Allies with Benefits: US Effect on European Demand for Military Expenditures

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Abstract

This paper examines the security relationship between the US and Europe, focusing on potential spill-over effects of US military expenditures on European demand for military expenditures during the early 21st Century. The goal is to determine whether or not European nations act as security cooperators with the US or free-riders with respect to their military expenditures. Past work in this area has found mixed results concerning the effect of US military expenditures, but focus strictly on the spill-overs within a formal alliance, specifically NATO, and use a time series dominated by Cold War dynamics. This study differentiates itself by accounting for both the US total military expenditures and its regional expenditures in Europe through incorporation of US military base and personnel deployments across Europe. Additionally, this paper also uses government revenue in its estimation to mitigate endogeneity. Results using Arellano-Bond dynamic analysis suggest that there is a strong probability of free-riding behavior among European states.

Keywords: Arellano-Bond; Europe; NATO; Panel; US

JEL Code: H56, C33

Introduction

The US-European security relationship has been an international staple since the establishment of the North Atlantic Treaty Organization (NATO) in 1949. NATO's first Secretary General Lord Ismay stated that a primary goal of the organization was to "keep the Americans in [Europe]" (Reynolds 1994, 13). However, over the course of the 21st Century US

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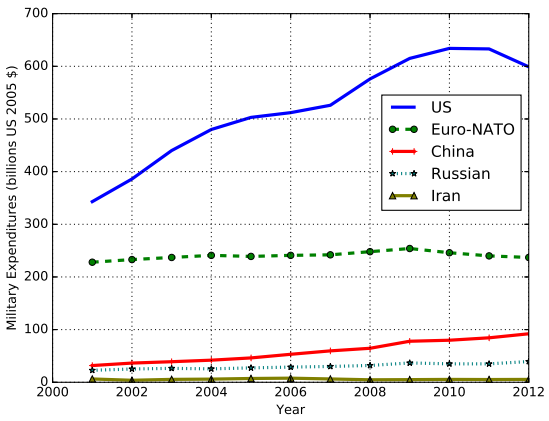
interests and attention have been drawn elsewhere: the Middle East, Central Asia, and South-East Asia. To understand what consequences this shift in attention may have, it is first important to establish what kind of security relationship the US and the European community have currently. Do European nations see US military expenditures as a complement to their own or as a substitute, if any effect at all? The goal of this paper is to estimate the potential effect US military expenditures may have on European demand for military expenditures.

Figure 1: Comparative Military Expenditures 2001-2012

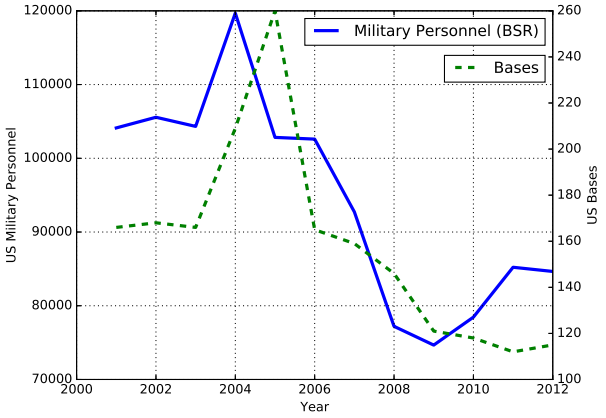


The US currently occupies a dominant position in terms of international power. Following the collapse of the Soviet Union in the early 1990s the world began a period of hegemony, dominated by the US. Figure 1, using data from the Stockholm International Peace Research Institute (SIPRI), plots US military expenditures alongside the aggregated military expenditures of all European NATO members[1], Russia, China, and Iran in real terms. China, Russia, and Iran are included because they are considered potential rivals. By 2011 the

[1]For the sake of brevity, all mentions of NATO past this point will be in reference to its European members exclusively

US was spending more than double all other NATO countries combined. This considerable expenditure of resources by the US is only 4.7% of US GDP (SIPRI), whereas the average military expenditure by European states is 1.4% of GDP for 2011.

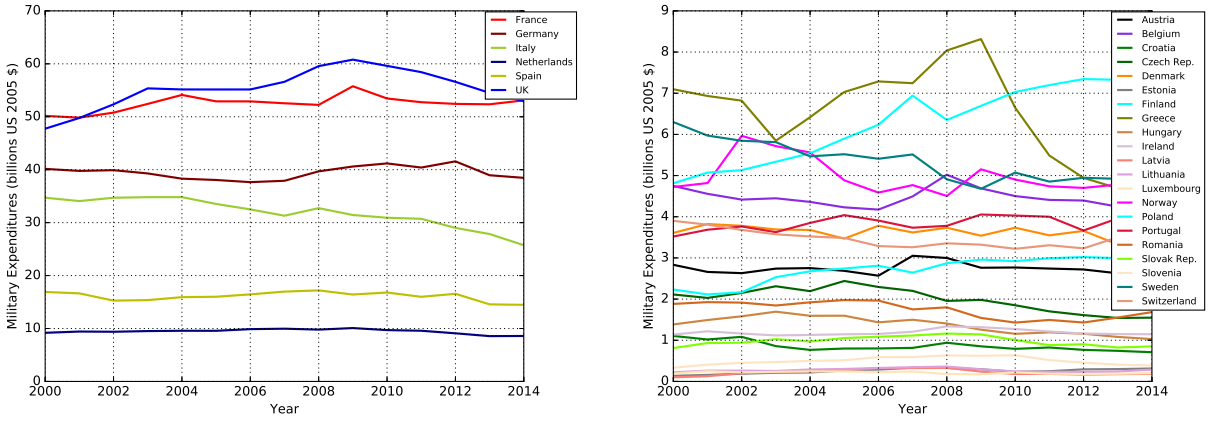
Figure 2: US Military Presence in Europe 2001-2012



