Alliance Participation and Military Spending

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January 7, 2019

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Abstract

1 Introduction

How does alliance participation affect military spending? Previous scholarship on this issue is divided between two competing camps. One group expects alliance participation to reduce military spending. The other expects alliance members will spend more on defense.

In this paper, I address the division between these two perspectives on alliance participation and military expenditures. In doing so, I make theoretical and empirical contributions. In my argument, I show when alliance participation increases and decreases military spending. Major and non-major power states use alliances for different purposes, so they respond differently to changes in treaty strength.

Major powers use strong treaty commitments to increase their influence. Strong treaties replace military spending as a source of influence, allowing large states to reduce spending. Non-major powers emphasize security from alliances, but also have high opportunity costs of military spending. Given a strong treaty commitment, these small states cannot reduce military spending without damaging the treaty. Weaker treaties still provide some security without tying military support to other costly commitments, allowing non-major powers to reduce military spending.

I test these predictions with a novel research design. First, I develop a latent measure of alliance treaty strength. Then, I employ that measure in a multilevel model which directly compares alliance treaties, and estimates the impact of each treaty on members' military spending.

Unifying scholarship on alliance participation and military spending has academic and practical value. Scholarship on this issue has paid little attention to differences between alliances.[1] As a result, we are left with competing assertions about the characteristics of alliances.

[1] See DiGiuseppe and Poast (2016) for an important exception.

These arguments are a poor guide for policy discussions. Policy debates emphasize reduced spending by alliance members- especially US allies. But these debates fail to understand that reduced defense spending by US allies is the result of different incentives for large and small states. Maintaining US influence requires additional military spending, and reflect the proclivity of the US (and other democracies) to form weaker alliance treaty commitments. Weak alliance commitments increase the need for costly reassurance, which in turn encourages reduced defense spending. Policy discussions emphasize reduced spending by US allies.

This argument and the evidence I present in this paper has several important implications. First, it shows the distributional consequences of alliance treaty design. The strength of a commitment shapes how larger and smaller alliance members allocate resources to the military.

I also show evidence of substitution between sunk costs and hands-tying signals in international politics. Usually these two actions are considered separately (Fearon, 1997; Fuhrmann and Sechser, 2014), but alliance politics mix the two. Major and non-major powers employ sunk costs and hands-tying in different ways because they have distinct goals and constraints.

Last, my argument accentuates tradeoffs in alliance politics. While strong commitments may lead junior partners to increase spending, these commitments also come with a risk of entrapment (Benson, 2012). Weak commitments reduce the risk of entrapment, but require additional spending to maintain influence.

The paper proceeds as follows. First, I briefly summarize competing arguments and mixed empirical evidence about alliance participation and military spending. Then I describe my argument of treaty strength and member size in more detail. The third and fourth sections describe the research design and results. The final section concludes with a discussion of the implications for scholarship and policy.

2 Force Multiplier vs Foreign Entanglement

I divide prior scholarship on alliance participation and military spending into two broad perspectives. The foreign entanglement view is that alliance participation will increase military expenditures. The force multiplier school expects alliance participation to reduce military spending.

2.1 Force Multiplier

Force multiplier arguments start with the premise that alliances and military spending both provide security. States substitute between these two foreign policy instruments (Most and Starr, 1989). Alliances provide security that states could not achieve without additional military spending (Morrow, 1993; Conybeare, 1994). Because military spending has opportunity costs, states will rely on their allies for security and and reallocate military spending to other desired goods.

Allied military capability replaces defense expenditures of member states. DiGiuseppe and Poast (2016) refine this logic by arguing that states will only reduce spending if their alliance is credible. Unreliable alliance capability cannot replace reliable domestic military spending.

Another argument in the force multiplier perspective links reduced military spending to a collective action problem. Olson and Zeckhauser (1966) argue that security from an alliance is a public good, so treaty members provide suboptimal contributions of military spending. Each member free-rides on other states, and smaller members exploit the larger. Spending less allows alliance members to consume more non-defense goods, but the alliance provides less security.

Both the substitution and public goods models expect alliance participation will reduce spending. These arguments are rooted in the opportunity costs of military spending. But the foreign entanglement group argues that alliances provide more than security.

2.2 Foreign Entanglement

The foreign entanglement perspective is less cohesive. These arguments share a common focus on multiple potential benefits of alliance participation, however. Military spending reinforces the benefits of alliance participation.

Diehl (1994) argues that alliances increase a states foreign policy responsibilities, necessitating extra military spending. By expanding what a state can achieve in international relations, states will increase military spending to pursue other foreign policy goals (Morgan and Palmer, 2006). Horowitz, Poast and Stam (2017) show that some states increase defense effort to make themselves a more attractive alliance partner. Others assert that alliances generate cooperation, leading to higher defense spending (Palmer, 1990; Quiroz Flores, 2011) Last, Senese and Vasquez (2008) argue that military spending and alliances are part of a spiral towards conflict that leads to simultaneous increases in spending and alliance participation.

The foreign entanglement perspective contains a crucial insight. Military spending can complement or facilitate alliance participation. However, this perspective does not consider the opportunity costs of military spending. Likewise, the force multiplier perspective does not acknowledge synergies between military spending and alliances.

