Ireland all countries are members of NATO. The panel includes 26 yearly observations from 1988 to 2013. The main variables under study are: (i) the Government debt of each European country considered; (ii) the US military spending; (iii) the military spending of European countries considered. The Government debt (*debt*) of each country is the General Government Gross Debt expressed in US dollars at constant prices (2005) [4]. We also consider the growth rate of debt, namely the deficit. The data on Military Expenditure (here termed *milex*) are drawn from the World Bank dataset and are based on SIPRI data. The United States military expenditure is labelled as *USmilex*. In addition we computed the average military expenditures of other European countries (here termed *emilexav*). That is, when considering a country *i*, *emilexav* denotes the average military spending of European countries other than *i*. In addition we consider the ratio between *emilexav* and GDP. Then we consider GDP per capita and the its growth rate in percentage terms (source World Bank).

TABLE 1 - Descriptive statistics of main variables. 1988-2013

	Obs.	Mean	Median	Std. Dev.	Min	Max
Debt	338	5.75e+11	2.31e+11	6.54e+11	1.94e+10	2.52e+12
GDP per capita	338	32616.96	31047.98	11472.47	12397.62	67804.55
GDP pc growth rate (%)	338	1.567	1.795	2.706	-8.975	10.161
US Military Expenditure (*USmilex*)	26	4.45e+11	4.28e+11	1.07e+11	3.20e+11	6.35e+11
US Military Expenditure / GDP ratio (%)	26	3.99	3.85	0.755	2.91	5.58
emilexav	338	1.63e+10	1.67e+10	1.68e+09	1.25e+10	1.92e+10
***emilexav*/GDP ratio (%)**	338	1.887	1.799	0.314	1.427	2.615

Hereafter, we first test for the presence of individual and common unit root. Breitung and Meyer (1994) proposed a unit root test valid for fixed T and for $N \rightarrow \infty$ (where N is the number of cross sections) imposing the restriction of equal parameter of the lag variable for all cross sectional units, while the lag order of the first differences terms may differ across them. The crucial hypothesis is the presence of cross sectional independence. The Breitung test was implemented by Levin et al. (2002) whose test (LLC) requires bias correction factors for cross-sectionally heterogeneous variance in order to estimate efficient pooled OLS parameters. Yet, Im, Pesaran and Shin (2003) proposed a test (hereafter IPS) for heterogeneous panels excluding that all countries have the same pace of convergences toward the equilibrium and, in addition, they reduce dramatically

[4] For some countries [Denmark (1988-1992), Germany (1988-1991), Portugal (1988-1990), and Sweden (1988-1993)] data from IMF were implemented by OECD information in order to have a balanced panel

the problem of cross sectional dependence by demeaning the data. An important consequence of the IPS approach is that it allows for the possibility of rejection of non-stationarity even if a single cross section time series variable is not stationary. This is the same approach of Maddala and Wu (1999) that used ADF unit root tests on each single cross section time series variable to build a non-parametric test based on ADF *p-value*.

In our panel, the LLC test fails to reject the hypothesis of common unit roots for *debt* in the case of both individual intercept and linear trend or none, and for *GDPpc* in the case of individual intercept and trend, while the *emilexav* series appears to be stationary. The same is in the Breitung test while in the IPS test, for the case of individual intercept and linear trend, the hypothesis of individual unit root is not rejected at standard statistical significance (5%) for variables in levels. If considering Maddala based Wu test and on Augmented Dickey-Fuller test for US Military Expenditure, results suggest that the series are non-stationary in levels, and stationary in first differences if no intercept and linear trend is added in the model specification. In this case the series show a pure stochastic trend without intercept. Results are in table 2.

Table 2: Panel Unit Roots Test: Schwarz Info Criterion (SIC) – Automatic selection – Max lags: 4. Spectral estimation: Bartlett. Bandwidth selection: Newey West . 309 obs.

Null hypothesis: Common unit root	**Individual intercept**		**Individual intercept and trend**		**None**	
	Statistic	**Prob.**	**Statistic**	**Prob.**	**Statistic**	**Prob.**
Levin, Lin and Chu						
Debt	**-1.682****	0.046	-0.988	0.162	5.421	1.000
Δ *Debt*	**-5.391*****	0.000	**-3.697*****	0.000	**-7.594*****	0.000
GDP pc	**-4.671*****	0.000	3.113	0.999	**7.300*****	0.000
Δ *GDP pc*	**-7.278*****	0.000	**-6.637*****	0.000	**-8.287*****	0.000
emilexav	**-4.517*****	0.000	**-2.611*****	0.004	**-3.396*****	0.000
Δ *emilexav*	**-4.346*****	0.000	**-2.742*****	0.003	**-9.296*****	0.000

Breitung					
Debt			-0.997	0.159	
Δ *Debt*			**-4.381*** **	0.000	
GDP pc			3.343	0.996	
Δ *GDP pc*			**-6.043*** **	0.000	
emilexav			**-3.458*** **	0.000	
Δ *emilexav*			**-5.639*** **	0.000	
Maddala and Wu[A]	λ statistic				
Debt	**46.131*** **		**38.348* **		2.065
Δ *Debt*	**83.983*** **		**63.854*** **		**104.493*** **
GDP pc	**62.824*** **		**45.022** **		3.450
Δ *GDP pc*	**125.111*** **		**118.63*** **		**165.425*** **
emilexav	**56.703 *** **		29.287		32.236
Δ *emilexav*	**66.816*** **		**38.696* **		**119.007*** **
Augmented Dickey-Fuller					
USmilex	-1.192		-2.264		0.221
Δ *emilexav*	-2.373		-2.264		**-2.430** **
Null hypothesis: Individual Unit Root	**Statistic**	**Prob**	**Statistic**	**Prob**	
Im, Pesaran and Shin (IPS)					
debt	-0.326	0.372	**-1.403* **	0.080	
Δ *debt*	**-6.092*** **	0.000	**-4.485*** **	0.000	
GDP pc	-0.803	0.211	4.326	1.000	
Δ *GDP pc*	**-6.321*** **	0.000	**-5.145*** **	0.000	
emilexav	**-4.008*** **	0.000	-1.245	0.106	
Δ *emilexav*	**-4.988*** **	0.000	**-2.459*** **	0.007	

[A] In the Maddala and Wu test the λ statistic is distributed as χ^2 with 26 degree of freedom. The null hypothesis of non-stationary panel is rejected if λ is on the right of the threshold values: 45.642 (1% level of significance: ***), 38.885 (5% level of significance: **), 35.563 (10% level of significance: *). The computation of statistics is available under request.

According to the results of Maddala and Wu test the variables are integrated of order one - I(1). We eventually test for the presence of cointegrating relationships among the series. We conduct the Pedroni and the Kao tests[5]. The Pedroni test rejects the null hypothesis of no cointegration for 5 out of the 11 statistics reported if individual intercept and/or deterministic trend is modelled, and 3 out of 11 when no intercept and deterministic trend are assumed. The rejection of no cointegration hypothesis is supported, in particular, by the ADF test specification. The rejection of no cointegration hypothesis in the Kao test, suggests that cointegrated relationships exist among variables and a long run relationship may be estimated. Results of tests are shown in table 3.