During the same time period where US total military expenditures were increasing, the US's physical presence in Europe was decreasing. Figure 2 shows the number of active US bases and military personnel deployed in Europe, based on data obtained for the US Defense Department's Base Structure Reports. Active US bases and military personnel essentially co-move with one another, peaking around 2004/2005 and then declining sharply thereafter. During the same time period, collective European military expenditures show very little variation but individually fluctuate as shown in Figure 3. If there were significant differences in terms of economic or demographic factors between Europe and the US, the disparity would make more sense but there are not. So the situation emerges where there are potentially two contrary forces potentially influencing European decision makers with respect to the US: total military expenditures and regional military expenditures.

The secondary goal of this paper is to examine whether European nations respond to

Figure 3: European Military Expenditures 2000-2014



the US total military expenditures, its regional expenditures, both, or neither. If such a relationship is found to exist, the next step is then to estimate the relative nature of the effect. European states could be security followers, wherein the US and Europe coordinate and and military expenditures co-move. European states could also be free-riders off the US, denoted by an inverse relationship in military expenditures. Findings show that US total military expenditures have a statistically significant and negative effect on European military expenditures after controlling for other factors while US regional factors show minimal importance. The structure of this paper is as follows: a review of relevant literature, theory, data, empirical analysis, and conclusion.

Related Literature

A rich literature exists on the factors shaping military expenditures. A traditional interpretation of military expenditures is to take the neoclassical approach and view military expenditures as a pure public good, wherein the state balances security and opportunity

costs (Smith 1989; Sandler 1993). Complicating the demand for military expenditures are other internal and external factors. Internal factors include economic variables, bureaucracy, politics, and ideology (Albalate et al. 2012; Bove and Brauner 2014; Töngür et al. 2015). External factors, which are the primary concern of this study, include the military spending of potential allies and enemies. Sandler and Hartley (2007) provide a comprehensive survey of the economic research on demand for military expenditures: examining arms-races, alliance formation, and public good models.

Understanding the influences of military expenditures is important because military expenditures can have a negative impact on economic growth. A survey by Dunne and Tian (2013) found that, in most cases, increases in military expenditures do not induce economic growth; Dunne and Nikolaidou (2011) found this to be the case in the EU15. A possible reason behind this is that military expenditures often have an inverse relationship with other forms of government spending (Nikolaidou 2008), because military expenditures divert resources that could be used for government services or development. Hence factors that increase military expenditures could result in welfare loss for a state, as resources transfer to defense and away from pursuits that are potentially more beneficial to economic growth, resulting in generally reduced growth for the state.

The negative opportunity costs of military expenditures are a potential reason why many empirical studies suggest security free-riding when states have allies (Gonzales and Montolio 2001; Nikolaidou 2008; Ringsmose 2010; Beeres et al. 2012). Conversely, other studies have shown that some states are security followers and their military expenditures co-move with allies (Smith 1989; Solomon 2005; Nikolaidou 2008[2]; Douch and Solomon 2012). A common

[2]Nikolaidou (2008) is cited on contrary points because they did individual time series analyses for various

theme among these studies is that they use a time series dominated by Cold War politics and predominantly focus on the security relations within a formal alliance, specifically NATO.

This paper extends existing work in several important ways. First, by testing the potential security spill-over effect to states outside a formal alliance through the inclusion of European states outside of NATO in the analysis. Second, the use of government revenue, as opposed to GDP, to better represent the resource constraints of European states and counter endogeneity. Third, using a more recent post-Cold War data set. The separation of Cold War and post-Cold War periods is important because past analysis has shown that relationships have changed (Dunne and Perlo-Freeman 2003) between the two periods. The time period of interest here covers several important strategic shifts: the transition of NATO to smaller scale crisis response, initiation of the Global War on Terrorism, and the Great Recession. A period encompassing these substantial shifts deserves independent analysis in order to make more effective policy recommendations.

Finally, a distinction is made between the US's total and regional military expenditures. Using information obtained through the US Department of Defense I am able to proxy for US regional military expenditures in Europe. The ability to make the distinction between the US's total and regional military expenditures is relevant because previous studies (Rosh 1988; Dunne and Perlo-Freeman 2003; Nordhaus et al. 2012, Skogstad 2016) have shown that the strategic environment a state faces significantly influences its demand for military expenditures. By making the distinction between international and regional security, a more nuanced analysis can be done.

European countries. In some cases Nikolaidou (2008) found cooperation and in other cases free-riding.

