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

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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 spillin effects of US military expenditures on European demand for military expenditures during the early 21st Century. The goal is to test whether or not European states view US expenditures as a complement or as a substitute to their own military expenditures. Past work in this area has found mixed results concerning the effect of US military expenditures, but focus strictly on the spillins within a formal alliance, specifically NATO, and use a time series dominated by Cold War dynamics. This study differentiates itself by accounting for both US total military expenditures and its regional expenditures through incorporation of US military base and personnel deployments across Europe. Additionally, this paper uses government revenue in its estimation to mitigate potential endogeneity. Findings using Arellano-Bond dynamic panel analysis suggest that there is a strong probability of substitution among European states.

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

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Introduction

The US-European relations have been an international security staple since the establishment of the North Atlantic Treaty Organization (NATO) in 1949. NATO's first Secretary General,

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Lord Ismay, stated that a primary goal of the organization was to "keep the Americans in, the Russians out" (Reynolds 1994, 13). For over 40 years, that is exactly what NATO did, protecting Europe from Soviet aggression and reinforcing cross Atlantic relations. However, after several decades of cooperation, US-European relations may be facing new challenges.

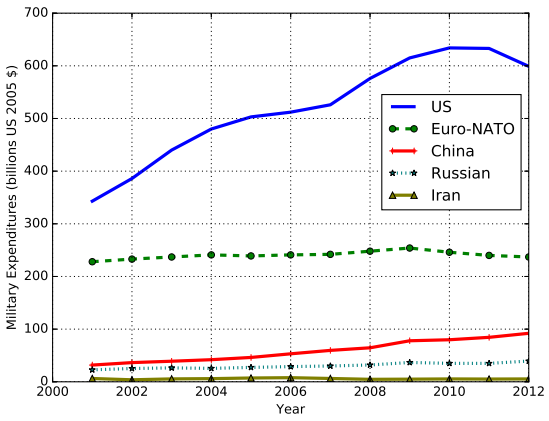
Over the course of the 21st Century US interests and attention have been drawn elsewhere. The Middle East, Central Asia, and South-East Asia have all become an increasing concern of US foreign policy. Furthermore, many within the US feel that European states have become too reliant upon the US for their security. As stated by former US Secretary of Defense Robert Gates "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).

To understand what consequences this shift in attention may have or the implications of security dependency for US-European relations, it is first important to establish what kind of security relationship the US and the European community have. Do European states see US military expenditures as a complement to their own efforts or as a substitute, or neither? While intentions are beyond this study, empirical analysis can provide some insight. The primary goal of this paper is to estimate the potential effect US military expenditures may have on European demand for military expenditures.

Compounding the analysis is the complexity and scale of the US military. 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 US hegemony. 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 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 1: Comparative Military Expenditures 2001-2012



During this period of increasing US total military expenditures, the US's physical presence in Europe decreased. Figure 2 shows the number of active US bases and military personnel deployed in Europe, based on data obtained from 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 thereafter. So there are potentially two contrary forces potentially influencing European military spending with respect

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

to the US: global military expenditures and regional military expenditures.