TABLE 3. PANEL COINTEGRATION TEST

Variables: *Debt*, *GDPpc*, *USmilex*, *emilexav*.

Sample 1988-2013. Observations: 378 - Cross-sections included: 13. Automatic lag length selection based on Schwarz Info Criterion with a max lag of 4 - Newey-West automatic bandwidth selection and Bartlett kernel

Pedroni Residual Cointegration Test - Null Hypothesis: no cointegration

Alternative hypothesis: common AR coefs. (within-dimension)						
Trend assumption	**No deterministic trend**		**Individual intercept and individual trend**		**None**	
	Stat	**Prob**	**Stat**	**Prob**	**Stat**	**Prob**
v-Stat	**1.653****	0.049	**6.584*****	0.000	-0.685	0.753
rho-Stat	0.986	0.838	1.943	0.974	1.377	0.916
PP-Stat	0.445	0.672	0.567	0.714	1.322	0.907
ADF-Stat	**-2.772*****	0.003	**-1.353***	0.088	**-3.294*****	0.001
	Weighted stat	**Prob**	**Weighted stat**	**Prob**	**Weighted stat**	**Prob**
v-Stat	**1.844****	0.036	**5.726*****	0.000	-1.081	0.860
rho-Stat	0.401	0.656	1.748	0.959	1.289	0.901
PP-Stat	-0.573	0.283	0.277	0.609	1.168	0.879
ADF-Stat	**-2.741*****	0.003	**-2.459*****	0.007	**-2.772*****	0.003
Alternative hypothesis: individual AR coeffs. (between-dimension)						
	No deterministic trend		**Individual intercept**		**None**	

[5] The first is a cointegration test based on residuals of a spurious regression carried out on I(1) variables, and it allows for heterogeneous intercepts and time trend among cross sectional units. Pedroni proposed several methods of constructing the statistics to test the null hypothesis of no cointegration; in particular he proposed two alternative hypothesis: the "within" and "between" dimension. In the within dimension, the coefficient of the first lag of the residual is imposed to be equal (and <1) for all cross sections, while in the between dimension the only restriction is that all the coefficients of the first lag of the residual are <1. The Kao Cointegration Test is based on the same approach as in Pedroni, but it considers countries specific intercepts and homogeneous coefficients on the first stage regressors.

	and individual trend					
	Stat	**Prob.**	**Stat**	**Prob.**	**Stat**	**Prob**
rho-Stat	1.965	0.975	2.705	0.997	3.365	0.999
PP-Stat	0.261	0.603	0.805	0.790	3.278	0.999
ADF-Stat	**-3.729*****	0.000	**-3.492*****	0.000	**-2.772*****	0.003

Kao Residual Cointegration Test - Null Hypothesis: no cointegration.

	t-Stat	Prob.
ADF	**-2.012****	0.022

IV. ARELLANO BOND PANEL ESTIMATION

In this section we estimate a panel regression to uncover first the short-run relationship between our measures of debt and military spending. In particular, we follow the Arellano-Bond (A-B) GMM method. We consider alternatively as dependent variables: (i) the stock of debt and (ii) the current deficit. As noted above, main explanatory variables are the US military spending and the average military spending of other European countries considered. These explanatory variables are logged and one-year lagged. We also consider the ratios between the latter and the national GDP. In other words we are taking into account the military burdens. In all estimations we also include the lagged value of the dependent variable so highlighting the first-order autoregressive process.

Then, we also consider a set of covariates drawn from the World Bank dataset, namely the GDP per capita and the level of unemployment. We employ also three controls to capture the political cycle and the political character of the countries. First we consider a dummy denoting whether in the previous year there had been a general election (*vote-1*). This links with the idea of fiscal imbalance determined by incumbents in electoral years. Alesina and Perotti (1995) and Alesina and Drazen (1991), for example, explained the increases in public expenditure and the delay in the fiscal adjustment by the incumbent cabinet before elections. Then we include the RAE index of legislative fractionalization (here *RAE Leg*) and an integer variable *Gov Party* bounded between 1 and 5 which captures the political attitude of the cabinet (where 1 stands for hegemony of right wing parties and 5 stands for leftist parties). The latter three controls have been drawn from Comparative Political Dataset[6] by Armingeon et al. (2014). As measure of financial openness we employ the Chinn-Ito index (*KAOPEN*) introduced in Chinn and Ito (2006)[7]. The greater is the index, the more financially open is the country. Descriptive statistics of the control variables are presented in table A.1 in the appendix.

Tables 4-5 below reports the results of the Arellano-Bond estimation. Summing up, in table 4 with regard to the current stock of debt the main results show that: (i) the current stock of debt is positively associated with one-year lagged US military spending (models 1,2); (ii) the growth rate of US military spending also appears to be positively associated the current stock of debt (model 4); (iii) the one year-lagged US military burden also appears to be positively associated with the dependent variable (model 5); (iv) there is no significant association with one-year lagged average military spending of European countries (models 1,2); (v) the current stock of debt appears to be negatively associated with the average one-year lagged military burden of other European countries.

Yet, control variables do present the expected signs. In particular, as expected the level of unemployment is positively associated with the stock of debt whereas the growth rate of GDP per capita exhibits a negative association. Among political variables, only the dummy capturing the electoral cycle is always significant, namely the debt increases with elections. The RAE index of legislative fractionalization is positively associated with the stock of debt in models 2 and 4. That is, the higher is the past fragmentation of the cabinet, the higher is the current stock of debt.

[6] Drawn at the website http://www.ipw.unibe.ch/content/team/klaus_armingeon/comparative_political_data_sets/index_ger.html [last access december 2014],

[7] Drawn at the website http://web.pdx.edu/~ito/Chinn-Ito_website.htm [last access December 2014].

TABLE 4 - Arellano-Bond Dynamic Panel-Data Estimation. GMM-type Observation 297-312 - countries: 13 - Time length 24 - Dependent variable: Ln Debt					
	1	**2**	**3**	**4**	**5**
Constant	0.091	3.931	**2.629*****	**2.553*****	**3.772*****
	(3.295)	(2.906)	(0.428)	(0.386)	(0.573)
Lagged debt	**0.874*****	**0.880*****	**0.888*****	**0.891*****	**0.848*****
	(0.020)	(0.021)	(0.017)	(0.015)	(0.021)
GDP Per Capita Growth	**-0.012*****	**-0.013*****	**-0.014*****	**-0.014*****	**-0.012*****
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Ln Unemployment	**0.122*****	**0.113*****	**0.116*****	**0.121*****	**0.137*****
	(0.014)	(0.014)	(0.015)	(0.016)	(0.015)
Ln US Military Expenditure (-1)	**0.055***	**0.072****			
	(0.029)	(0.029)			
US Military Expenditure on GDP (-1)					**0.011***
					(0.007)
Δ% US Military Expenditure (-1)			0.108	**0.144***	
			(0.077)	(0.076)	
Ln *emilexav* (-1)	0.060	-0.128			
	(0.150)	(0.128)			
emilexav on GDP (avg) (-1)					**-0.083*****
					(0.024)
Δ% *emilexav* (-1)			0.168	0.171	
			(0.214)	(0.218)	
Vote (-1)	**0.023****	**0.018****	**0.026*****	**0.020****	**0.024*****
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Rae Leg (-1)	0.002	**0.002***	0.002	**0.002***	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Gov Party (-1)	-0.0004	-0.003	-0.003	**-0.005***	-0.001
	(0.026)	(0.002)	(0.003)	(0.003)	(0.003)
KAOPEN (logged)	**0.030****		0.010		0.015
	(0.130)		(0.133)		(0.013)
Wald test χ^2	5856.48***	6283.75***	5073.51***	5243.81***	5892.04***