Theory

The theoretical model of this paper follows Smith's (1989) neoclassical approach to deriving a state's demand for military expenditures. In Smith's approach the state functions as a rational actor seeking to maximize a welfare function, W, which is a function of security, S, non-military expenditures, C, and subject to a budget constraint:

$$W = f(S, C, Z) \tag{1}$$

With Z being a vector of parameterizing internal domestic variables. Maximization of the state's welfare function is subject to a budget constraint:

$$Y = P_{ME}ME + P_C C \tag{2}$$

P_{ME} and P_C are the respective prices of ME and C while Y is total state income. The second constraint is security, S, which is a function of a state's military expenditures, ME, regional security concerns, R, international security concerns, G, and other parameterizing variables, X. R includes the military expenditures of potential allies and enemies on a more local level, while G includes more global concerns, such as terrorism and distant rogue states.

$$S = f(ME, R, G, X) \tag{3}$$

Maximization of the state's welfare functions subject to the security and budget constraints yields a ME demand function of:

$$ME = f(Y, P_M, P_C, R, G, Z, X) \tag{4}$$

The above is the standard general form for demand for military expenditures. For the purposes of this paper the general form is expanded upon to the following:

$$ME = f(ME_{-1}, Y, GE, Trade, US^T, US^R, NATO_{-i}, PopDen, Dis, I) \quad (5)$$

Thus European demand for military expenditures becomes a function of demand for other government services, national income, US total and regional military expenditures, neighboring NATO expenditures, potential threats, and other internal parameterizing variables:

- ME_{-1} is one period lag of military expenditures. A one period lag of military expenditures is used to account for bureaucratic inertia of a state. The use of lagged military expenditures, though theoretically relevant, creates estimations issues which will be discussed later.

- Y is total government income.

- GE is other government expenditures excluding military. Government expenditures represents the opportunity costs of military expenditures. Since military expenditures often crowd out other government expenditures (e.g. guns verse butter) the coefficient is expected to be negative.

- US^R and US^T are US military expenditures at the regional and total levels.

- $NATO_{-i}$ is the aggregated military expenditures of all European NATO members excluding the military expenditures of country i if they are a member for that year.

- $Trade$ is the country's summed value of exports and imports of both goods and services.

- $PopDen$ is population density. Population density is included to capture any scale public good effect military expenditures may have (Dunne and Perlo-Freeman 2003;

Nikolaidou 2008) and to capture the defensive burden of protecting the country's landmass. A large sparsely populated country is harder to defend than one that is highly concentrated.

- Dis is the distance between each country's capital and Moscow, Russia using the shortest route on a major road network, determined through Google Maps.

- I is a vector of indicator variables for NATO membership, the presence of at least one active US base in the country's territory, and participation in the Iraq War.

Military expenditures are assumed to be a normal good and therefore should have a positive relationship with respect to government income. Past studies have used GDP for government income in the demand function; however, this study uses government revenue instead. Whereas GDP encompasses all economic activity in the state, of which the government only partially controls, government revenue is a better reflection of the resources available to policymakers. Since the period of analysis does not contain large scale Clauswitzian style total warfare, this is a reasonable decision to make. Using government revenue also avoids endogeneity issues because military expenditures are included in GDP, which range between 1-4% of GDP for European states (SPIRI). An unfortunate downside of using government revenue is that some years are unavailable for certain countries, slightly unbalancing the panel. As a robustness check, alternative specifications were run using GDP in place of government revenue.

The US and NATO military expenditures are used to assess if there is any spill-over effect. If the coefficient for either is negative and significant, it would indicate that US and NATO military expenditures are seen as a substitute for a state's own military expenditures,

suggesting security free-riding. If the coefficients are positive and significant, that would indicate that US and NATO military expenditures are seen as complementary. Lack of significance or significant coefficients of zero for either would suggest European states are autarkic in their security choices. A core assumption of this paper is that the relationship is one way, i.e. European military expenditures do not influence US military expenditures.

As stated earlier, a secondary goal of this paper is to distinguish the effects of US total and regional military expenditures. The separation between the two is important because countries face different issues at the regional and international levels. At the regional level a country is more aware of the issues, risks, and actors at play; known unknowns. However, at the international level, issues become more complicated and harder to identify; unknown unknowns. Additionally, the difficulties of security increase exponentially the further a country tries to project itself beyond its borders. Thus, at the regional level the presence of a powerful outside allied actor may be viewed as beneficial but not critical. However, at the international level, a powerful interest-aligned ally could be viewed as more valuable to smaller states.

An issue with using US regional military expenditures in Europe is that the necessary data is not available. Only US total military expenditures are available, regional expenditures are not. To get around this gap in the data, I use US military personnel and base information from the US Department of Defense as a proxy for regional military expenditures. Recall from Figure 2 that US active bases and military personnel roughly follow one another, so it is reasonable to believe that they can be used as a proxy. As with total US military expenditures, the interpretation of the coefficients is the same. During the empirical analysis the US regional expenditures are analyzed multiple ways: the regional total, country specific,

and interaction terms between US military personnel and bases at both the regional and country level.