Figure 2: US Military Presence in Europe 2001-2012

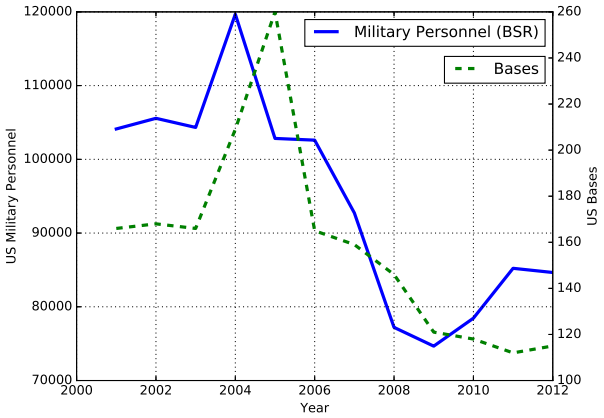
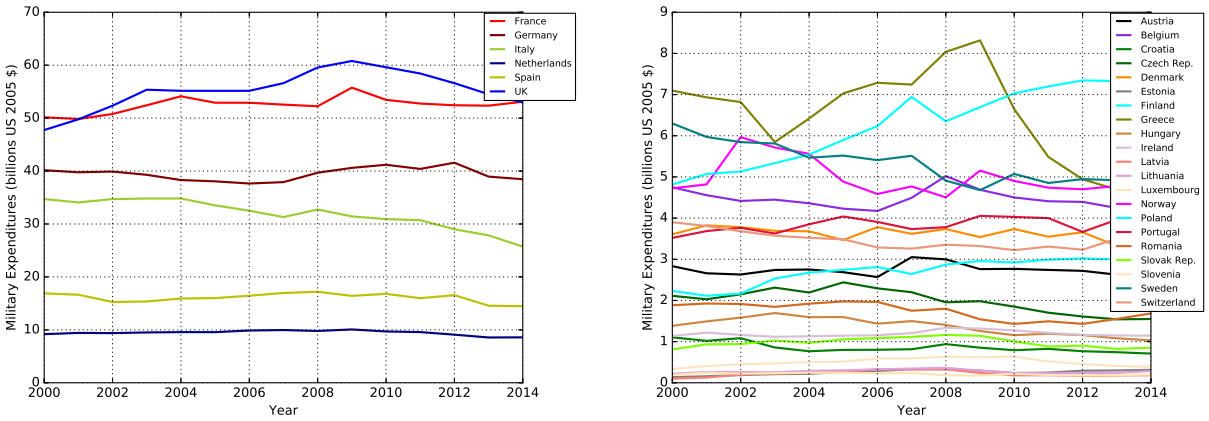


Figure 3: European Military Expenditures 2000-2014



A secondary goal of this paper is to examine whether European states respond to the US global military expenditures, US regional expenditures, both, or neither; and if European states respond differently to US global and regional military expenditures. While aggregate European military expenditures display very little variation, there is individual fluctuation as shown in Figure 3, adding validity to this analysis. This study's findings suggest that US regional factors show minimal importance while US global military expenditures have a

statistically significant and negative effect on European military expenditures. 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.

Understanding the causes and effects of military expenditures is important because military expenditures can have a negative impact on economic growth. A survey by Dunne and Tian (2013) finds that, in most cases, increases in military expenditures do not induce economic growth; Dunne and Nikolaidou (2011) find this to be the case amoung 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 other 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 opportunity costs of military expenditures are a potential reason why many empirical studies suggest that when state have reliable allies, security free-riding is more likely (Gonzales and Montolio 2001; Nikolaidou 2008; Ringsmose 2010; Beeres et al. 2012). Conversely, other studies give evidence 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 element 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, a distinction is made between the US's global 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) find that the strategic environment a state faces significantly impact its demand for military expenditures. By making the distinction between global and regional security, a more nuanced analysis can be done regarding the factors influencing European military expenditures.

Second, I test pan-European security relations outside a formal alliance structure through the inclusion of non-NATO European states in the analysis. This is important because the high degree of European integration, especially in regards to security arrangements, means

[2]Nikolaidou (2008) is cited on contrary points because they do individual time series analyses for various European countries. In some cases Nikolaidou found cooperation and in other cases substitution.

that focusing on members of a single alliance is inappropriate and it is better to look at Europe as a whole. Third, this paper uses government revenue, opposed to GDP, as a better empirical representation of European income constraints and as well as counters endogeneity.

Finally, I use a more recent post-Cold War data set. The separation of Cold War and post-Cold War periods is important because parameter relationships have likely changed between the two periods (Dunne and Perlo-Freeman 2003). The time period of interest here also 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 warrants independent analysis in order to make more effective policy recommendations.

Theory

While the emphasis of this paper is empirical analysis, it is important to contextualize results within a coherent theoretical framework. Olson and Zeckhauser's (1966) seminal work establishes the pure public goods model of military expenditures which is used for studies of burden-sharing within formal alliances. Murdoch and Sandler (1984) expand upon Olson and Zeckhauser's work and employ the joint product model wherein allied military expenditures produce a collective level of deterrence. Sandler and Hartley (2007) provide a comprehensive survey of the economic research and models concerning security and military expenditures. However, because the interest of this paper concerns the security choices of a state with respect to allied 'spillins'[3] and includes states outside a formal alliance, Smith's

[3]The positive security externality provided by allied military expenditures.

