

Alliance Participation, Treaty Depth, and Military Spending

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Texas A&M University

**How does alliance participation affect
military spending?**

A Tale of Two French Alliances

A Tale of Two French Alliances

France and Belgium 1920



A Tale of Two French Alliances

France and Belgium 1920



France and Poland 1925



**Does alliance participation
increase military spending?**

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increase military spending?
Or decrease it?**

Treaty depth increases free-riding in alliances by non-major powers.

What Does That Mean?

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- **Depth:** The extent of military cooperation an alliance treaty promises.
- **Free-riding:** Low defense spending by alliance participants.
- **Non-major powers:** Countries with less capability and ambition in international politics.

**Depth reveals a tradeoff between
reassurance and free-riding in alliance
politics.**

Why Should You Care?





Competing Claims and Results

	Decrease	Increase	Null
Most & Siverson 1987			X
Conybeare 1994	X		
Diehl 1994		X	
Goldsmith 2003			X
Morgan & Palmer 2006		X	
Quiroz-Flores 2011		X	

Alliance Heterogeneity

- Alliances can *increase or decrease* military spending.

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- Alliances can *increase or decrease* military spending.
- Depends on alliance characteristics.

**Treaty depth is a key source of
differences between alliances.**

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1. Argument: Treaty Depth and Non-Major Powers

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3. Evidence from US alliances

Argument

Opportunism in Alliances

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Free-riding

Free-riding means alliance members:

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1. Rely on partners for protection and
2. Reduce defense spending.

**Deep alliances lead to more
free-riding.**

Treaty Depth

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2. **Formal defense cooperation:**
 - Bases, policy coordination, military aid, side agreements, formal institutions.

Limits on Free-Riding

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1. Greater alliance credibility: reduces leverage over free-riding.
2. Efficiency gains from defense cooperation.

Depth is relevant for non-major powers because they are more prone to free-ride.

Non-Major Powers

- Emphasize immediate security.

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- Constraint: Opportunity costs of military spending.

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- Emphasize immediate security.
- Constraint: Opportunity costs of military spending.
- Under some conditions, alliance participation *decreases* military spending.

Hypothesis 1: The impact of alliance participation on percentage changes in non-major power military spending will be lower in deep alliances, relative to shallow alliances.

Empirical Analysis

I need two things to test the prediction:

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1. Measure of treaty depth— measurement model.

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2. Connect alliance-level variation with state-level outcomes— multilevel Bayesian analysis.

Measuring Treaty Depth

I use a latent variable model to infer treaty depth from observed promises.

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My measure of depth for each alliance is the posterior mean of a latent factor.

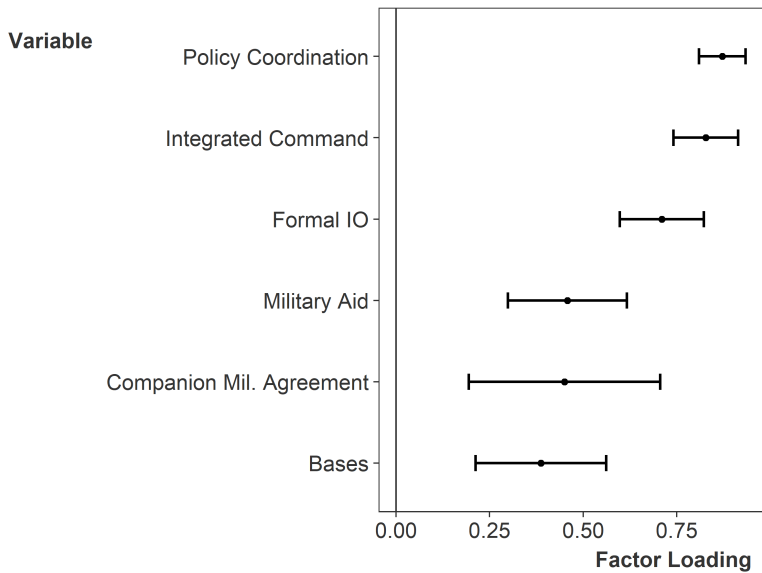
Details of Measure

- Multiple observed indicators of depth in ATOP alliances with military support:
 - *Defense Cooperation*: bases, integrated command, military aid, IO formation, defense policy coordination, other military agreements.