The NATO figure is the aggregation of all the military expenditures of European NATO members excluding Iceland[3]. NATO and the US were separated to isolate each of their respective effects. NATO was used because while other pan European security organizations have formed (e.g. the EU's Common Security and Defence Policy), NATO remains the most prominent of the international defense organizations in Europe. Over the period of analysis NATO expanded its membership (2004 and 2009). For the relevant years, the military expenditures for the new NATO members were added to the aggregation. In this form, the NATO variable used here is very similar to the "Security Web" variable employed by Rosh (1988) and Dunne and Perlo-Freeman (2003) but instead of a measure of potential enemies, it instead accounts for potential regional allies exclusively. Because an individual NATO member's military expenditures are removed from the aggregation, there is little concern for endogeneity.

Rosh (1988) and Dunne and Perlo-Freeman (2003) include trade, imports plus exports, to account for the potential ease a country might have in purchasing arms abroad, potentially increasing military expenditures. In this analysis trade is included for slightly different reasons. Here trade is used to represent how vulnerable a country is to potential international instability and conflict. If a conflict were to disrupt trade, a country highly dependent upon trade would suffer more than an a more insular country. The more a country is engaged in trade, the more it will need to spend on defense to protect its trade. A small country that is

[3]Iceland was excluded due to data availability issues. However, Icelands military expenditures are tiny relative to the rest of NATO, averaging only $21 million over the years available, so there should be no loss in statistical validity

highly dependent on trade is more likely to value the presence of an outside stabilizing force, such as the US. Given that many European countries have export intensive economies, this is an important variable to include.

Distance is included to account for the sense of uneasiness that might arise from proximity to a potential threat, which in this case would be Russia. Distance from Moscow was chosen as a threat proxy because even though the Cold War is over, Russia still represents the most pressing existential security concern to European countries, with Moscow being its political and economic center. Though during the period of analysis there was cooperation between Russian and the West in the form of the NATO-Russia Council, recent events diminish its relevancy. Russian transgressions in Ukraine and posturing along Baltic States suggests that the tenure of the NATO-Russia Council was little more than an unsteady detente than genuine peace building. Furthermore, incidences such as the 2007 cyberattack on the Estonian government and the 2008 invasion of Georgia (which was considering joining NATO prior to the invasion) further emphasize the continued tensions between East and West.

It is necessary to use a threat proxy instead of the military expenditures of potential threats because of both practical and theoretical reasons. Even twenty years after the end of the Cold War, reliable data for military expenditures from Russia remains difficult to acquire and highly suspect. However, it is believed that these figures are highly correlated with those of the US and NATO (Solomon, 2005) and thus do not inhibit analysis greatly. Given the US's considerable intelligence capabilities, this does not seem like an unreasonable assumption. The same argument can be made for threats stemming from terrorist organizations and other rogue states. The distance variable should help to mitigate the absence of Russian military expenditures.

Solomon (2005) also notes that empirical analysis of military expenditures should include a variable for the ratio of the military price deflator and the civilian price deflator, since military prices move differently than civilian prices. Unfortunately, few countries separately track their military price deflator so this data cannot be included.

Data

To assess the potential spill-over effect of US military expenditures on European demand for military expenditures this study uses a panel series of 27 countries for years 2000 to 2014. European nations were chosen because of the relative homogeneity between states (developed, democratic, pro-West, etc.), lack of significant interstate and intrastate conflict, and minimal regional tension[4]. The time period, 2000-2014, was chosen for the previously stated policy reasons as well as practical limitations. Some variables used in the empirical analysis, most significantly those used to proxy US regional military expenditures, are only available for the given time period.

Previous research into the factors behind military expenditures used multiple time series case studies (Nikolaidou 2008; Douch and Solomon 2012). This approach works when each country faces a unique security environment. However, when several countries face a similar security environment and are relatively similar in characteristics, as is the case with Europe, panel analysis becomes feasible allowing for a far more robust sample size. To illustrate this point, the sample domestic data for each country has been put into an Andrews Plot[5] in

[4]Persistent tensions between the Balkan nations and Turkey's issues with internal extremists are why they are excluded.

[5]An Andrews Plot puts data through a finite Fourier Series that preserves the mean and variance. For more information see Garcıa-Osorio and Fyfe (2005)

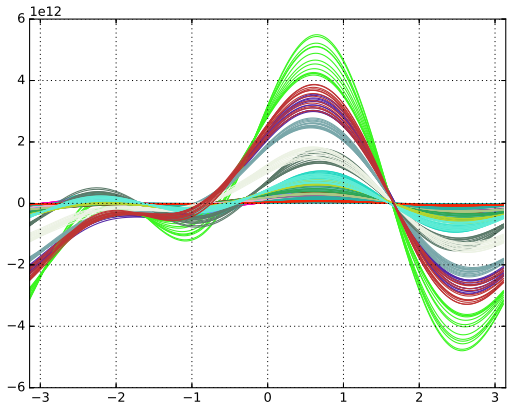
Table 1: Sample Countries, 2000-2014

Austria*	Greece	Poland
Belgium	Hungary	Portugal
Croatia	Ireland*	Romania
Czech Republic	Italy	Slovakia
Denmark	Latvia	Slovenia
Estonia	Lithuania	Spain
Finland*	Luxembourg	Sweden*
France	Netherlands	Switzerland*
Germany	Norway	UK

*=Non-NATO

Figure 4. Each color represents a sample country and each line an observation. While the axes values are relatively unimportant, the relevant detail is that overall the data flows in roughly the same manner and there are no extreme outliers, validating the use of panel data.