(1989) demand model is the most appropriate. The demand model allows for explanation of the optimal amount of military expenditures based on a state's internal factors, potential threats, and possible security spillins from allies. An additional benefit of the demand approach is relatively easy empirical translation.

The theoretical model of this paper is based on Smith's (1989) neoclassical approach to deriving a state's demand for military expenditures. In Smith's approach state i functions as a rational actor seeking to maximize its welfare function, W, which is a function of security, S, consumption, C, and a vector of parameterizing internal domestic variables, Z:

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

Maximization of state i's welfare function is subject to a budget constraint:

$$Y = ME + CE \tag{2}$$

Where ME is military expenditures, CE is non-military consumption expenditures, and Y is total state income. $ME = P_M M$ and $CE = P_C C$, M and C being military and consumption goods with P_M and P_C their respective prices. P_C is normalized, leaving the ratio, P_M/P_C. Usually it is assumed that military and civilian prices behave the same, dropping from analysis. Solomon (2005) notes that military prices can move separately from civilian prices. Unfortunately, few countries separately track their military price deflator so this data cannot be included in the estimation.

Security is a function of a state i's own military expenditures, ME, the aggregate spillin of allied military expenditures, Q, potential threats, Th, and other security factors, X:

$$S = f(ME, Q, Th, X) \tag{3}$$

Regarding Q, assuming a Nash-Cournot specification wherein all n countries in the system have made their best-response equilibrium choices, state i takes a function of the military expenditures of all others as given:

$$Q = f\left(\sum_{j=1}^{n} ME_j\right) \tag{4}$$

where $j \neq i$. The exact nature of the function is dictated by the specifics of the spillin. Collective defense organizations such as NATO are predicated upon Q being essentially a linear combination, whereas other alliance structures may only see a portion of allied spillin.

The Nash-Cournot specification is appropriate since this study includes states outside a formal alliance structure, but there is still some degree of expected security cooperation. The military expenditures of other states induce a different response from state i depending on if one is an ally or rival. Allied expenditures, Q, could be viewed as either complements, substitutes, or neither. The military expenditures of rivals, Th, usually has a positive effect on state i's military expenditures. An empirical implication of the Nash-Cournot specification is using lags of the Q and Th variables during estimation.

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

$$ME = f(Y, P_M/P_C, Q, Th, Z, X) \tag{5}$$

The above is the standard general form of state i's demand for military expenditures. For the purposes of this study the general form expands to the specific setting, leading to the following:

$$ME = f(ME_{t-1}, Y, GE, Trade, PopDen, NATO_{-i}, US^G, US^R, Russia, Iraq) \quad (6)$$

Thus European demand for military expenditures becomes a function of demand for other government expenditures, national income, US global and regional military expenditures, neighboring NATO expenditures, Russian military expenditures, and participation in the Iraq War:

- ME_{t-1} is a 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. Military expenditures are assumed to be a normal good and therefore should have a positive relationship with respect to government income.

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

- $Trade$ 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 land-

mass. A large sparsely populated country is harder to defend than one that is highly concentrated.

- $NATO_{-i}$ is the aggregated military expenditures of all European NATO members excluding the military expenditures of country i if they are a member.
- US^G and US^R are US military expenditures at the global and regional levels.
- $Russia$ is Russian military expenditures, the threat variable.
- $Iraq$ is an indicator variable for participation in the Iraq War. If a state participated in the conflict one would expect their military expenditures to increase as a result.

The $NATO$, US^G and US^R are used to assess the individual spillins that might be affecting European demand for military expenditures. $NATO$, US^G and US^R could each have a different effect on European demand for military expenditures: either complementary, substitutive, or neither. Empirical analysis should give evidence as to what the potential relationship is. If the coefficient for either is negative and significant, it would indicate that US and NATO military expenditures are seen as substitutes for a state's own military expenditures (free-riding). If the coefficients are positive and significant, that would indicate that US and NATO military expenditures are seen as complementary (following). 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.