2.3 Mixed Evidence

Arguments about characteristics of arms and alliances could be settled by a preponderance of empirical evidence. Unfortunately, the divided state of theory is reinforced by mixed empirical results.[2] Some studies find a positive association between alliance participation and military spending. Others find a negative relationship.

The wide range of methodologies and samples in previous studies can be divided into into

[2]Because tests of the public goods model regress military spending as a share of GDP on GDP, I ignore most tests of the public goods theory of alliances in summarizing prior results. These studies are subject to an identification problem.

specific and general research designs. Specific studies examine the impact of a few alliances, usually by tracking how a state responds to the military spending of a key ally. General studies compare many states using dummy indicators of alliance participation. Each design has different virtues and shortcomings.

A specific study examines a few alliances in great detail, but lacks generalizability. Most support for the substitution of arms and alliances comes from specific designs (Barnett and Levy, 1991; Morrow, 1993; Sorokin, 1994; Plümper and Neumayer, 2015). But other specific studies find increased spending by alliance members (Conybeare and Sandler, 1990; Chen, Feng and Masroori, 1996).

General models capture a wide range of state-year observations at the cost of inferences about particular alliances. Dummy indicators of alliance participation lump diverse alliances together in a state-level measure. Table 1 summarizes previous results from general models of alliance participation and military spending. Like specific studies, general studies produce mixed results. Work by DiGiuseppe and Poast (2016) and Horowitz, Poast and Stam (2017) provides the most reliable estimates.

	Decrease	Increase	Null
Most and Siverson (1987)			X
Conybeare (1994)	X		
Diehl (1994)		X	
Goldsmith (2003)			X
Morgan and Palmer (2006)		X	
Quiroz Flores (2011)		X	
DiGiuseppe and Poast (2016)	X		
Horowitz, Poast and Stam (2017)		X	

Table 1: General Findings of Association Between Alliance Participation and Military Spending

Two theoretical and empirical issues explain prior mixed results. First, there is substantial heterogeneity among alliances. Treaties vary in their obligations, membership, and capability. Alliance heterogeneity makes it difficult to infer general relationships from specific studies, and

undermines binary measures of alliance participation in general studies.

Second, depending on their size, alliance members have different goals. The public goods theory of alliances suggests that differences in alliance member size matter (Olson and Zeckhauser, 1966; Dudley and Montmarquette, 1981; Garfinkel, 2004). Large and small alliance participants face different constraints. My argument incorporates alliance heterogeneity and differences in member size to explain when alliance participation increases or decreases military spending.

3 Argument

This argument predicts growth in military spending. Growth in military spending is the best measure of state responses to alliance participation. Military spending is subject to a "ratchet effect" whereby increases are rarely offset by decreases. Using growth in spending instead of changes or levels facilitates comparisons across diverse states and time periods. It also limits the risk of spurious inferences from non-stationarity in military spending over time.

So increases and decreases in military spending refer to growth in military expenditures. Lower growth in spending can lead to lower levels of spending, but that is not necessary. Alliance participation may accelerate or arrest the growth of defense budgets.

Two dimensions shape the association between alliance participation and military spending-state size and alliance treaty strength. Major and non-major powers face different opportunities and constraints, so they respond differently to greater alliance treaty strength. Strong and weak alliances have different impacts on major and non-major powers.

3.1 Treaty Strength

Alliances are a costly signal of shared interests among members. Because the treaty is costly, it makes intervention more likely by forming a credible commitment (Fearon, 1997; Morrow, 2000). The costs formalized in a treaty commitment give it strength.

Some treaties are more costly than others. Public, formal promises of military support expose alliance participants to audience costs (Morrow, 2000). Other costly commitments generate sunk costs for members, making the commitment more credible (Morrow, 2000). Thus, promises in a treaty provide information to members and potential opponents (Leeds, 2003).

Stronger alliance treaties make more costly promises. Attaching few conditions to military support is one source of strength (Benson, 2012). Other costly promises include integrated military command, aid, forming international organizations and establishing bases. These commitments make strong alliance treaties more credible.

Both strong and weak alliances provide foreign policy gains for members. States only form treaties they intend to honor. Strong alliances entail a greater loss in freedom of action. These treaties mix hands-tying and sunk costs, and the constraints on members' freedom of action make the treaty more credible. But the same things that make the treaty credible also reduce members' freedom of action.

Strong alliance commitments generate distinct tradeoffs for major and minor power participants. Alliance participants balance the twin risks of abandonment and entrapment (Snyder, 1997; Benson, 2012). Through concerns of abandonment or entrapment and the opportunity costs of military spending, treaty strength shapes incentives of members to increase or decrease military spending.

3.2 Major Powers

States are the key actors in this theory. However, not all states are equivalent. Major powers have greater size and foreign policy ambition.

Major powers are larger than other states. Increasing state size alters the opportunity costs of military spending. All states face opportunity costs from military spending, but they are lower in large states.