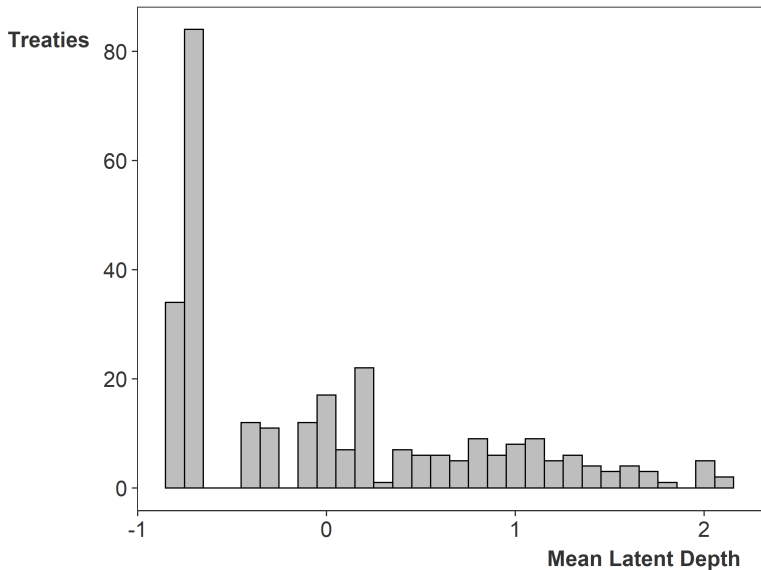
Details of Measure

- Multiple observed indicators of depth in ATOP alliances with military support:
 - *Defense Cooperation*: bases, integrated command, military aid, IO formation, defense policy coordination, other military agreements.
- Semiparametric mixed factor analysis. (Murray et al 2013)