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

and active of the international defense organizations in Europe. Any large scale security crisis affecting Europe would likely involve NATO. So how European states response to the aggregated military expenditures of the European members of NATO allows one to assess the degree of security coordination across the continent.

As stated earlier, a secondary goal of this paper is to distinguish the effects of US global and regional military expenditures. The separation of the two is important because countries face different issues at the regional and global levels. At the regional level a country is more aware of the issues, risks, and actors at play; known unknowns. However, at the global level, issues become more complicated and harder to identify; unknown unknowns. Additionally, the difficulties of security increase dramatically the further a country tries to project itself beyond its borders. US actions outside of Europe; nation building, combating terrorism, anti-piracy, are 'out-of-area' spilling (Sandler and Shimizu 2014). Thus, at the regional level the presence of a powerful outside allied actor may be viewed as beneficial but not critical. However, at the global level, a powerful interest-aligned ally could be viewed as more valuable to smaller states.

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. Additionally, a small country that is 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.

Russian is used as the threat variable because Russia still represents the most pressing existential security concern to European states, and as such should have a positive effect on European demand for military expenditures. Although there has been 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.

Data

To assess the potential effects of US military expenditures on European demand for military expenditures, this study uses a panel series of 28 countries for years 2000 to 2014. 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.

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. Some European states were excluded from the analysis due to practical and theoretical reasons. The various European microstates were excluded as they

Table 1: Sample Countries, 2000-2014

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

*=Non-NATO

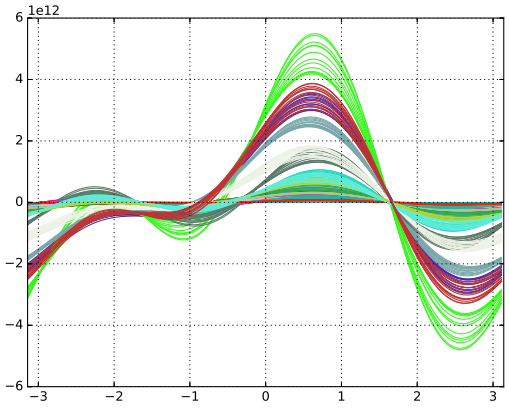
are inconsequential to the analysis and their security is guaranteed by other states in the sample. Many of the Balkan states and Turkey were excluded due to data availability issues. Moreover, it is felt that the idiosyncratic properties of these states are likely to make them outliers, distorting results.

Previous research into the factors influencing military expenditures generally used multiple time series case studies (Nikolaidou 2008; Douch and Solomon 2012). Using multiple time series 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[4] in 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.

Country level data were obtained through Stockholm International Peace Research Institute (SIPRI), the World Bank, and Eurostat. Governmental financial figures were converted

[4]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)

Figure 4: Andrews Plot of Sample Countries



from percent GDP to level and normalized to US$ 2005 figures. 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. Sandler (1993) proposes using government revenue as the income variable, but few empirical papers follow this suggestion probably due to data availability. The issue of data availability persists somewhat and unbalances the panel slightly in this study. 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). As a robustness check, alternative specifications were run using GDP in place of government revenue.

In translating the theoretical variables for US global and regional military expenditures, US global military expenditures are easily obtained and empirically represented through US total military expenditures. However, 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 proxies for US regional military expenditures. Recall from Figure 2 that US active bases and military personnel in Europe roughly follow one another, so it is reasonable to believe that they can be used as proxies for US regional military expenditures. For the purposes of this paper, an active base is any US installation that has military personnel. Civilian or deactivated facilities are not included in the analysis. As with US total military expenditures, the interpretation of the coefficients is the same. In the empirical analysis the US regional expenditures are analyzed using the proxies in multiple ways: the regional total, country specific, and interaction terms between US military personnel and bases at both the regional and country levels.