When considering as dependent variable the current deficit rather than the current stock of debt, the results (in table 5) highlight a different dynamic in the very short run. In fact, the current deficit appears to be much more responsive to the military expenditure of other European countries rather than to US expenditure. That is, the current deficit is positively associated with the average military expenditures of other European countries considered in models 6-7 and the elasticities are relatively high, namely 0.47 and 0.52 respectively. Yet, in models 6-7 the relationship between deficit and US military expenditures exhibit a negative coefficient. The feasible interpretation of these two results is that in the short run each European country is more influenced by other European countries rather than US. This is confirmed in model 10 when considering the military burden of the other European countries.

TABLE 5 - Arellano-Bond Dynamic Panel-Data Estimation. GMM-type
Observation 297-312 -Cross sections 13 - Time length 24
Dependent variable: Current Deficit (ΔDebt)

	6	**7**	**8**	**9**	**10**
Constant	**-9.454*****	**-10.249*****	-0.063	-0.031	-0.154
	(3.241)	(3.978)	(0.109)	(0.105)	(0.120)
Lagged deficit	**0.317*****	**0.397*****	**0.382*****	**0.433*****	**0.407*****
	(0.060)	(0.059)	(0.059)	(0.061)	(0.059)
GDP Per Capita Growth	**-0.011*****	**-0.011*****	**-0.011*****	**-0.012*****	**-0.013*****
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Ln Unemployment	**0.041****	0.020	0.029	0.007	0.002
	(0.020)	(0.019)	(0.021)	(0.021)	(0.019)
Ln US Military Expenditure (-1)	**-0.066*****	**-0.078*****			
	(0.025)	(0.029)			
Δ Ln US Military Expenditure (-1)			-0.042	-0.104	
			(0.090)	(0.094)	
US Military Expenditure on GDP (-1)					0.002
					(0.009)
Ln *emilexav* (-1)	**0.472*****	**0.520*****			
	(0.148)	(0.186)			
Δ Ln *emilexav* (-1)			0.205	0.225	
			(0.265)	(0.260)	
emilexav on GDP (-1)					**0.057****
					(0.025)
Vote (-1)	0.016	**0.025****	0.015	**0.024****	**0.024****
	(0.10)	(0.010)	(0.010)	(0.101)	(0.010)
Rae Leg (-1)	0.002	0.001	0.001	0.001	0.001
	(0.014)	(0.001)	(0.001)	(0.001)	(0.001)
Gov Party (-1)	-0.006	-0.001	-0.005	-0.002	-0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Ln Kao		0.005		-0.020	-0.003
		(0.017)		(0.105)	(0.018)
Wald test χ^2	170.42***	188.72***	151.20***	173.68***	180.64***

V. FULLY MODIFIED OLS

In what follows we attempt to highlight the long-run relationships between debt and military spending. In order to do that we employ the **fully modified technique (FMOLS)** for cointegrating vectors in dynamic panel data[8]. The estimator proposed for single cross section time series firstly by Phillips and Hansen (1990) was refined for heterogeneous cointegrated panel by Pedroni (2000). For sake of parsimony, we only consider the four cointegrating equation deterministic specifications: no constant and linear trend, constant, constant and trend (linear and quadratic). All specifications are estimated with pooled (P), pooled weighted (PW) and grouped method (G). Results are reported in table 6 below.

TABLE 6 - Fully Modified method estimation (FMOLS). Obs 325. Periods 25, cross countries 13. Dependent variable*: debt*. Long run covariance estimates (Bartlett kernel, Newey-West fixed bandwidth)

	Cointegrating equation deterministics					
	none			constant, no trend		
	P	PW	G	P	PW	G
GDPpc	-0.407	**-0.299*****	**2.008*****	-0.255	**-0.112*****	**0.375*****
	(0.299)	(0.0005)	(0.132)	(0.210)	(0.017)	(0.099)
USmilex	**3.254*****	**2.768*****	0.070	**1.102*****	**1.036*****	**0.838*****
	(0.434)	(0.0007)	(0.092)	(0.140)	(0.018)	(0.066)
emilexav	**-2.406*****	**-1.909*****	**0.162****	**-5.128*****	**-4.781*****	**-4.413*****
	(0.474)	(0.0002)	(0.162)	(0.614)	(0.027)	(0.302)
Adj R-squared	0.115	0.009		0.958	0.958	
S.E. of regr.	1.110	1.125		0.243	0.242	
Wald test χ^2	67232***	2.7e08***		135***	74119***	
	constant and linear trend			constant and quadratic trend		
	P	PW	G	P	PW	G
GDPpc	-0.235	**-0.109*****	**0.394*****	-0.191	**-0.105*****	**0.433*****
	(0.210)	(0.017)	(0.093)	(0.210)	(0.015)	(0.093)
US milex	**1.086*****	**1.035*****	**0.806*****	**1.121*****	**1.041*****	**0.822*****
	(0.140)	(0.018)	(0.063)	(0.140)	(0.018)	(0.062)
Emilexav	**-5.108*****	**-4.802*****	**-4.344*****	**-5.207*****	**-4.805*****	**-4.400*****
	(0.613)	(0.028)	(0.284)	(0.614)	(0.026)	(0.281)
Adj R-squared	0.958	0.958		0.958	0.958	
S.E. of regr.	0.243	0.242		0.243	0.242	
Wald test χ^2	134***	74701***		146***	79179***	

S.E. in parenthesis. Statistical significance: ***99%, **95%, *90%.

[8] The estimation has been run by means of Eviews 8.

Since the variables are logged the estimated coefficients are to be interpreted as the punctual elasticities of dependent variable with respect to one point percentage change of independent variables. In table 6 it is shown that with the exemption of grouped method estimation without intercept and trend, in all models the variable *USmilex* has a positive and significant impact on *debt*. That is, in the long run, according to our panel framework, the increase in the level of the US military expenditure translates into an increase of stock of gross public debt in European countries. The growth of national debts as a consequence of United States military engagement is ranged from a minimum of 0.806 and a maximum of 3.254. In brief, the results of long run relationships partially confirm the Arellano-Bond short run estimations of previous section. The military expenditures of other European countries, in particular, influence the level of *debt* negatively, and the long run effect is significant. Doubts emerge about the role of GDP per capita in determining the long run level of *debt*. In pooled and pooled weighted estimations the coefficients significantly associated are negative and ranged between 0.105 and 0.299. In grouped estimation method the coefficients are always significant and positive. In the case of no intercept and trend the impact reaches 2%, but this is the case of no significance of US military expenditure influence.