Figure 4: Andrews Plot of Sample Countries



Country level data were obtained through Stockholm International Peace Research Institute (SIPRI), the World Bank, and Eurostat. Governmental financial figures were converted from percent GDP to level and normalized to US$ 2005 figures. Distance measures are between Moscow and each European capital, calculated using Google Maps and based on the shortest route on a major road network. Information for US military personnel and bases in Europe were obtained through the US Department of Defense Base Structure Report (BSR)

and the Defense Manpower Data Center (DMDC). The BSR is a yearly report that details all active US bases and base personnel deployments worldwide, while the DMDC tracks all US military personnel deployments worldwide. While DMDC releases quarterly reports of deployments, older records only include the September reports, thus these were the reports used for all years.

The distinction between the BSR and DMDC is that the DMDC includes deployments to countries where the US does not possess its own facilities and the deployments can be for much shorter periods. For the purposes of this paper, only US facilities that had military personnel were counted as a US base. Including the BSR and DMDC data enables testing the importance of total vs. regional US military expenditures to the European community. A downside of using the BSR is that the report in its current form only goes back to 2001 and stops including military personnel figures in 2012, thus limiting the time span of the panel. As shown in Table 3, different specifications of the BSR and DMDC data were used, the first being regional aggregation of US bases and military personnel and the second country specific. For the regional total DMDC figures, US military personnel in countries outside of the sample countries but included in the regional sphere, such as the Balkans and Turkey, were included. Variables that are country invariant are noted in Table 4.

Empirical Analysis

The empirical testing used in this paper is an extension of that utilized by Dunne and Perlo-Freeman (2003) but expanded upon to fullfil the stated goals. Initial specification testing is done using a static fixed effects (FE) model followed by a dynamic model. As

Table 2: Data Description, European Variables

Label	Variable	Source	Period	Interval	Units
ME	Military Expenditures	SIPRI	2000-2014	Annual	2005 US$ (Millions)
GE	Government Expenditures	World Bank	2000-2014	Annual	2005 US$ (Millions)
GDP	Gross Domestic Product	World Bank	2000-2014	Annual	2005 US$ (Millions)
GR	Government Revenue	Eurostat	2000-2014	Annual	2005 US$ (Millions)
Trade	Summed Exports and Imports	World Bank	2000-2014	Annual	2005 US$ (Millions)
NATO	Aggregated NATO Military Expenditures	SIPRI	2000-2014	Annual	2005 US$ (Millions)
PopDen	Population Density	World Bank	2000-2014	Annual	Population per km^2
Dis	Distance	Google Maps	2000-2014	Constant	Kilometers
Has Base	US military base in territory	BSR	2001-2012	Annual	Indicator
NATO Member	NATO member for given year	SIPRI	2000-2014	Annual	Indicator
Iraq	Involved in the Iraq War	SIPRI	2000-2014	Annual	Indicator

Table 3: Data Description, US Military Variables

Label	Variable	Source	Period	Interval	Units
US	total US military expenditures	SIPRI	2000-2014	Annual	2005 US$ (Millions)
US milper BSR total	US military personnel, regional total	BSR	2001-2012	Annual	Individual
US base BSR total	US military bases, regional total	BSR	2001-2012	Annual	Individual
US milper BSR country	US military personnel, country specific	BSR	2001-2012	Annual	Individual
US base BSR country	US military bases, country specific	BSR	2001-2012	Annual	Individual
US milper DMDC total	US military personnel, regional total	DMDC	2000-2014	Annual	Individual
US milper DMDC country	US military personnel, country specific	DMDC	2000-2014	Annual	Individual

Table 4: Summary Statistics

Label	**Mean**	**Std. Dev.**	**Min**	**Max**	***n***	***T***	***N***
ME	9,669	15,566	97	69,978	27	13	351
GE	103,507	147,196	1,861	551,227	27	12.85	347
GDP	558,293	798,686	9,922	3,158,594	27	13	351
GR	192,238	273,391	2,786	994,125	27	12.67	342
Trade	408,635	502,078	8,851	2,712,892	27	13	351
NATO	230,568	17,416	175,948	253,558	27	13	351
PopDen	128.34	92.04	13.86	403.31	27	13	351
Dis	2,244	897	904	4,563	27	13	351
Has Base	.352	.478	0	1	27	12	324
NATO Member	.721	.449	0	1	27	13	351
Iraq	.157	.364	0	1	27	13	351
US*	506,716	105,011	338,889	634,442	27	13	351
US milper BSR total*	94,338	14,197	74,663	119,687	27	12	324
US base BSR total*	159	43	112	260	27	12	324
US milper BSR country	3,456	12,858	0	86,060	27	12	324
US base BSR country	6	22	0	209	27	12	324
US milper DMDC total*	102,782	54,247	76,183	279,887	27	13	351
US milper DMDC country	3,807	15,679	0	199,950	27	13	351

*=Country invariant

in Dunne and Perlo-Freeman (2003), this paper uses the double log form of the dependent and independent variables. Results from a Box-Cox specification test suggest the use of the double-log form as well[6]. However, because some countries do not have either a US base or military personnel, in models using country level US military personnel and bases these variables remain in their original linear form. Also during the country level specification of US forces, the indicator variable for having a US base is dropped due to collinearity. An added benefit of using the double-log specification is that coefficients are now elasticities. Results from a Hausman test indicate that country specific fixed effects (α_i) should be used. Corrections for hetereoskedasticity were implemented using clustered robust standard errors. Interaction terms for US military personnel and bases at the regional level and for trade and total US military expenditures were initially included but dropped due to collinearity.