Information for US military personnel and bases in Europe was 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 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. Including the BSR and DMDC data enables testing of the importance of global vs. regional US military expenditures to the European community. A short coming of the BSR is that reports only goes back to 2001 and stops including military personnel at bases in 2012, thus limiting the time span this data can be used. 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 but in the regional sphere, such as the Balkans and Turkey, were included. Country invariant variables are denoted in Table 4.

It should be noted that data for US total military expenditures includes those incurred for the Iraq War. There are several reasons why the costs of the Iraq War were not removed from the analysis. First, many European countries participated in the conflict, most notably the UK, so US spending in Iraq would be strategically relevant to them. Second, while many countries sampled did not participate in the conflict or voiced opposition to the conflict, it could be argued that after the initial invasion it was within the strategic interests of European states that the US remain in Iraq to maintain stability. Had the US pulled out prematurely, it likely would have further destabilized the region and resulted in a massive diaspora from Iraq, similar to the current refugee crisis emanating from Syria. Third, there is no good way to disentangle the costs of the Operation Iraqi Freedom from US total military expenditures. There are some estimates available, but these generally only include the costs that explicitly took place within the conflict; they do not include the extended support, training, and logistical costs that were also involved in the conflict. Finally, previous literature that analyzed potential spillin of US military expenditures did not control for other US excursions, such as the Vietnam War (Smith 1989; Solomon 2005; Nikolaidou 2008; Douch and Solomon 2012).

The NATO figure is the aggregation of all the military expenditures of European NATO members excluding Iceland[5]. Over the period of analysis NATO expanded its membership

[5]Iceland was excluded due to data availability issues. However, Icelands military expenditures are tiny

Table 2: Data Description, European Variables

Label	**Variable**	**Source**	**Period**	**Interval**	**Units**
ME	Military Expenditures	SIPRI	2000-2014	Annual	2005 US$ (Millions)
GR	Government Revenue	Eurostat	2000-2014	Annual	2005 US$ (Millions)
GDP	Gross Domestic Product	World Bank	2000-2014	Annual	2005 US$ (Millions)
GE	Government Expenditures	World Bank	2000-2014	Annual	2005 US$ (Millions)
Trade	Summed Exports and Imports	World Bank	2000-2014	Annual	2005 US$ (Millions)
Popden	Population Density	World Bank	2000-2014	Annual	Popluation per km^2
Iraq	Involved in the Iraq War	SIPRI	2000-2014	Annual	Indicator
ΔRussia	% Change in Russian Military Expenditures	SIPRI	2000-2014	Annual	Percentage
NATO	Aggregate NATO Military Expenditures	SIPRI	2000-2014	Annual	2005 US$ (Millions)

(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 Rosh (1988) and Dunne and Perlo-Freeman (2003) employ but instead of a measure of potential enemies, it 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.

Instead of using the level of Russian military expenditures, yearly percentage change in Russian military expenditures is used. While Russia does remain a threat to Europe, reliable data for military expenditures remains difficult to acquire. For much for the time period of interest, only estimated values are available. Additionally, it is believed that Russian military expenditures are highly correlated with the US's (Solomon 2005). Using the percent change smooths out the noise of using the estimated data as well as the issue of correlation with the US.

relative to the rest of NATO, averaging only $21 million over the years available, so there should be no loss in statistical validity

Table 3: Data Description, US Military Variables

Label	Variable	Source	Period	Interval	Units
US	US total military expenditures	SIPRI	2000-2014	Annual	2005 US$ (Millions)
US milper BSR total	US military personnel, regional total	BSR	2001-2012	Annual	Individual
US bases 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 bases BSR country	US military bases, country specific	BSR	2001-2012	Annual	Individual
US milper DMDC total	US military personnel, country specific	DMDC	2000-2013	Annual	Individual
US miulper DMDC country	US military personnel, regional total	DMDC	2000-2013	Annual	Individual