As the number of taxpayers falls, the marginal cost per taxpayer of an increase in military

spending rises (Dudley and Montmarquette, 1981). Increasing military expenditures impose a larger burden. Larger economies reduce this tax price of defense effort.

Major powers also benefit from economies of scale in defense spending. More production of defense goods lowers the cost of additional units (Moravcsik, 1991; Alesina and Spolaore, 2006). Thus, major powers have lower marginal costs of military spending.

Major powers also have a wide range of foreign policy interests. These interests are the result of economic ties, scale, and their ability to pursue a wide range of issues. While some states focus on immediate security, others pursue more ambitious foreign policy goals (Fordham, 2011; Markowitz and Fariss, 2017). Major powers have the means and motivation to pursue broad foreign policy interests.

Major powers employ alliances and military spending to defend partners and gain influence (Morrow, 1991). Shaping the policies of other states and ensuring their alignment benefits major powers. By aiding other states, major powers increase their influence.

Major powers gain influence by impacting the expected outcome of potential conflicts.[3] How much influence a major power has depends on how likely they are to intervene, and the amount of capability they possess. Intervention by a highly capable state has a large impact on potential war outcomes. A state that is seen as highly likely to intervene gains influence, and alliances alter the perceived probability of intervention.

Given shared interests, there is some baseline probability that a state will intervene in conflict. By increasing the probability of intervention, alliances give major powers more influence. The greater the rise in the perceived probability of intervention, the more influence.

Strong treaties provide more influence by increasing the perceived probability of intervention. This allows major powers to realize their desired level of influence without spending as much on military capability. Greater treaty strength substitutes for military spending as a source of influence.

[3]Influence has many dimensions. Here, influence deals with security.

Major powers are concerned with entrapment in alliances. States can invoke alliance commitments to involve their partners in unwanted conflicts. Entrapment results from incentives to uphold a reputation for honoring treaties, and flips the putative direction of influence. Strong alliance treaties increase the risk of entrapment (Snyder, 1997; Benson, 2012; Yarhi-Milo, Lanoszka and Cooper, 2016).

Therefore, major powers balance entrapment and influence in alliance treaty design. Strong treaties provide more influence, but also come with a risk of entrapment. So in some cases, major powers will accept the opportunity costs of higher growth in military spending to retain the freedom of action in a weak treaty. Non-major powers face a different tradeoff.

3.3 Non-Major Powers

Non-major powers emphasize immediate security. Small states use alliances and military spending to protect their homeland (Morrow, 1991). In doing so, they face a different set of constraints than major powers.

Small states have a higher marginal cost of military spending. They are less able to access economies of scale in defense. The tax price of spending is also higher than in major powers. Thus, non-major powers have higher marginal costs of military expenditures. This creates incentives for these states to reduce the defense burden when possible.

Non-major powers fear abandonment— that their partners will not honor promises of military support. Potential abandonment generates insecurity. Stronger alliance commitments reduce the fear of abandonment.

Lost freedom of action is the cost of greater security from a strong treaty for non-major powers. Though strong treaties provide more security, they also restrict member's freedom of action. The influence of other alliance members constrains reductions in defense spending. Tying promises of military support to other conditions gives partners more leverage to demand adequate defense effort. Non-major powers lose some residual control in strong alliances (Lake, 1996).

Under a weak treaty, non-major powers still gain security, but they also retain the freedom to reduce defense spending. Given their high opportunity costs of military spending, non-major powers have incentives to rely on allied capability in place of their own. Thus, growth in defense spending will increase in alliance treaty strength for non-major powers.

Their relative emphasis on abandonment or entrapment and different constraints on military spending lead major and non-major powers to respond differently to greater alliance treaty strength. Strong treaties will reduce growth in major power military spending, relative to weak treaties. Conversely, strong treaties will raise growth in non-major power military spending.

3.4 Predictions

As institutions, alliances structure exchanges among participants (Williamson, 1985; North, 1990; Diermeier and Krehbiel, 2003). For major powers, strong alliances substitute for military spending as a tool of influence. Connecting military support to other promises gives large states more influence. As a result, increasing alliance treaty strength will reduce growth in military spending in major powers.

Under a weak treaty, large states have less formal influence. But the treaty still increases their foreign policy reach and obligations. To maintain their influence, major powers will increase military expenditures given a weaker treaty.

By contrast, military spending should increase in treaty strength for non-major powers. Strong treaties provide more security by adding other costly promises. This increases the sense of obligation for alliance partners. Moreover, these strong treaties create the expectation members will uphold the treaty.

Given a weak treaty, non-major powers still gain some security without military support being tied to other obligations. As a result, they are free to reduce military spending. Allied states less formal leverage to check the incentives of non-major power partners to reduce spending under a weaker treaty. Weak treaties provide security, but also give small states the freedom to reduce

	Strong Treaty	Weak Treaty
Major Power	(1) Decreased Growth Spending	(2) Increased Growth Spending
Minor Power	(3) Increased Growth Spending	(4) Decreased Growth Spending

Table 2: Summary of Argument

spending. Strong treaties provide more security, with less freedom for small states to reduce spending.

Therefore, I expect that major and non-major powers will respond differently to participation in strong and weak treaties. I summarize the two dimensions of the argument in Table 2. Each cell corresponds to a combination of major power status and treaty strength.