VI. VAR ANALYSIS

Given the heterogeneity of the panel, to refine the study, in this section we follow a VAR analysis for each country in the sample. In fact, we aim to take into account specific country attitude in our sample. First, we test for unit roots in each single time series used in cointegrating analysis on the previous section, that is *debt*, *GDPpc*, *USmilex* and *emilexav*. The Augmented Dickey-Fuller (ADF) test is performed selecting an automatic lag length based on Schwarz Info Criterion (SIC). In addition we performed the Phillips-Perron (PP) test which uses spectral estimation (Bartlett kernel) method with automatic selection of bandwidth (Newey-West). The null hypothesis is the existence of unit roots.

Additional tables A.2-A.5 in the appendix summarize the results. Briefly, the hypothesis of unit root in *debt* series is rejected (at standard 5% significance) only in few cases: Finland (for the ADF test with intercept and linear trend), Spain (ADF in the case of intercept and linear trend), and Sweden (ADF with intercept). On the contrary, almost all tests reject the hypothesis of unit root in first differences. In particular both ADF and PP tests suggest that *debt* is not stationary in levels and stationary in first differences, especially for no trend and intercept specification. With respect to *GDPpc* the hypothesis of non-stationarity is rejected at 5% standard level for 4 out of 78 statistics: Germany (ADF and PP test for the case of intercept and linear trend), Greece (ADF test with intercept and trend) and Portugal (PP test with intercept). The tests support the idea of difference stationarity since the hypothesis of not stationarity is often rejected especially in the case of no trend or intercept specification. Again, test of stationarity on average military expenditures of other European countries support the idea of unit roots in the series given that only for France (ADF test with intercept) the null hypothesis is rejected. With regard to GDP per capita the hypothesis of non stationarity is rejected many times. Eventually, we test the presence of cointegrating relationships among the four variables selected. We use the Engle-Granger (EG) and Phillips-Ouiliaris (PO) single equation cointegration tests for group of variables provided by EViews. *Debt* is the dependent variable and the null hypothesis is that the series are not cointegrated. Results in table 7 support the idea of no cointegrated relationships among the variable selected assuming *debt* as dependent, at single country level. The hypothesis of no cointegration is rejected only for Germany and Finland in the ADF test at conventional 5% level.

This result suggests to estimate a vector autoregressive (VAR) model instead of long run relationships, searching for confirmation about our panel estimations performed by the Arellano-Bond model. Table 8 below summarizes the results. The findings show that the stock of debt has a strong and significant autoregressive components, in the case of Spain it is greater than 1, supporting the idea of problems in managing the fiscal policy of public debt reduction. With respect to other variables we note that, whenever significant, the impact of lagged US military expenditure on the current stock of debt is positive, ranging between 0.053 of Italy and 0.583 of Ireland. The opposite holds for the lagged military expenditure of other European countries given that (with the exception of Italy) the sign is negative so seemingly counterbalancing the impact of US military expenditures. When looking at the relationship between GDP per capita and debt, we notice that for Greece and Portugal the debt appears to be pro-cyclical, while for Belgium, Italy and Spain it is countercyclical.

The graphs below show the impulse response functions associated to each country. They summarize the accumulated response of *debt* to non-factorized one unit innovation on US military spending for a period of 10 years. Of relevance is the response of *debt* to change in US military expenditure in Ireland, Italy, Portugal and Spain, countries that are recognized as the most vulnerable from a fiscal burden perspective.

Table 7. Single equation cointegration test: *Debt* as dependent. Lag selected by Schwartz Info Criterion (SIC) with d.f. adjustment for variance. Null hypothesis: the series are non cointegrated.

		Equation and regressors specification		
Country	**Test method**	**Intercept and trend**	**intercept**	**None**
Belgium	EG	-2.649	-2.649	-2.037
		(0.656)	(0.624)	(0.712)
	PO	-2.829	-2.829	-1.308
		(0.571)	(0.540)	(0.934)
Denmark	EG	-3.032	-3.032	-2.652
		(0.476)	(0.447)	(0.422)
	PO	-3.110	-3.110	-1.779
		(0.440)	(0.412)	(0.814)
Finland	EG	-2.844	-2.844	**-4.674****
		(0.564)	(0.533)	(0.016)
	PO	-2.880	-2.880	-2.070
		(0.547)	(0.517)	(0.697)
France	EG	-2.860	-2.860	-2.197
		(0.557)	(0.526)	(0.639)
	PO	-2.902	-2.901	-2.197
		(0.537)	(0.506)	(0.639)
Germany	EG	-3.759	-3.759	**-4.176****
		(0.201)	(0.185)	(0.041)
	PO	-2.535	-2.535	-2.800

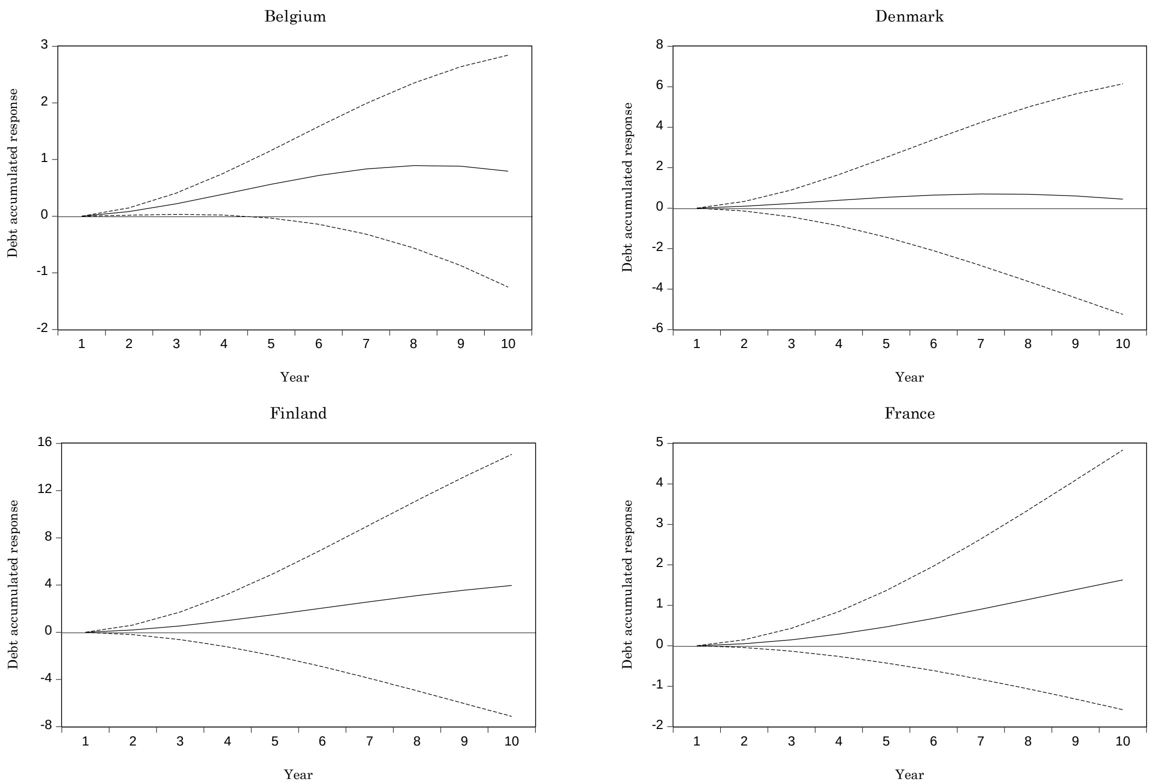
		(0.707)	(0.675)	(0.356)
Greece	EG	-4.753**	-4.753**	-1.404
		(0.047)	(0.043)	(0.916)
	PO	-3.548	-3.548	-1.726
		(0.264)	(0.244)	(0.832)
Ireland	EG	-2.344	-2.344	-3.233
		(0.787)	(0.756)	(0.206)
	PO	-2.098	-2.098	-1.047
		(0.869)	(0.843)	(0.965)
Italy	EG	-3.928	-3.928	-3.040
		(0.155)	(0.142)	(0.269)
	PO	-3.911	-3.911	-1.293
		(0.159)	(0.149)	(0.936)
Norway	EG	-1.957	-1.957	-1.897
		(0.905)	(0.882)	(0.770)
	PO	-2.227	-2.227	-2.164
		(0.829)	(0.799)	(0.654)
Portugal	EG	-3.180	-3.180	-0.988
		(0.423)	(0.394)	(0.970)
	PO	-2.436	-2.436	-0.962
		(0.750)	(0.718)	(0.972)
Spain	EG	-1.915	-1.915	-3.667
		(0.915)	(0.892)	(0.106)
	PO	-2.174	-2.174	-1.045
		(0.846)	(0.818)	(0.965)
Sweden	EG	-3.802	-3.802	**-3.681***
		(0.189)	(0.174)	(0.099)
	PO	-2.572	-2.572	-2.114
		(0.691)	(0.659)	(0.677)
UK	EG	-3.959	-3.959	-2.675
		(0.157)	(0.144)	(0.416)
	PO	-2.258	-2.258	-1.149
		(0.818)	(0.7889	(0.955)