Table 4: Summary Statistics

	Mean	Std. Dev.	Min	Max	T	n	N
ME	12,224.83	20,693.73	101	103,232	15	28	420
GE	126,424.05	186,439.43	1,764	828,867	15	28	420
GR	504,756.76	513,500.47	139,556	1,569,831	14.89	28	417
GDP	545,215.18	797,645.58	9,944	3,226,807	15	28	420
Trade	561,935.36	929,505.33	9,322.80	6,185,422.0	15	28	420
Popden	128.52	103.26	12.30	500.89	15	28	420
Iraq	0.15	0.35	0	1	15	28	420
NATO*	232,533.93	17,256.55	176,069	255,935	15	28	420
ΔRussia*	0.10	0.08	0.02	0.35	15	28	420
US*	510,456.52	97,920.73	338,909	634,489	15	28	420
US milper BSR total*	94,338.17	14,196.70	74,663	119,687	12	28	336
US bases BSR total	158.75	43.02	112	260	12	28	336
US milper BSR country	3,332.69	12,641.52	0	86,060	12	28	336
US bases BSR country	5.56	21.83	0	209	12	28	336
US milper DMDC total*	107,627.00	57,128.06	67,255	296,834	14	28	392
US milper DMDC country	3,566.26	14,975.28	0	199,950	14	28	392

*=Country invariant

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 fulfill the stated goals. Initial specification testing is done using a static fixed effects (FE) model while final analysis is done using the Arellano-Bond dynamic panel estimator.

Results from a Box-Cox specification test suggest the use of the double-log form.[6] However, because some countries do not have either a US base or military personnel, in models using country specific US military base and personnel deployments these variables remain in their original linear form. Additionally, Russian military expenditures have already been transformed into yearly percentage change so there is no need to log. An added benefit of using the double-log specification is that coefficients are now elasticities.

A fixed effects model is employed because it helps account for the unique properties of each state in the sample that might affect their security choices but are not explicitly accounted for by the other variables, such geography and other time invariant characteristics. Results from a Hausman test support the use of of country specific fixed effects. Corrections for heteroskedasticity were implemented using clustered robust standard errors. Interaction terms for US military personnel and bases at the regional level and for trade and US total military expenditures were initially included but dropped due to collinearity. As per the Nash-Cournot specification external spillin security variables, US variables and NATO, have been lagged 1 period. ΔRussia is not lagged because as a percentage change, the time dimension is already accounted for. Lagging these variables also helps mitigate potential

[6]The Box-Cox test suggested a transformation of .047 and .136 on the dependent and independent variables respectively. Since a transformation with these values would lack clear interpretability, the double-log is applied.

issues of simultaneity.

Static Fixed Effects Model

The static FE model was used for specification testing across the eight models because there are more tools available to test the strength of fit. The primary objective of the static model is to ascertain what empirical form of US regional variables affects European military expenditures: regional totals, country specific, and BSR vs. DMDC. The secondary objective is to test if government revenue or GDP is a better empirical representation of state income.

Tables 5 and 6 contain the results from eight specifications of the static FE models tested, each column representing a different econometric model. Table 5 contains models using government revenue, GR, while Table 6 uses GDP. Findings suggest that model 4, judged by the overall R^2, variable significance, and the AIC and BIC values; seem to be the most robust. The benefits of using GR seem to more than make up for unbalancing the panel. While model 4 seems to be the best model, model 3 presents interesting properties with only being slightly inferior to model 4. Thus, the variables used in models 3 and 4 will each be evaluated in a dynamic model in the next section.

Across models it is quite clear that US military expenditures are important to European policymakers, but it is US total military expenditures that matters most. At no point across specifications does the number of US military personnel seem to 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.

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

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. 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 could also coincide 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 throughout the area.