Table 2 can be distilled into two distinct hypotheses. The first prediction addresses growth in military spending for large states as treaty strength increases. If weak treaties lead large states to increase spending, and strong treaties decrease spending, then growth in major power military expenditures will decrease as treaty strength increases.

> HYPOTHESIS 1: As alliance treaty strength increases, growth in major power military spending will decrease.

The second prediction deals with increasing treaty strength in non-major powers. If weak treaties lead small states to decrease spending, and strong treaties increase their spending, then growth in non-major power military spending will increase as treaty strength increases.

> HYPOTHESIS 2: As alliance treaty strength increases, growth in non-major power military spending will increase.

Testing these two predictions requires two things. First, my hypotheses compare different alliance treaties, so the the research design should also compare treaties. Second, the design must measure alliance treaty strength and compare different treaties. The next section describes how I address these two issues.

4 Research Design

There are two novel components in my research design. First, I develop a latent measure of alliance treaty strength. Then, I employ that measure in a multilevel model which connects alliance-level variation to state-level outcomes. To test differences between major and non-major powers, I estimate the same multilevel model in separate samples of major and non-major powers from 1816 to 2007. The next section describes my measure of alliance treaty strength.

4.1 Measuring Alliance Treaty Strength

Observed alliance treaty conditions reflect the underlying strength of the treaty. A stronger alliance will contain more costly promises. Therefore, we can use observed alliance characteristics to infer treaty strength.

Treaty strength and credibility depends on the costs of abrogation and other costly promises in the pact (Leeds, 2003). The costs of abrogation reflect the primary commitments in the treaty, including defensive or offensive military support, and conditions on military support.[4] Sunk costs promises in alliances include integrated military command, international organization formation, basing rights, promises to make other agreements, and economic or military aid.

This conceptualization generates several potential measures of treaty strength. One is to focus on an important indicator of treaty strength, such as unconditional military support, and code a dummy measure of its presence. Treaty strength is multidimensional, however, so this kind of measure is too coarse.

Another option is constructing an additive index of sources of treaty strength. Treaties with better military support, and costly promises would have higher index values, and therefore greater strength. Such indexes assume each indicator of strength is equally important, which is unlikely. The costs of abrogation are a crucial source of alliance credibility, and should matter more than

[4]Some alliances promise only neutrality, consultation, or non-aggression, rather than active military engagement.

associated sunk cost promises.

Latent variable modeling offers a better way to measure alliance treaty strength. It does not reduce strength to one alliance characteristic, or apply arbitrary weights to an index. Instead, latent variable models use observed treaty characteristics to infer an unobservable concept the observed data reflects.

Latent variable models have a rich history in political science (Clinton, Jackman and Rivers, 2004; Treier and Jackman, 2008; Fariss, 2014). Benson and Clinton (2016) use the latent variable model of Quinn (2004) to measure alliance scope, depth and capability. I also use a latent variable model, but update Benson and Clinton's approach to focus on treaty strength and use a better estimator.

I use the Bayesian Gaussian Copula Factor Model of Murray et al. (2013) to measure alliance treaty strength. Observed alliance characteristics come from the ATOP data (Leeds et al., 2002). Murray et al's model improves on mixed factor analysis for continuous, ordinal, and binary observed data by using a semiparametric approach. With discrete observed variables and non-Gaussian latent variables, the dependence among the latent variables and their marginal distributions are both influenced by the latent variables. Their model encodes the dependence structure of a multivariate latent data using a Copula, and expresses the latent variables and factor loadings as a series of latent normal variables.

Besides the semiparametric terms, this measurement model employs factor analysis. Factor analysis estimates the association between observed variables and the latent factor. Each observed variable has a factor loading— the association between the observed variable and the latent variable. Like standardized regression coefficients, factor loadings range from -1 to 1, so observed variables can be positively or negatively correlated with the latent variable.

For each observation, a linear combination of observed alliance characteristics predicts latent treaty strength.[5] I took observed alliance characteristics for all 745 alliances in version 4 of the

[5]This is like regression with an unobserved outcome, but the analogy is imperfect.

ATOP data (Leeds et al., 2002). Treaty strength is reflected by promises of defensive support, offensive support, neutrality, consultation, non-aggression, unconditional military support, military aid, economic aid, bases, international organization formation, integrated military command, and promises to form new agreements in multiple issue areas. I fit this model with those observed variables and one latent factor. Parameter expanded Gibbs sampling, the default generalized double Pareto (GDP) prior, 10,000 burn-in iterations of the MCMC chain, and 20,000 samples thinned every 20 observations ensured convergence. Because treaty strength is the main quantity of interest for this paper, I focus on the posterior distributions of the latent factor.

Figure 1 describes the latent measure for 745 ATOP alliances from 1815 to 2016. Each alliance has a unique posterior distribution of the latent measure of strength. The mean of that distribution measures expected strength, given the design of the treaty.

As the top panel of Figure 1 shows, most alliances are relatively weak. 456 of the 745 have no promises of offensive or defensive support, reducing the costs of abrogation. The remaining 289 treaties almost all have positive mean strength.