The null hypothesis is rejected at 10 (*), 5 (**) and 1 (***) per cent respectively according to MacKinnon (1996) p-values.

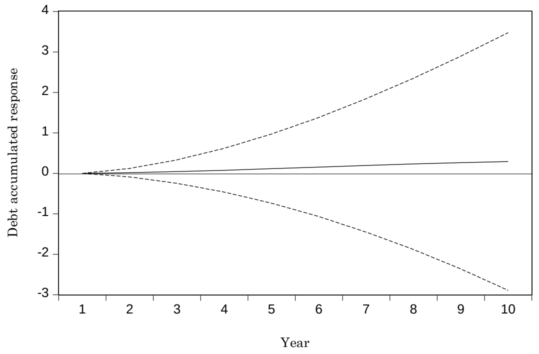
TABLE 8 - Unrestricted VAR. Dependent variable: *debt* – 25 observations

	$debt_{t-1}$	$GDPpc_{t-1}$	$USmilexp_{t-1}$	$emilexav_{t-1}$
Belgium	**0.938*** **	**-0.118** **	**0.082** **	0.030
	(0.056)	(0.057)	(0.032)	(0.074)
Denmark	**0.897*** **	-0.288	0.089	0.140
	(0.102)	(0.174)	(0.117)	(0.203)
Finland	**0.918*** **	-0.324	0.196	0.010
	(0.069)	(0.306)	(0.203)	(0.167)
France	**0.982*** **	-0.134	0.049	0.026
	(0.064)	(0.265)	(0.048)	(0.068)

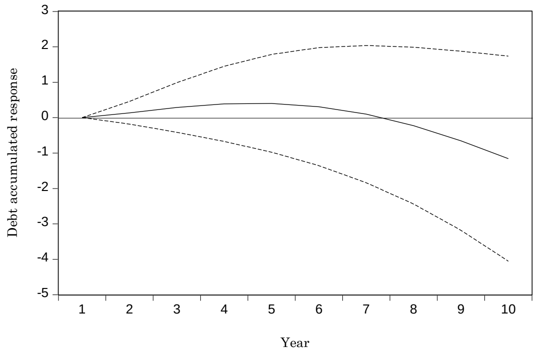
Germany	**0.947*****	-0.018	0.015	0.040
	(0.095)	(0.334)	(0.052)	(0.051)
Greece	**0.749*****	**0.318****	0.116	**-0.205***
	(0.077)	(0.149)	(0.081)	(0.115)
Ireland	**0.906*****	-0.047	**0.583*****	**-0.539*****
	(0.075)	(0.093)	(0.179)	(0.144)
Italy	**0.954*****	**-0.200****	**0.053****	**0.084*****
	(0.036)	(0.080)	(0.020)	(0.027)
Norway	**0.802*****	0.297	-0.116	0.209
	(0.154)	(0.315)	(0.196)	(0.169)
Portugal	**0.815*****	**0.225****	**0.317*****	**-0.252*****
	0.076	(0.102)	(0.093)	(0.060)
Spain	**1.030*****	**-0.391****	**0.292*****	**-0.198****
	(0.058)	(0.155)	(0.081)	(0.078)
Sweden	**0.950*****	-0.249	0.096	0.057
	(0.087)	(0.211)	(0.147)	(0.164)
UK	**0.936*****	0.159	0.176	**-0.194****
	(0.080)	(0.175)	(0.115)	(0.090)



Germany



Greece



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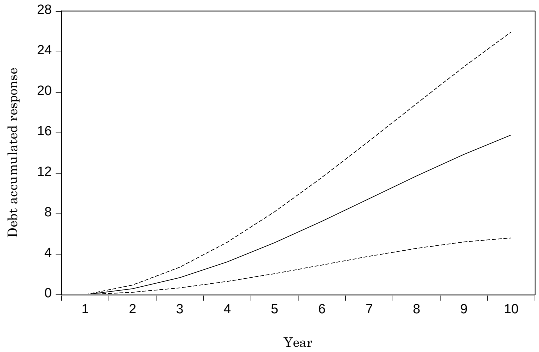

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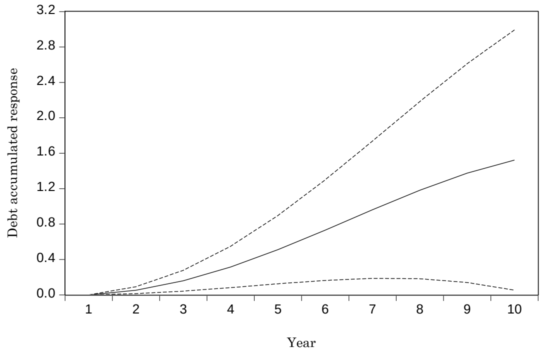