Static Fixed Effects Model

Tables 5 and 6 contain the results from eight specifications of the static model run, each column represents a different econometric model tested. Table 5 contains models using government revenue, GR, while Table 6 used GDP. For certain models some variables were omitted, denoted by '$\sim$'. Findings suggest that Model 4, judged by the overall R^2, variable significance, and the AIC and BIC values; seems to be the most robust. The benefits of using GR more than make up for unbalancing the panel. The variables used in Model 4 form the basis for the dynamic model used in the next section.

Across models it is quite clear that US military expenditures are important to European

[6]The Box-Cox test suggested a transformation of .115 and .229 on the dependent and independent variables respectively. Since a transformation with these values would lack clear interpretability, the double-log is applied which is common in the literature.

policymakers, but it is US total military expenditures that matters most. At no point across specifications does the number of US military personnel matter: neither regional total, country specific deployments, nor differentiating between the BSR and DMDC data. Given that the US uses its European bases as staging grounds for operations elsewhere[7], it is possible that these troops are not seen as a permanent force to be relied upon. As a robustness check, total and regional US military expenditures variables were included in the same model. In all cases again only US total military expenditures are significant.

[7]For example, the US African Command headquarters is actually in Stuttgart, Germany

Table 5: Static Fixed Effect Models with GR

	Model 1		Model 2		Model 3		Model 4	
ME	**Coefficient**	**Robust Std. Err.**	**Coefficient**	**Robust Std. Err.**	**Coefficient**	**Robust Std. Err.**	**Coefficient**	**Robust Std. Err.**
GR	0.244	(0.322)	0.226	(0.321)	0.260	(0.320)	0.219	(0.321)
GE	0.468	(0.245)*	0.517	(0.240)**	0.471	(0.244)*	0.509	(0.238)**
Trade	0.067	(0.155)	0.035	(0.156)	0.086	(0.158)	0.035	(0.158)
NATO	1.359	(0.576)**	1.489	(0.580)**	1.625	(0.579)***	1.511	(0.584)**
PopDen	0.585	(0.576)	0.188	(0.680)	0.646	(0.605)	0.191	(0.687)
Dis	1.344	(0.218)***	1.461	(0.243)***	1.269	(0.237)***	1.447	(0.243)***
Has base	0.278	(0.053)***	~		0.281	(0.055)***	~	
NATO member	0.074	(0.044)	0.070	(0.047)	0.077	(0.045)	0.069	(0.048)
Iraq	0.102	(0.032)***	0.109	(0.032)***	0.095	(0.032)***	0.109	(0.033)***
US*	-0.560	(0.149)***	-0.574	(0.159)***	-0.571	(0.148)***	-0.563	(0.157)***
US milper BSR total	-0.081	(0.069)	~		~		~	
US base BSR total	0.053	(0.025)**	~		0.026	(0.027)	~	
US milper BSR country (linear)	~		0.000	(0.000)	~		~	
US base BSR country (linear)	~		-0.002	(0.005)	~		-0.001	(0.002)
BSR milper-base interact country	~		0.000	(0.000)	~		~	
US milper DMDC total	~		~		0.014	(0.018)	~	
US milper DMDC country (linear)	~		~		~		0.000	(0.000)
BSR-DMDC interact	~		~		~		0.000	(0.000)
Constant	-30.418	(15.189)*	-32.958	(14.541)**	-38.724	(14.649)**	-33.381	(14.698)**
N	324		324		324		324	
Overall R^2	.743		0.776		0.732		0.781	
AIC	-616		-592		-615		-591	
BIC	-574		-546		-574		-545	