The bottom panel of Figure 1 plots the posterior means and uncertainty in those estimates against the start year of the treaty. Even after accounting for posterior uncertainty, it is possible to distinguish between strong and weak treaties. Weak treaties are concentrated in the 20th century, when non-aggression and consultation alliances proliferated.

The scale of the latent measure is not itself informative. The key information is differences in the latent measure between treaties. The mean of treaty strength is 0.01, and the median is -0.10. By this metric a 1938 consultation pact between France and Czechoslovakia (ATOPID 2120) is quite average.

The weakest treaty is a neutrality and non-aggression treaty between Georgia and Kazakhstan (ATOPID 4476). A similar treaty between between Ukraine and India (ATOPID 4188) scores -1.36 on the latent measure. The three strongest treaties are an 1867 alliance between Prussia and Hesse (ATOPID 1290), a 1955 treaty between Greece and Turkey governing relations in Cyprus and the

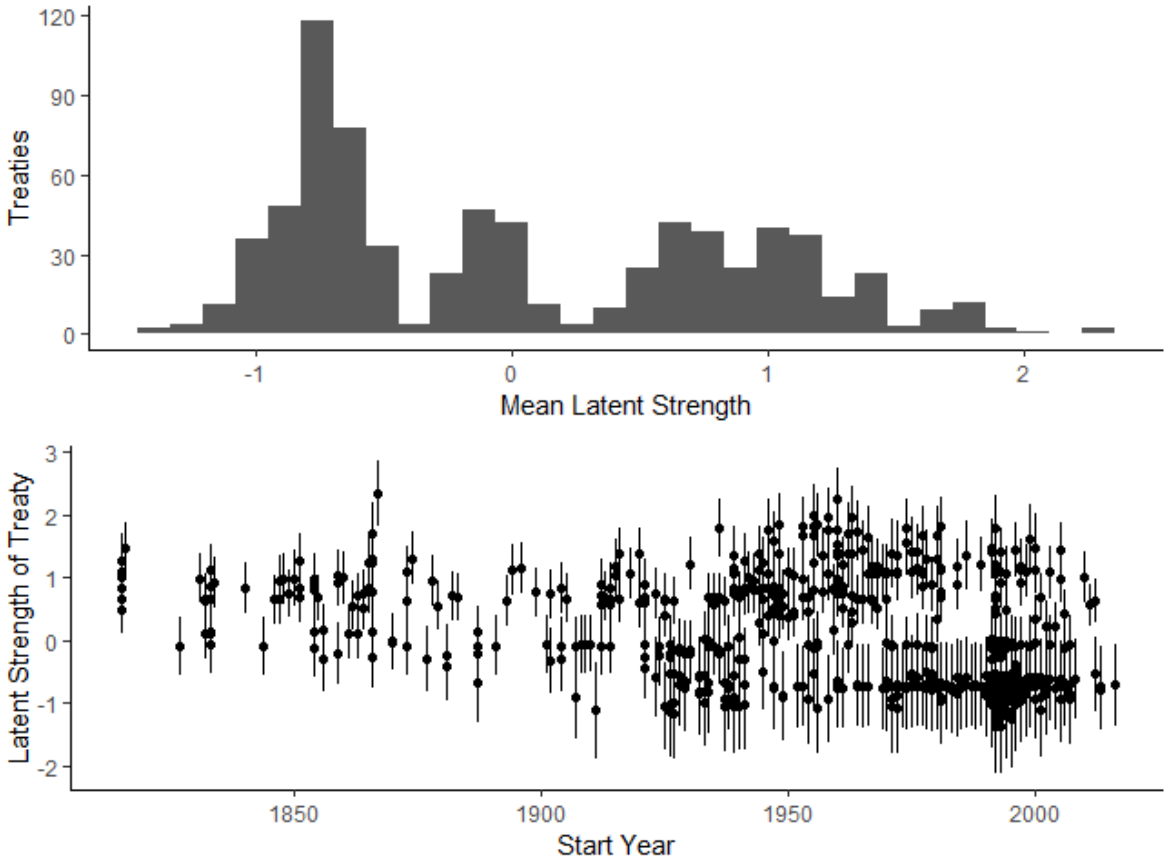

Figure 1: Summary of latent measure of alliance treaty strength for 745 alliances from 1816 to 2016. The top panel is a histogram of the expected of alliance treaty strength. The bottom panel plots mean treaty strength (points) and the standard deviation (error bars) against the start year of the treaty.

United Arab Republic (ATOPID 3300). NATO, the best-known alliance, scores 0.75- so its formal promises are stronger than average, but not exceedingly strong. The weak treaties made few costly promises, while stronger treaties led to substantial concessions for members.

This measure has face and discriminant validity. In this measure weak treaties had few sacrifices for participants. Also, the measurement model divides treaties into two distinct clusters of weak and strong commitments. Incorporating these changes in treaty strength and other variation among alliances is the key contribution of the multilevel model I use to estimate the association between treaty strength and members military spending.