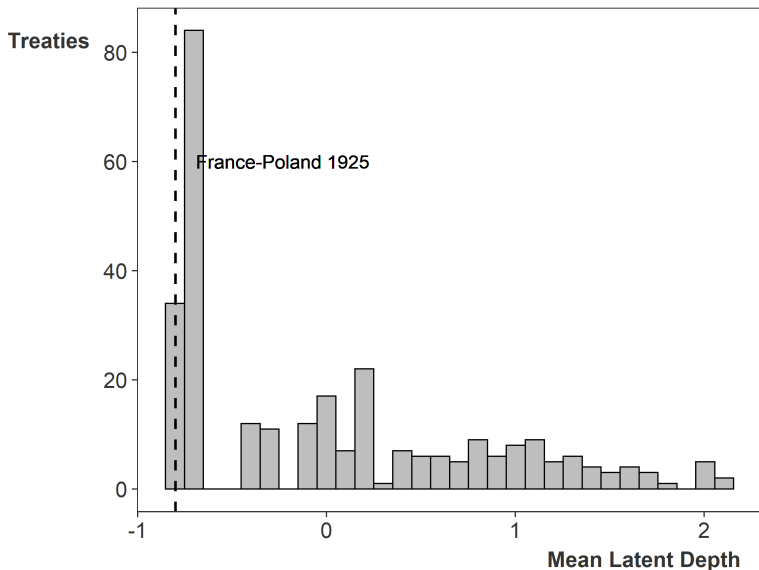
Factor Loadings



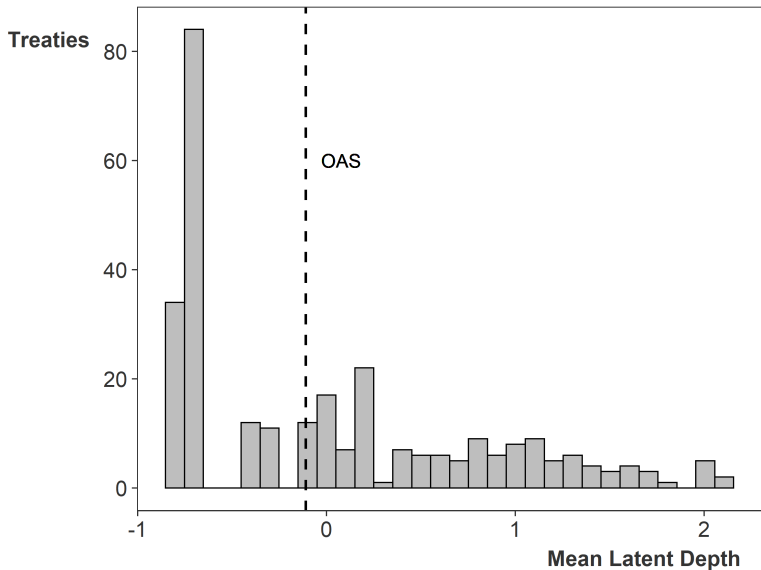
Latent Measure of Treaty Depth



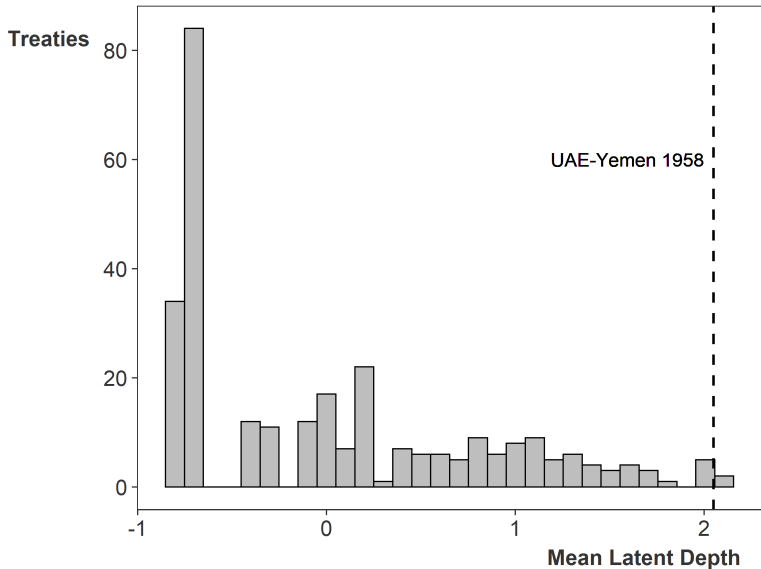
Latent Measure of Treaty Depth: Shallow



Latent Measure of Treaty Depth: Typical



Latent Measure of Treaty Depth: Deep



Empirical Analysis: Multilevel Model

- Link alliance-level variation with state-level outcomes.

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- Two connected regressions: alliance and state-level.
- Alliance characteristics modify the association between alliance membership and percentage changes in spending.

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1. Matches the theoretical argument by comparing alliances.
2. Explicitly model heterogeneous effects of alliances.
3. States are members of multiple alliances.
4. Includes multiple salient alliance characteristics.

$$\begin{array}{ccccccc} \% \text{ Change} & = & \text{Varying} & + & \text{State} & + & \text{Alliance} \\ \text{Mil. Ex.} & & \text{Intercepts} & & \text{Vars.} & & \text{Participation} \end{array}$$

$$\begin{array}{ccccccc} & & & & & \text{Alliance} & \\ & & & & & \text{Characteristics} & \\ & & & & & \downarrow & \\ \% \text{ Change} = & \text{Varying} & + & \text{State} & + & \text{Alliance} & \\ \text{Mil. Ex.} & \text{Intercepts} & & \text{Vars.} & & \text{Participation} & \end{array}$$

ML Model

$$\begin{array}{ccccccc} & & & & & & \text{Alliance} \\ & & & & & & \text{Characteristics} \\ & & & & & & \downarrow \text{Depth -} \\ \% \text{ Change} = & \text{Varying} & + & \text{State} & + & \text{Alliance} \\ \text{Mil. Ex.} & \text{Intercepts} & & \text{Vars.} & & \text{Participation} \end{array}$$

$$\text{Growth} = \text{Mil. Ex.} + \text{Varying Intercepts} + \text{State Vars.} + \text{Alliance Characteristics}$$