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	0.107	(0.250)	0.185	(0.249)	0.118	(0.249)	0.180	(0.250)
GE	0.721	(0.243)***	0.707	(0.236)***	0.735	(0.239)***	0.697	(0.234)***
Trade	0.014	(0.123)	0.016	(0.123)	0.015	(0.122)	0.015	(0.123)
PopDen	0.161	(0.586)	0.169	(0.599)	0.18	(0.586)	0.175	(0.606)
ΔRussia	0.152	(0.123)	0.318	(0.095)***	0.18	(0.094)*	0.303	(0.093)***
Iraq	0.082	(0.032)**	0.093	(0.032)**	0.077	(0.032)**	0.094	(0.032)***
Constant	-14.064	(11.490)	-25.580	(13.494)*	-17.011	(13.086)	-25.998	(13.737)*
Lagged Variables								
NATO	1.035	(0.417)**	1.554	(0.505)***	1.096	(0.451)**	1.573	(0.514)***
US*	-0.469	(0.158)***	-0.608	(0.156)***	-0.467	(0.153)***	-0.598	(0.154)***
US milper BSR total	-0.011	(0.088)						
US base BSR total	0.082	(0.030)**			0.074	(0.030)*		
US milper BSR country (linear)			0.000	(0.000)				
US base BSR country (linear)			0.000	(0.005)			-0.001	(0.002)
BSR milper-base interact country			0.000	(0.000)				
US milper DMDC total					0.019	(0.013)		
US milper DMDC country (linear)							0.000	(0.000)
BSR-DMDC interact country							0.000	(0.000)
N	335		335		335		335	
Overall R^2	0.919		0.911		0.917		0.913	
AIC	-661		-656		-662		-655	
BIC	-623		-614		-624		-613	

***=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	0.438	(0.345)	0.554	(0.343)	0.428	(0.342)	0.542	(0.346)
GE	0.551	(0.231)**	0.517	(0.227)**	0.573	(0.229)**	0.509	(0.226)**
Trade	-0.106	(0.172)	-0.125	(0.173)	-0.101	(0.173)	-0.125	(0.175)
PopDen	0.242	(0.596)	0.250	(0.606)	0.251	(0.594)	0.256	(0.611)
ΔRussia	0.175	(0.122)	0.310	(0.087)***	0.186	(0.089)**	0.288	(0.084)***
Iraq	0.082	(0.031)**	0.090	(0.029)***	0.077	(0.077)**	0.091	(0.029)***
Constant	-13.312	(10.541)	-22.726	(11.809)*	-16.101	(11.787)	-23.042	(12.074)*
Lagged Variables								
NATO	0.881	(0.435)*	1.286	(0.496)**	0.951	(0.462)**	1.304	(0.507)**
US*	-0.418	(0.161)**	-0.522	(0.160)***	-0.414	(0.158)**	-0.511	(0.160)***
US milper BSR total	-0.022	(0.089)						
US base BSR total	0.072	(0.028)**			0.063	(0.063)**		
US milper BSR country (linear)			0.000	(0.000)				
US base BSR country (linear)			-0.002	(0.005)			-0.002	(0.002)
BSR milper-base interact country			0.000	(0.000)				
US milper DMDC total					0.016	(0.014)		
US milper DMDC country (linear)							0.000	(0.000)
BSR-DMDC interact country							0.000	(0.000)
N	336		336		336		336	
Overall R^2	0.927		0.922		0.925		0.924	
AIC	-671		-669		-671		-669	
BIC	-632		-627		-633		-630	

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

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 heteroskedasticity were implemented using clustered robust standard errors.

Table 7 shows the results of static models 3 and 4 transformed into a dynamic models A and B respectively. Results from an Arellano-Bond test in Table 7 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. The dynamic model uses the same basic specification as the previous static model but incorporates a one period lag of a state's own military expenditures, resulting in more coherent results. Prior to the dynamic transition, GE and $Trade$ were each found to be highly correlated[8] with GR, making it impossible to separate their individual effects, so GE and $Trade$ were removed from analysis. A Wald test of overall significance suggested that these variables did not contribute to the analysis, and leading to the results in Table 7.

As with the static models, US regional variables again show no statistical significance. It appears that no feasible combination of the data available representing US regional military expenditures has a statistically measurable impact on European states. Either these are not the regional US variables European states respond to or European states do not factor in US regional variables into their security choices. Again, a Wald test on both models confirmed