4.2 Multilevel Model

Multilevel modeling combines standard approaches in the literature. Studies of specific alliances provide more detail, while general studies in panel data rely on coarse measures of alliance participation. In this model, I estimate the impact of each alliance on member's military spending, but also the overall association between treaty strength and military expenditures. To overcome common estimation challenges, I fit this model in the Bayesian framework using STAN (Carpenter et al., 2016).[6]

The multilevel model is more complex than traditional approaches. But added complexity has several benefits. First, multilevel modeling allows my test to match the theory. My predictions compare strong and weak treaties- and the alliance level regression in a multilevel model contains a corresponding coefficient. Relying on a state-level proxy for alliance strength generates comparisons among states, which may produce misleading inferences.

Last, multilevel modeling facilitates comparisons among alliances. The alliance-level regression controls for other alliance characteristics that are correlated with alliance strength and military spending. Partial pooling allows me to estimate the unique impact of each alliance on members military spending. Comparing patterns in these alliance-specific coefficients provides additional

[6]See the appendix for details of the weakly informative prior distributions and evidence of convergence.

evidence to examine Hypotheses 1 and 2 as well as the importance of treaty strength.

This model contains two distinct but connected regressions. The base is a state-level regression, which is similar to a regular panel data model. An alliance-level regression predicts parameters in the state-level regression, not unlike an interaction.

The state-level regression can be expressed as:

$$y \sim student_t(\mu, \nu, \sigma) \tag{1}$$

y is the outcome of interest— growth in military spending. I model growth in spending with a t-distribution to address large outliers in spending growth. μ, the mean of the t-distributed outcome, is a function of several covariates.

$$\mu = \alpha + \alpha^{st} + \alpha^{yr} + W\gamma + Z\lambda \tag{2}$$

Growth in spending is a function of an overall intercept α, state and year varying intercepts α^{st} and α^{yr}, and a matrix of state-level control variables W. The $Z\lambda$ term adds alliance participation to the state-level model.

Z is a matrix of state participation in alliances. Columns correspond to alliances, and rows with state-year observations. If a state is not part of an alliance, the corresponding cell of the matrix is zero. If a state is part of an alliance in a given year, the corresponding cell of the matrix is the log of total allied military spending.

I use total allied spending in the alliance participation matrix because how much capability a treaty provides shapes its value. Therefore, the λ parameters capture alliance members' responsiveness to changes in allied capability. Each alliance has a unique λ, which come from a common distribution. These coefficients are a function of a second alliance-level regression.

The second part of the multilevel model uses alliance characteristics to predict how allied spending is associated with alliance members military spending. The λ parameters are the dependent

variable in an alliance-level regression, which includes alliance treaty strength. Therefore, I focus interpretation on this second-level regression, where:

$$\lambda \sim N(\theta, \sigma_{all}) \tag{3}$$

and

$$\theta = \alpha_{all} + \beta_1 \text{Treaty Strength} + X\beta \tag{4}$$

Hypothesis 1 predicts that β_1 will be negative among major powers, and Hypothesis @ predices that β_1 will be positive for non-major powers. In this alliance-level regression, $\mathbf{X}$ is a matrix of alliance-level control variables and α_{all} is the constant. Adding σ_{all} means that the predictions of λ are not deterministic— the alliance level regression contains an error term. Coefficients in the alliance-level regression are like marginal effects in an interaction. A change in treaty strength modifies λ, which affects growth in military spending.

Consider one observation as an example of how the model works. Growth in Argentina's military spending in 1955 depends on Argentina's economic growth, political regime, conflict participation, and rivals. It is also affected by Argentine participation in the Rio Pact and OAS.

$$\begin{aligned}\text{Argentina 1955} = \text{Overall mean} + \text{Argentine Intercept} + \text{1955 Intercept} + \text{Argentine Characteristics} \\ + \lambda_{OAS} * \text{OAS Expenditure} + \lambda_{Rio} * \text{Rio Pact Expenditure}\end{aligned} \tag{5}$$

λ_{OAS} and λ_{Rio} are modified by the alliance level regression. The institutional design and membership of these treaties alter the λ parameter. Alliances that Argentina does not participate in have no impact on growth in military spending.

4.3 Sample and Covariates

I estimate this model on two sub-samples of states from 1816 to 2007. Alliance participation data comes from the ATOP project (Leeds et al., 2002). I focus on participation in defensive or offensive treaties, because it is hard to compare these treaties with consultation, neutrality or non-aggression pacts. Direct promises of military support make allied capability important.

My argument suggests that major and non-major powers use alliances for different purposes. Major powers focus on influence, non-major powers emphasize immediate territorial security. Therefore, the data-generating process connecting alliance participation and military spending should be different for these two states. To capture these differences, I estimate the model in separate samples- one sample of major powers, the other of non-major powers. I employ the classification of major power status from the Correlates of War Project.

The non-major power sample contains 8,668 observations. There are 930 major power observations. Though the major power sample is smaller and has fewer units, Bayesian estimation and partial pooling can generate plausible estimates (Stegmueller, 2013).