***=1% significant, **=5% significant, *=10% significant

Table 6: Static Fixed Effects with GDP

	Model 5		Model 6		Model 7		Model 8	
ME	**Coefficient**	**Robust Std. Err.**	**Coefficient**	**Robust Std. Err.**	**Coefficient**	**Robust Std. Err.**	**Coefficient**	**Robust Std. Err.**
GDP	0.457	(0.441)	0.497	(0.443)	0.444	(0.444)	0.480	(0.445)
GE	0.343	(0.239)	0.378	(0.216)*	0.364	(0.237)	0.374	(0.215)*
Trade	-0.011	(0.202)	-0.063	(0.210)	0.012	(0.214)	-0.061	(0.213)
NATO	1.127	(0.635)*	1.224	(0.665)*	1.422	(0.640)	1.253	(0.670)*
PopDen	0.559	(0.581)	0.177	(0.673)	0.591	(0.611)	0.180	(0.678)
Dis	1.354	(0.234)***	1.467	(0.263)***	1.296	(0.248)***	1.451	(0.262)***
Has Base	0.276	(0.053)***	~		0.277	(0.054)***	~	
NATO Member	0.066	(0.047)	0.058	(0.050)	0.067	(0.049)	0.058	(0.051)
Iraq	0.099	(0.031)***	0.102	(0.030)***	0.094	(0.031)***	0.102	(0.030)***
US*	-0.498	(0.156)***	-0.501	(0.167)***	-0.514	(0.156)***	-0.490	(0.167)***
US milper BSR total	-0.096	(0.071)	~		~		~	
US base BSR total	0.048	(0.026)*	~		0.017	(0.030)	~	
US milper BSR country (linear)	~		0.000	(0.000)	~		-0.002	(0.002)
US base BSR country (linear)	~		-0.003	(0.005)	~		~	
BSR milper-base interact country	~		0.000	(0.000)	~		~	
US milper DMDC total	~		~		0.007	(0.021)	~	
US milper DMDC country (linear)	~		~		~		0.000	(0.000)
BSR-DMDC interact	~		~		~		0.000	(0.000)
Constant	-26.412	(14.770)*	-29.301	(14.297)*	-35.233	(14.272)**	-29.746	(14.497)*
N	324		324		324		324	
Overall R	0.747		0.792		0.747		0.799	
AIC	-619		-596		-617		-594	
BIC	-577		-550		-576		-549	

***=1% significant, **=5% significant, *=10% significant

Table 7: Countries with US bases, 2001-2012

Belgium	Germany
Greece	Italy
Luxembourg	Netherlands
Norway	Portugal
Spain	UK

Contrasting the results for US military personnel, the variables for US bases are more interesting. The number of US bases in a country seems to be unimportant while the regional total of US bases is significant in two of the specifications (Models 1 and 5) and has only a minor effect. However, the indicator variable 'Has Base' is highly significant and positive. It would seem that the number of bases is relatively inconsequential, only the presence of one is needed. A possible reason being that opening a new base or reactivating an old facility is a considerable investment of resources on the part of the US and not something done brashly. The opening and closing of US bases overseas also coincides with strategic shifts of the US. Thus if the US is opening bases in a region it could be a sign of increasing regional tension, provoking increased military expenditures. Additionally, having a US base in a state's territory may also provide an additional level of protection since rogue states may be hesitant to attack a European state if it risks evoking the ire of the US, which would likely act to protect its personnel, material, and strategic interests. The positive effect of having a US base could also be attributed to a kind of watchdog effect wherein the physical presence of the US implicitly cajoles the host state into spending more on its defense. However, examining the countries that have US bases in Table 7, none of them appear to be facing prominent security threats and with the exception of Greece, are all economically developed countries and could simply have more resources to spend on defense.

Distance has a positive effect on military expenditures, denoting that those further away

from Russia spend more on military expenditures. This result, as with the 'Has Base' variable, is likely due to the fact that many many former Soviet satellites are still attempting to catch up to their western colleagues in terms of economic development.

Note that the coefficient for GE is positive and strongly significant. Recall that GE represents the opportunity cost of military expenditures for a state, thus it should have an inverse relationship with military expenditures. There are two possible explanations for this counterintuitive result. One possibility is that governments are simply increasing both simultaneously, increasing budget deficits accordingly. During the period of analysis many countries in the sample accrued large sovereign debts, an issue many of which are still struggling with. The alternative is the possibility of estimation error. In either case the static FE model has fulfilled its purpose in providing the specification to be used in the dynamic model.

Dynamic Model

Since inclusion of a lagged dependent variable with fixed effects results in biased and inconsistent estimates (Nickell 1981), the use of dynamic panel methods is justified. Judson and Owen (1999) suggest that models matching the conditions of this dataset ($T \approx 10$, unbalanced), should employ estimation using the Arellano and Bond method (1991) to achieve consistent and efficient results. As with the static models, corrections for hetereoskedasticity were implemented using clustered robust standard errors.

Table 8 shows the results of Static Model 4 transformed into a dynamic model. Results from an Arrelano-Bond test in Table 8 show that inclusion of a one period lag of the depen-

Table 8: Initial Dynamic Model

ME	**Coefficient**	**Robust Std. Err.**
Lagged ME	0.434	(0.106)***
GR	0.391	(0.155)**
GE	0.279	(0.188)
Trade	-0.066	(0.0789)
NATO	0.788	(0.318)**
PopDen	0.450	(0.495)
Dis	0.203	(0.223)
NATO member	0.002	(0.027)
Iraq	0.089	(0.026)***
US	-0.400	(0.118)***
US base BSR country (linear)	0.000	(0.001)
US milper DMDC country (linear)	0.000	(0.000)
BSR-DMDC interact	0.000	(0.000)
Constant	-16.057	(9.050)*
N	297	
Arrellano-Bond Test		
	z	(P-value)
AR(1)	-3.115	(0.002)
AR(2)	-1.600	(0.110)