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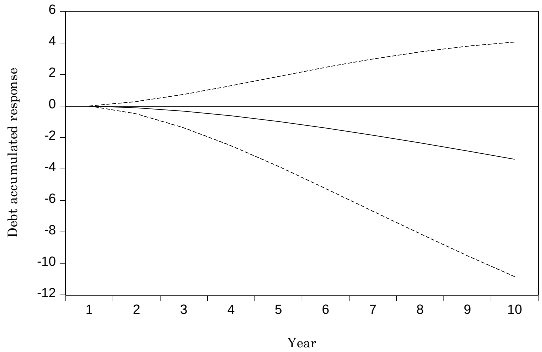
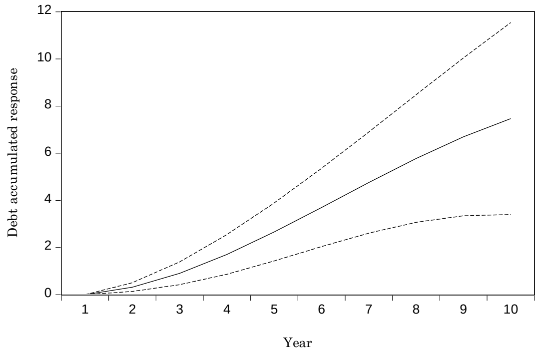


Portugal



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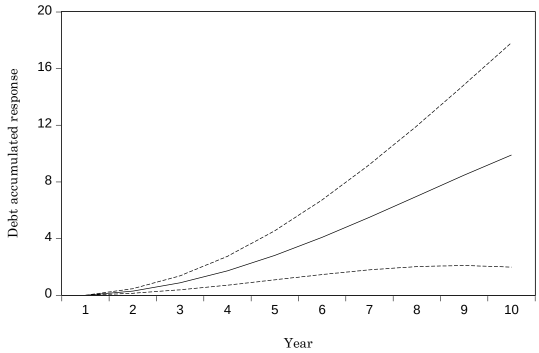
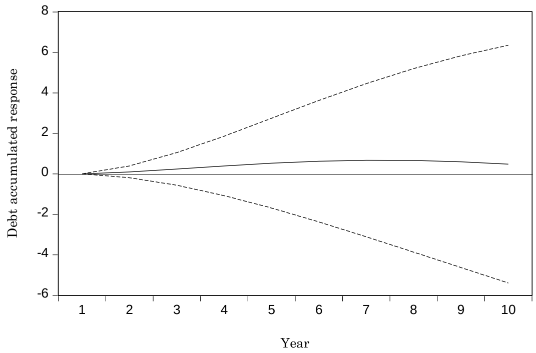
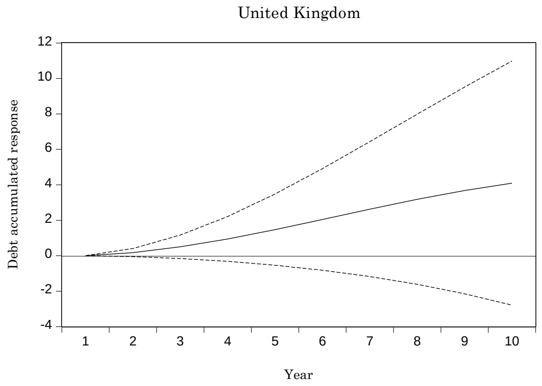


Sweden





CONCLUSIONS

The aim of this paper was to investigate the relationship between US military spending and public debt in a sample of European countries. The empirical analysis has been run exploiting a panel of 13 European countries: Belgium, Finland, Denmark, France, Germany, Greece, Ireland, Italy, Norway, Portugal, Spain, Sweden and United Kingdom. With the exception of Finland and Ireland all countries are members of NATO. The empirical strategy consisted in different steps: (i) a unit root tests (ii) a set of panel cointegration tests; (iii) an Arellano-Bond panel estimation; (iv) a FMOLS estimation to highlight the long run relationship between debt and relevant variables; (v) a VAR analysis for each country.

In the Arellano-Bond estimation the main results show that: (i) the current stock of debt of European countries is positively associated with one-year lagged US military spending; (ii) the growth rate of US military spending also appears to be positively associated the current stock of debt in European countries; (iii) the one year-lagged US military burden also appears to be positively associated with the dependent variable. With regard to the results of the A-B estimation, as additional novelty we would claim that we analyse the impact of military expenditures on debt also taking into account some aspects of the political cycle. This is by no means a trivial aspect because choices of public spending are generally sensitive to political cycle. Needless to say, this may hold also for military spending and especially in democratic countries.

In the FMOLS estimations, in all models there is evidence that the US military spending has a positive and significant impact on gross public debt in European countries. In most model long-run elasticities are around 1%. In the VAR analysis, only a subset of countries show a significant association between their stock of debt and US military spending. Interestingly, among others, southern countries like Italy, Portugal and Spain show such significant association.

In sum, the empirical results confirm the main hypothesis of this work, namely that European sovereign debt is also associated in the long run with US military expenditures. This empirical evidence confirms a predictable interdependence between US and European countries. Moreover, the findings of this paper pose an additional explanation on the determinants of 2009 sovereign debt crisis in Europe. In fact, in the light of the results one can maintain that previous US military spending had played a role to generate the current stock of European debt. Needless to say, security and strategic consideration lead the policy choices on military expenditure but the detrimental impact on the whole economy is often disregarded or underestimated. So in general, this paper contributes to this line of research. In particular, this papers focuses on the fiscal impact of the hegemon country's choices on smaller or weaker countries. This is the main novelty we would claim for this work. This represents a relevant departure from the existing literature that have analyzed traditionally the impact of national military spending on national economic performance (either debt or economic growth). Yet, this matters significantly if considering that threats to security are by no means the sole reason to increase military spending. In fact, apart from security issues, military spending is determined because of internal political economy considerations.

As noted above in the introduction, the ultimate concern of this paper is that periods of massive military spending can have a substantial impact on economies and eventually on stability of polities. This is nothing but a modest point of departure. Needless to say, further research is needed in order to unpack the relationships and the dynamics between US military spending and the economic performances of states within the international community.

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APPENDIX

TABLE A.1 - Descriptive statistics of control variables in AB Estimation. (1988-2013)

	Obs.	Mean	Median	Std. Dev.	Min	Max
Unemployment rate	325	8.696	8.144	4.039	1.617	25.126
Rae Leg	325	70.603	71.468	10.272	52.802	88.976
Gov Party	324	2.818	3	1.607	1	5
Kao open	325	1.969	2.422	0.872	-1.175	2.422
Vote	323	0.263	0	0.441	0	1

Table A.2 –Unit Root Tests

Unit root test		Equation specification					
		Ln Debt			Δ Ln Debt		
		intercept	intercept and trend	none	intercept	intercept and trend	None
Belgium	ADF	**-2.913*** (0.060)	-2.153 (0.492)	0.766 (0.873)	**-2.741*** (0.082)	-2.677 (0.253)	**-2.655**** (0.010)
	PP	-1.752 (0.394)	-1.736 (0.705)	0.953 (0.904)	**-2.741*** (0.082)	-2.677 (0.253)	**-2.655**** (0.010)
Denmark	ADF	-1.921 (0.318)	-2.456 (0.344)	0.162 (0.724)	**-2.938*** (0.056)	-2.872 (0.188)	**-3.000***** (0.004)
	PP	-1.511 (0.511)	-1.762 (0.692)	0.102 (0.706)	**-2.964*** (0.053)	-2.899 (0.180)	**-3.024***** (0.004)
Finland	ADF	**-3.919***** (0.007)	**-4.370***** (0.01)	1.191 (0.935)	-2.440 (0.142)	-2.700 (0.245)	**-2.085**** (0.038)