In the state-level regression, I control for several correlates of alliance participation and military spending. State-level covariates include GDP growth (Bolt et al., 2018), regime type, international war (Reiter, Stam and Horowitz, 2016), civil war participation (Sarkees and Wayman, 2010), annual MIDs (Gibler, Miller and Little, 2016), rival military spending (Thompson and Dreyer, 2012) and a dummy for Cold War years. Alliance level variables include my measure of treaty strength, number of members and share of democracies at time of formation (Chiba, Johnson and Leeds, 2015), and whether the US or USSR participated in a treaty during the Cold War. Two dummy indicators of wartime alliances and asymmetric obligations (Leeds et al., 2002) are also part of the alliance-level regression.

Democratic membership in an alliance is associated both with limited obligations (Chiba, Johnson and Leeds, 2015) and military spending (DiGiuseppe and Poast, 2016), making it a particularly important alliance-level covariate. State and alliance-level controls for threat and conflict partici-

pation capture situations where states are more likely to seek allies. The next section describes the results from my research design.

5 Results

Because I use Bayesian modeling to estimate the association between treaty strength and growth in military spending, there are no conventional indicators of statistical significance. Instead, each coefficient has a posterior distribution— the possible values of the coefficient conditional on the prior and observed data. Thus I calculate the positive and negative posterior probability for the treaty strength coefficient to assess Hypotheses 1 and 2.

Figure 2 plots the full posterior density of the treaty strength coefficients in the major and minor power samples. The smaller sample for major powers produces more variance in all the coefficient estimates. 96% of the posterior mass for major powers is negative. 94% of the posterior mass for minor powers is positive. There is little overlap between these two posteriors— there is a 99% chance that the association between treaty strength and military spending is larger for minor powers than major powers.

These two coefficient estimates match the predictions of Hypotheses 1 and 2. For major powers, increasing treaty strength is associated with lower growth in military spending. Greater treaty strength is associated with higher growth in military spending for non-major powers.

How substantively important is treaty strength? Among major powers, the mean of the treaty strength coefficient is -0.05, and median growth in military expenditures is 0.04.[7] So a one-unit increase in treaty strength offsets the typical annual growth in military spending.

For non-major powers, the mean of the treaty strength coefficient is 0.03, and median growth in military expenditures is 0.06. Greater treaty strength increases growth in minor power military expenditures by about a third of typical growth. Increasing treaty strength has a large substantive

[7]The median is a better summary of the dependent variable because large positive and negative outliers influence the mean.