[8]Correlation coefficients of .995 and .957 respectively

Table 7: Initial Dynamic Models

	Model A		Model B	
ME	**Coefficient**	**Robust Std. Err.**	**Coefficient**	**Robust Std. Err.**
GR	0.418	(0.155)***	0.421	(0.148)***
PopDen	0.971	(0.445)**	0.947	(0.448)**
ΔRussia	0.176	(0.071)**	0.198	(0.070)***
Iraq	0.063	(0.023)***	0.070	(0.023)***
Constant	-25.571	(8.381)***	-26.799	(8.600)***
{{Lagged Variables}				
$\underline{\text{ME}}_{\{t-1\}}$	0.458	(0.075)***	0.459	(0.076)***
NATO	1.238	(0.249)***	1.321	(1.321)***
US	-0.378	(0.083)***	-0.406	(0.089)***
US base BSR total	0.013	(0.018)		
US milper DMDC total	0.010	(0.011)		
US base BSR country (linear)			0.000	(0.001)
US milper DMDC country (linear)			0.000	(0.000)
BSR-DMDC interact country			0.000	(0.000)
N	307		307	
Arellano-Bond Test	z	(P-value)	z	(P-value)
AR(1)	-3.646	(0.000)	-3.639	(0.000)
AR(2)	-0.974	(0.327)	-0.929	(0.349)

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

Table 8: Final Dynamic Model

ME	**Coefficient**	**Robust Std. Err.**
GR	0.390	(0.145)***
PopDen	0.645	(0.360)*
ΔRussia	0.175	(0.07)**
Iraq	0.070	(0.024)***
Constant	-20.830	(8.039)***
Lagged Variables		
ME_{t-1}	0.486	(0.079)***
NATO	1.106	(0.257)***
US	-0.361	(0.085)***
N	362	
Arellano-Bond Test	z	(P-value)
AR(1)	-3.490	(0.001)
AR(2)	-0.913	(0.355)

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

that the analysis was likely better off without these US regional variables, leading to the final dynamic model.

From Table 8, we observe that the coefficients for own lagged military expenditures, GR, Population density, change in Russian military expenditures, US total 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 US total military expenditures is -.361, indicating that US total military expenditures likely negatively affect European military expenditures. This means that on average among European states some degree of strategic substitution off the US is possibly taking place. Additionally since this was estimated using a double-log form, the -.361 represents an elasticity of substitution between US and European military expenditures. Thus a 10% increase in total US military expenditures would on average likely result in a 3.6% decrease in military expenditures in

Europe, all else equal. Conversely, the coefficient for NATO is 1.106, implying a substantial level of co-movement with and within the alliance.

The near unit elasticity with NATO military expenditures denotes a high degree of security coordination across the continent. It is hard to imagine a scenario in which a European state is attacked, even one outside of NATO, and it not provoking a collective response from the rest of the continent. European handling of the conflicts of the Balkans in the 1990s exemplifies this tacit cohesion. The significance and positive effect of collective NATO military expenditures is unsurprising given the substantial level of community development 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.

European states also appear to be acutely aware of their regional security concerns, specifically the threat Russia poses. While there is still a substantial gap in military expenditures between the two parties as shown in Figure 1, it appears that European states respond positively to increases in Russian military expenditures. Given the events in Ukraine, which began in 2013, this effect may be even stronger in the future.

Combining the results for US regional variables, US total military expenditures, NATO military expenditures, and the change in Russian military expenditures; a potentially interesting story emerges. European states 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 global 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 was insignificant in the analysis, 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 military personnel and base deployments across Europe, 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 demonstrating that government revenue can be used to represent government 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 government income constraints and mitigates endogeneity.

Going back to the statements by Gates at the beginning of this paper, it would appear that Gates was correct in his assertion that European states see US military expenditures as a substitute for their own, but it is at the global rather than at the regional level. However, to claim that Europe is free-riding off the US, would be an oversimplification.

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

on security, 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?" What is clear is that the current status quo is infeasible in the long run: it is economically infeasible for the US, 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 the relations developed over last half century 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.

A possible solution is the institution of a payment structure similar to the one employed during the Gulf War; wherein the US military engaged Iraqi forces but the operation was partially financed by European states. This solution builds off the potential returns to scale in security provided by a global hegemon, but is more economically sustainable. A quasi-protectorate system may seem incompatible with the notion of sovereignty, but so long as interests are aligned there could very well be efficiency gains from a single hegemon, one subsidized by allies, pursuing global stability.

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