	PP	-2.094	-1.679	1.631	-2.440	-2.882	**-2.342****
		(0.248)	(0.731)	(0.971)	(0.142)	(0.185)	(0.021)
France	ADF	-1.351	-2.377	2.170	**-2.752****	-2.869	-1.524
		(0.589)	(0.381)	(0.991)	(0.080)	(0.189)	(0.117)
	PP	-1.429	-1.772	5.454	**-2.774***	-2.869	-1.525
		(0.552)	(0.688)	(1.000)	(0.077)	(0.189)	(0.117)
Germany	ADF	-1.767	-1.283	5.357	**-3.567****	**-4.025****	**-2.111****
		(0.387)	(0.869)	(1.000)	(0.015)	(0.022)	(0.036)
	PP	-1.693	-1.380	4.547	**-3.581****	**-4.032****	**-1.963****
		(0.422)	(0.842)	(1.000)	(0.014)	(0.02)	(0.049)
Greece	ADF	-2.020	-2.934	3.937	**-4.802*****	**-5.148*****	**-3.280*****
		(0.277)	(0.170)	(0.999)	(0.001)	(0.002)	(0.002)
	PP	-2.250	-2.858	4.151	**-4.809*****	**-5.166*****	**-3.280*****
		(0.195)	(0.192)	(0.999)	(0.001)	(0.002)	(0.002)
Ireland	ADF	-0.980	-1.270	0.831	-2.304	-2.562	**-2.160****
		(0.743)	(0.871)	(0.884)	(0.179)	(0.299)	(0.032)
	PP	0.145	-0.375	1.066	-2.351	-2.554	**-2.196****
		(0.923)	(0.983)	(0.920)	(0.165)	(0.302)	(0.030)
Italy	ADF	-1.808	2.901	0.978	-2.039	-1.922	**-1.827***
		(0.368)	(0.179)	(0.908)	(0.269)	(0.612)	(0.065)
	PP	**-2.772***	-2.501	2.477	-2.097	-1.922	**-1.850***
		(0.078)	(0.325)	(0.995)	(0.247)	(0.612)	(0.062)
Norway	ADF	-1.660	-2.920	0.796	**-3.809*****	**-3.921****	**-3.806*****
		(0.438)	(0.175)	(0.878)	(0.009)	(0.027)	(0.001)
	PP	-1.740	-1.618	0.672	**-3.795*****	**-3.902****	**-3.791*****
		(0.400	(0.766)	(0.855)	(0.009)	(0.028)	(0.001)
Portugal	ADF	-2.090	-0.643	2.022	**-3.778****	**-4.805*****	**-2.564****
		(0.999)	(0.967)	(0.987)	(0.022)	(0.005)	(0.013)
	PP	2.198	-0.647	3.209	**-3.362****	**-4.279****	**-2.486****
		(0.999)	(0.966)	(0.999)	(0.023)	(0.013)	(0.015)
Spain	ADF	-0.864	**-3.586***	1.235	-2.289	-2.272	**-1.897***
		(0.782)	(0.055)	(0.940)	(0.183)	(0.432)	(0.056)
	PP	-0.648	-1.504	2.151	-2.252	-2.223	**-1.813***
		(0.842)	(0.801)	(0.990)	(0.194)	(0.456)	(0.067)
Sweden	ADF	**-3.793*****	-1.421	0.939	-2.565	-2.737	**-2.443****
		(0.009)	(0.829)	(0.902)	(0.114)	(0.232)	(0.017)
	PP	-1.836	-1.567	0.705	**-2.681***	-2.825	**-2.577****
		(0.355)	(0.777)	(0.861)	(0.092)	(0.202)	(0.012)
UK	ADF	0.273	**-3.527***	2.787	**-4.056*****	**-3.913****	-1.573
		(0.971)	(0.059)	(0.998)	(0.005)	(0.028)	(0.107)
	PP	0.635	-1.979	2.091	-2.257	-1.959	**-1.791***
		(0.988)	(0.584)	(0.989)	(0.193)	(0.593)	(0.070)

Table A.3 – Unit Root Tests

Unit root test		Equation specification					
		Ln GDPpc			Δ Ln GDPpc		
		intercept	intercept and trend	none	intercept	intercept and trend	None
Belgium	ADF	-2.448 (0.140)	-0.099 (0.992)	3.767 (0.999)	**-3.742**** (0.010)	**-4.348**** (0.011)	**-2.963***** (0.005)
	PP	-2.448 (0.140)	-0.177 (0.990)	-3.414 (0.996)	**-3.722**** (0.010)	**-4.348**** (0.011)	**-2.885***** (0.006)
Denmark	ADF	-1.941 (0.309)	-0.162 (0.990)	-2.446 (0.995)	**-3.444**** (0.019)	**-4.039**** (0.021)	**-2.995***** (0.004)
	PP	-1.848 (0.350)	-0.162 (0.990)	-2.031 (0.987)	**-3.445**** (0.019)	**-4.010**** (0.022)	**-2.995***** (0.004)
Finland	ADF	-0.721 (0.823)	-1.188 (0.891)	-1.789 (0.979)	**-3.116**** (0.039)	-3.044 (0.142)	**-3.050***** (0.004)
	PP	-0.796 (0.803)	-1.490 (0.806)	1.523 (0.965)	**-3.199**** (0.033)	-3.131 (0.122)	**-3.114***** (0.003)
France	ADF	-2.321 (0.174)	-0.667 (0.965)	-3.382 (0.995)	**-3.572**** (0.015)	**-3.773**** (0.036)	**-3.096***** (0.003)
	PP	-2.321 (0.174)	-0.667 (0.965)	-3.382 (0.999)	**-3.522**** (0.016)	**-3.696**** (0.042)	**-3.063***** (0.004)
Germany	ADF	-1.335 (0.597)	**-5.395***** (0.001)	-3.764 (0.999)	**-3.850***** (0.009)	**-3.683**** (0.048)	**-3.266***** (0.002)
	PP	-1.577 (0.479)	**-4.945***** (0.003)	-5.668 (1.000)	**-5.294***** (0.000)	**-5.213***** (0.002)	**-3.145***** (0.003)
Greece	ADF	-1.651 (0.442)	**-4.304**** (0.013)	1.984 (0.985)	**-3.170**** (0.037)	-1.599 (0.763)	-1.534 (0.115)
	PP	-1.375 (0.578)	-0.393 (0.982)	0.606 (0.841)	-1.391 (0.570)	-1.599 (0.763)	-1.534 (0.115)
Ireland	ADF	-1.768 (0.386)	-0.878 (0.942)	0.677 (0.855)	-1.690 (0.423)	-2.372 (0.383)	-1.603 (0.101)
	PP	-2.175 (0.220)	0.041 (0.995)	2.272 (0.993)	-1.751 (0.394)	-2.404 (0.368)	**-1.622*** (0.098)
Italy	ADF	-2.518 (0.123)	0.314 (0.998)	-1.454 (0.960)	**-3.184**** (0.034)	**-4.175**** (0.017)	**-3.234***** (0.002)
	PP	-2.518 (0.123)	0.822 (0.999)	1.262 (0.943)	**-3.165**** (0.035)	**-4.018**** (0.022)	**-3.214***** (0.003)
Norway	ADF	**-2.668*** (0.094)	0.595 (0.999)	1.193 (0.935)	-1.971 (0.296)	**-3.280*** (0.094)	-1.531 (0.116)
	PP	-2.335 (0.169)	0.262 (0.997)	2.681 (0.997)	-1.971 (0.296)	-3.216 (0.105)	-1.441 (0.136)
Portugal	ADF	-1.788 (0.377)	-0.494 (0.977)	0.871 (0.891)	**-2.895*** (0.067)	**-3.477*** (0.069)	**-2.870***** (0.006)
	PP	**-3.171**** (0.034)	-0.697 (0.962)	2.104 (0.989)	**-2.864*** (0.065)	**-3.410*** (0.074)	**-2.858***** (0.006)