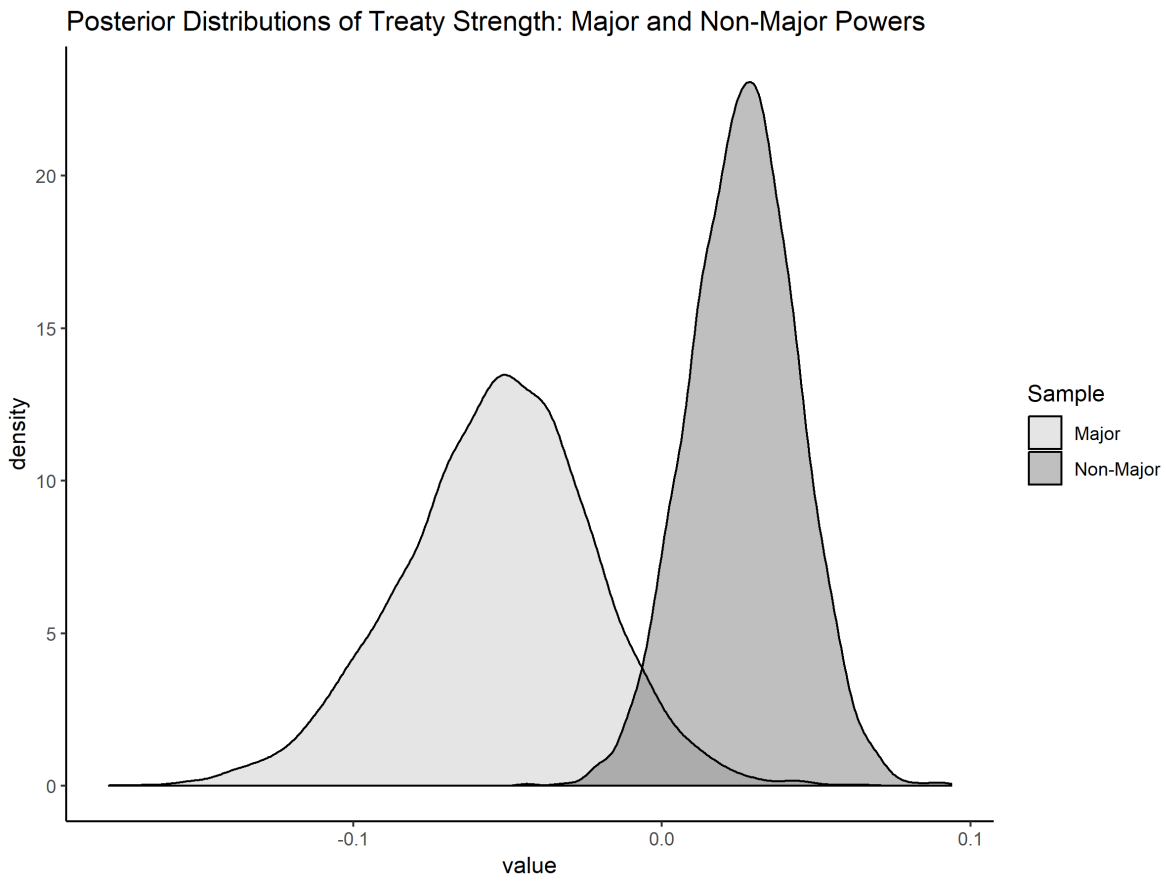

Figure 2: Posterior density of treaty strength coefficient in major and non-major power samples, 1816 to 2007. 96% of the major power posterior mass is negative. 94% of the non-major power posterior mass is positive.

effect, relative to the scale of the data. It also has a large influence on the overall association between changes in allied spending and growth in state defense spending.

If greater treaty strength has a large influence on the λ parameters, there will be a clear trend in the value of λ across the range of alliance treaty strength. We should observe a negative trend in the expected value of λ as treaty strength increases in major power alliances. Conversely, we should observe a positive trend in λ for non-major power alliances.

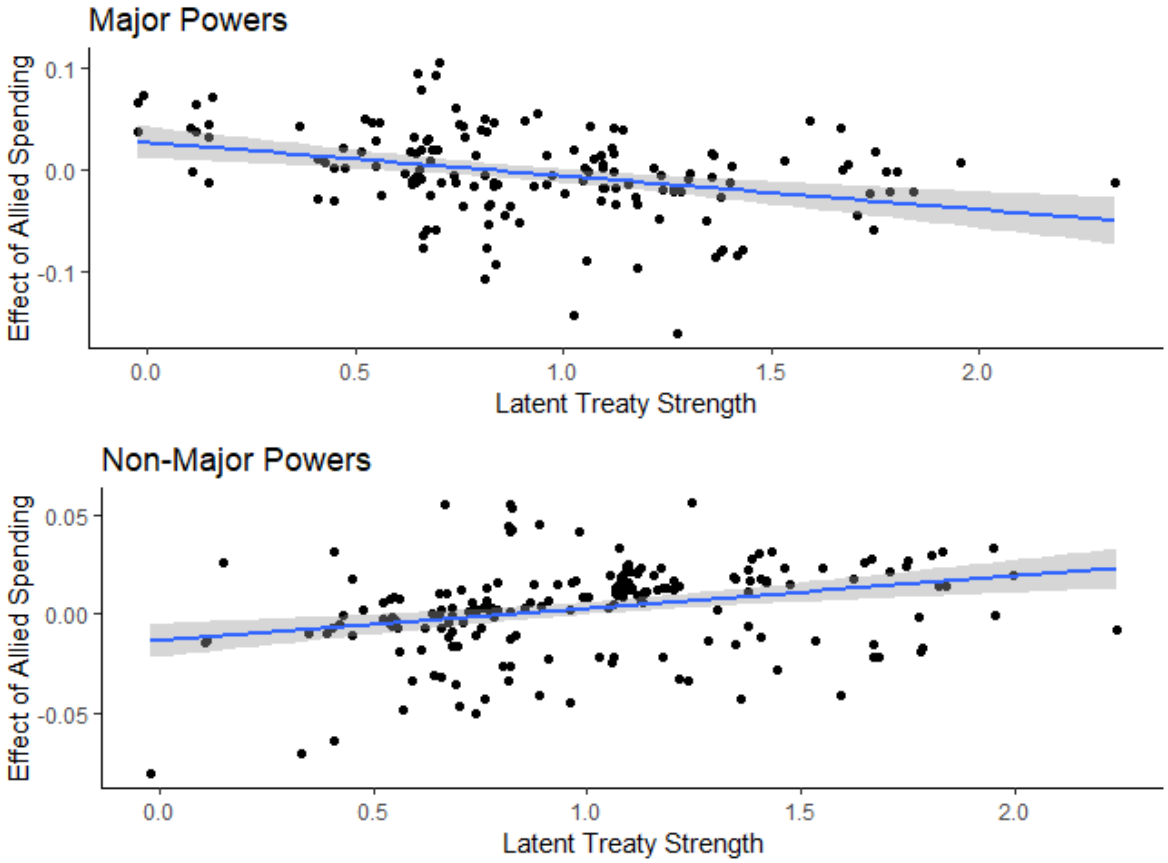

Figure 3: Scatter plots of trends in mean λ parameters and treaty strength. Trend lines estimated using linear regression.

Figure 3 plots the expected value of the association between allied spending and state spending λ against treaty strength in the two samples. In the major power sample, there is a slight negative trend in the scatter plot. For non-major powers, the trend is positive. In both samples, the correlation between mean λ and treaty strength is statistically significant.

Because λ captures the total impact of an alliance, this pattern suggests that increasing alliance strength has an important role. Even holding other alliance characteristics constant, alliance strength drives the overall effect of allied spending down for major powers, and up for non-major powers. Greater alliance treaty strength has the expected impact on military spending in strong and weak states.

6 Discussion

7 Conclusion

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