***=1% significant, **=5% significant,
*=10% significant

Table 9: Final Dynamic Model

ME	**Coefficient**	**Robust Std. Err.**
Lagged ME	0.510	(0.098)***
GR	0.435	(0.134)***
NATO	0.982	(0.328)***
PopDen	0.880	(0.371)**
Dis	0.087	(0.229)
Has base	0.153	(0.054)***
NATO member	-0.004	(0.026)
Iraq	0.072	(0.022)***
US	-0.359	(0.090)***
Constant	-21.042	(8.759)**
N	297	
Arellano-Bond Test		
	z	**P-value**
AR(1)	-3.322	0.001
AR(2)	-1.699	0.089

***=1% significant, **=5% significant

dent variable is appropriate and that the requirements of the Arellano and Bond dynamic panel estimation are met. The dynamic model uses the same basic specification as the previous static model but incorporates a one period lag of military expenditures, resulting in more coherent results. As in the static models, the variables for US military personnel (DMDC) and bases are insignificant. A Wald test of overall significance showed that these variables added nothing to the analysis, and were thus dropped leading to the results in Table 9. GE and GR were also highly correlated with one another, so GE was dropped along with $Trade$. Again, a Wald test confirmed that the analysis was better off without these variables. Due to its significance in the previous static models, the indicator variable for having a US base was reintroduced in the final model.

Results from AR(1) and AR(2) tests on Table 9 show that inclusion of a one period lag of the dependent variable is appropriate and that the requirements of the Arellano and Bond dynamic panel estimation are met. From Table 9, we observe that the coefficients for lagged

military expenditures, GR, total US military expenditures, NATO military expenditures, and the Iraq War indicator are all significant.

As before, we see that the military expenditures of the US and NATO are highly significant and have inverse effects from one another. The coefficient for total US military expenditures is -.359, indicating that US total military expenditures negatively affect European military expenditures. This means that on average among European states some degree of free-riding off the US is possibly taking place. Additionally since this was estimated using a double-log form, the -.359 represents an elasticity of substitution between US and European military expenditures. Thus a 10% increase in total US military expenditures would on average result in a 3.5% decrease in military expenditures in Europe, all else equal. Conversely, the coefficient for NATO is .982, implying a substantial level of co-movement with and within the alliance.

Given the insignificance of the variable for NATO membership, the spill-over effect of NATO military expenditures makes more sense. It is hard to imagine a scenario in which a European nation is attacked, even one outside of NATO, and it not provoking a collective response from the rest of the continent. US and European handling of the conflicts of the Balkans in the 1990s exemplifies this tacit cohesion. The significance of NATO military expenditures and insignificance of NATO membership is unsurprising given the substantial level of community development the European states have sought post WWII. Since nearly all European states face the same security threats and have entrenched defensive relationship, co-movement and strategic coordination is natural.

Whereas in the static model distance was significant, in the dynamic model it has dropped out. It seems that proximity to Russia does not matter to European states, though given

the events in Ukraine, which began in 2013, these results may change if the timeline is expanded. Combining the results for distance, US military personnel and bases, total US military expenditures, NATO military expenditures, and NATO membership; a potentially interesting story emerges.

Europeans do not seem to rely on the US for regional security, they either believe their defensive structures and organizations are sufficient for the task or US intervention is expected should the worst happen. However, at the international level the US's willingness to endure the costs of operating as a hegemon seems to be tolerated. Since the US and Europe share many of the same international norms, the US is less likely to be viewed as a threat. Also many European states have export based economies, and though trade proved insignificant in the model, the need to keep trade open may explain a greater concern for overall global stability rather than regional.

Conclusion

The dynamic panel analysis of this paper gives evidence that US military expenditures negatively affect European demand for military expenditures. However, a distinction is made between US total and regional military expenditures; with regional expenditures, as proxied by US troop and bases deployment, having no statistically significant impact on European states. This finding suggests that there is probably some degree of free-riding behavior among European states but only through US total military expenditures. Additionally, this paper has added to the defense economics literature on demand for military expenditures by showing that government revenue can be used to represent income empirically. While

historical data for government revenue may not be as prevalent as GDP information, for contemporary analysis it is better in that it is more representative of income constraints and mitigates endogeneity.

Based on these findings in terms of policy recommendations, a reexamination of US-European security arrangements may be in order. As the US deficit rises, crisis emerge elsewhere, the US's relatively high military expenditures may not be feasible indefinitely. As resources become stretched, the US may be less inclined to tolerate potential European free-riding. In a farewell speech concerning US-NATO relations, former US Secretary of Defense Robert Gates stated that "the blunt reality is that there will be dwindling appetite and patience in the U.S. Congress and in the American body politic writ large to expend increasingly precious funds on behalf of nations that are apparently unwilling to devote the necessary resources or make the necessary changes to be serious and capable partners in their own defense." (Schultz 2011). However, to fault European states for free-riding is an over simplification.

It appears that European states are merely capitalizing on what they perceive as a security surplus provided by the US. No one has forced the US to expend so many resources, it has done so under its own volition. With this in mind, The question to ask then is not why do European states free-ride, but instead why does the US spend so much more on security that other states are able to free-ride. The current status quo is infeasible in the long run: it strains relations between longtime allies and leaves Europe ill prepared for sudden crisis. However, there is too much that binds the US and Europe together for that alliance to be dismissed entirely. A better course of action is for both parties to reevaluate their respective security policies and find a more optimal arrangement for all.

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