Spain	ADF	-1.436 (0.548)	-0.577 (0.973)	0.618 (0.843)	-2.141 (0.231)	-2.533 (0.311)	**-2.187**** (0.030)
	PP	-2.291 (0.182)	-0.107 (0.995)	1.994 (0.986)	-2.148 (0.229)	-2.631 (0.271)	**-2.172**** (0.031)
Sweden	ADF	-0.168 (0.931)	-1.811 (0.669)	2.866 (0.998)	**-3.641**** (0.012)	**-3.579*** (0.053)	**-3.047***** (0.004)
	PP	-0.249 (0.920)	-1.948 (0.600)	2.866 (0.998)	**-3.622**** (0.013)	**-3.561*** (0.055)	**-3.047***** (0.004)
UK	ADF	-1.611 (0.462)	0.102 (0.995)	1.473 (0.961)	**-2.679*** (0.092)	-2.870 (0.189)	**-2.165**** (0.032)
	PP	-1.412 (0.560)	-0.419 (0.981)	2.630 (0.997)	**-2.647*** (0.098)	-2.791 (0.214)	**-2.110**** (0.036)

Table A.3 – Unit Root Tests

Unit root test		Equation specification					
		Ln *Emilexav*			Δ Ln *Emilexav*		
		intercept	intercept and trend	None	intercept	intercept and trend	none
Belgium	ADF	-2.499 (0.128)	-2.405 (0.368)	-0.883 (0.323)	**-2.701*** (0.088)	-2.668 (0.257)	**-2.592**** (0.012)
	PP	-1.768 (0.387)	-1.674 (0.733)	-0.892 (0.320)	**-2.674*** (0.093)	-2.642 (0.267)	**-2.558**** (0.013)
Denmark	ADF	-2.534 (0.120)	-2.430 (0.356)	-0.903 (0.315)	**-2.712*** (0.087)	-2.686 (0.250)	**-2.593**** (0.012)
	PP	-1.797 (0.373)	-1.687 (0.727)	-0.936 (0.302)	**-2.692*** (0.090)	-2.668 (0.257)	**-2.565**** (0.013)
Finland	ADF	-2.562 (0.114)	-2.458 (0.344)	-0.922 (0.307)	**-2.673*** (0.093)	-2.647 (0.265)	**-2.544**** (0.013)
	PP	-1.810 (0.367)	-1.696 (0.723)	-0.967 (0.289)	**-2.656*** (0.096)	-2.647 (0.265)	**-2.519**** (0.014)
France	ADF	**-3.657**** (0.012)	**-3.576*** (0.054)	-0.832 (0.345)	**-2.688*** (0.091)	-2.670 (0.256)	**-2.592**** (0.012)
	PP	-1.899 (0.327)	-1.773 (0.687)	-0.845 (0.340)	**-2.737*** (0.083)	-2.727 (0.236)	**-2.634**** (0.011)
Germany	ADF	-1.850 (0.349)	-1.843 (0.652)	-0.930 (0.304)	**-3.452**** (0.019)	**-3.364*** (0.080)	**-3.392***** (0.002)
	PP	-1.575 (0.480)	-1.551 (0.783)	-0.759 (0.377)	**-3.493**** (0.017)	**-3.408**** (0.074)	**-3.430***** (0.001)
Greece	ADF	-2.607 (0.105)	-2.472 (0.337)	-0.929 (0.304)	**-2.693*** (0.090)	-2.699 (0.246)	**-2.565**** (0.013)
	PP	-1.825 (0.360)	-1.671 (0.734)	-0.943 (0.299)	**-2.672*** (0.093)	-2.699 (0.245)	**-2.536**** (0.014)
Ireland	ADF	-2.539 (0.119)	-2.433 (0.355)	-0.915 (0.310)	**-2.705*** (0.088)	-2.681 (0.252)	**-2.580**** (0.012)

	PP	-1.808 (0.368)	-1.693 (0.724)	-0.955 (0.294)	**-2.682*** (0.092)	-2.659 (0.260)	**-2.548**** (0.013)
Italy	ADF	**-2.653*** (0.097)	-2.478 (0.335)	-0.782 (0.367)	-2.509 (0.126)	-2.574 (0.294)	**-2.421**** (0.018)
	PP	-1.824 (0.361	-1.591 (0.768)	-0.871 (0.329)	-2.551 (0.117)	-2.614 (0.278)	**-2.463**** (0.016)
Norway	ADF	-2.537 (0.120)	-2.437 (0.353)	-0.885 (0.322)	**-2.662*** (0.095)	-2.635 (0.269)	**-2.548**** (0.013)
	PP	-1.808 (0.368)	-1.692 (0.725)	-0.924 (0.307)	**-2.662*** (0.095)	-2.635 (0.269)	**-2.548**** (0.013)
Portugal	ADF	-2.481 (0.132)	-2.381 (0.379)	-0.934 (0.302)	**-2.750*** (0.081)	-2.715 (0.240)	**-2.619**** (0.011)
	PP	-1.811 (0.367)	-1.699 (0.721)	-0.981 (0.283)	**-2.722*** (0.085)	-2.688 (0.249)	**-2.582**** (0.012)
Spain	ADF	-2.520 (0.124)	-2.400 (0.370)	-0.845 (0.339)	**-2.850*** (0.066)	-2.839 (0.198)	**-2.753**** (0.008)
	PP	-1.839 (0.354)	-1.713 (0.715)	-0.913 (0.311)	**-2.831*** (0.069)	-2.820 (0.204)	**-2.729**** (0.008)
Sweden	ADF	-2.532 (0.121)	-2.436 (0.354)	-0.859 (0.333)	**-2.685*** (0.091)	-2.656 (0.261)	**-2.583**** (0.012)
	PP	-1.802 (0.371)	-1.694 (0.724)	0.886 (0.323)	**-2.685*** (0.091)	-2.656 (0.261)	**-2.583**** (0.012)
UK	ADF	-2.167 (0.225)	-2.362 (0.388)	**-1.723*** (0.080)	**-2.945*** (0.055)	-2.877 (0.186)	**-2.674***** (0.010)
	PP	-1.561 (0.487)	-1.719 (0.713)	-1.356 (0.158)	**-2.945*** (0.055)	-2.877 (0.186)	**-2.642**** (0.011)