↓

$$\text{Alliance Participation}$$

ML Model

$$\begin{array}{ccccccc} & & & & & \text{Alliance} & \\ & & & & & \text{Characteristics} & \\ & & & & & \lambda = \alpha_{all} + \beta_1 \text{Depth} + \mathbf{X}\beta & \\ & & & & & \downarrow & \\ \text{Growth} = & \text{Varying} & + & \text{State} & + & \text{Alliance} & \\ \text{Mil. Ex.} & \text{Intercepts} & & \text{Vars.} & & \text{Participation} & \\ y = & \alpha + \alpha^{st} + \alpha^{yr} & + & \mathbf{W}\gamma & + & \mathbf{Z}\lambda & \end{array}$$

Sample and Key Variables

- **Sample:** Non-major power states (COW)— 1816-2007.

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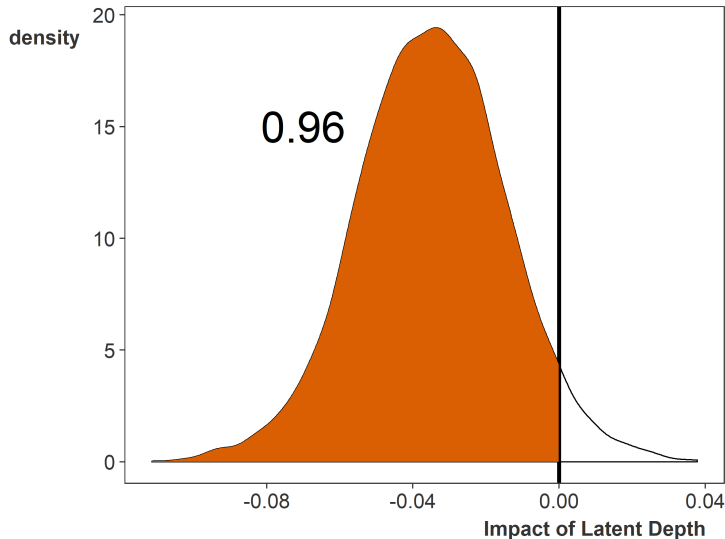
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- **Alliance-Level IV:** Mean treaty depth

- **State-Level Controls:** Interstate war, civil War, annual MIDs, GDP growth, POLITY, Cold War, rival military expenditures.

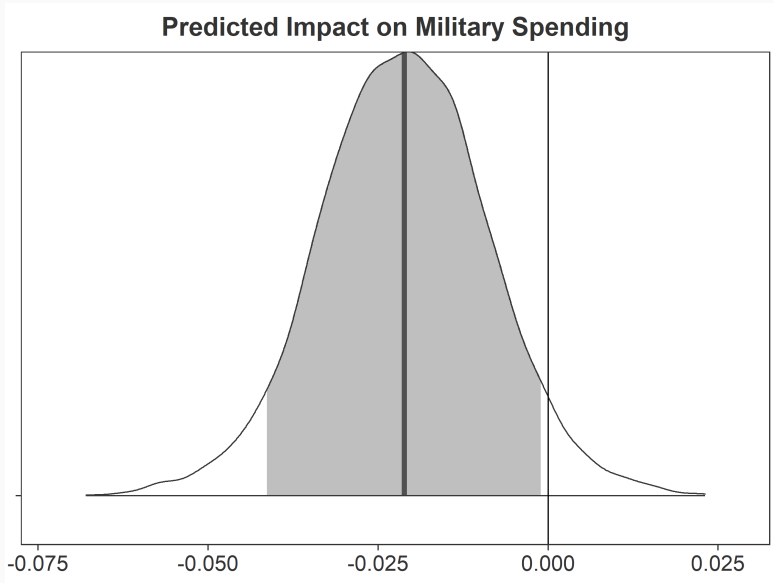
- **State-Level Controls:** Interstate war, civil War, annual MIDs, GDP growth, POLITY, Cold War, rival military expenditures.
- **Alliance-Level Controls:** Unconditional military support, economic issue linkages, foreign policy concessions, share of democracies, number of members, wartime, asymmetric obligations, US member (Cold War), USSR member.

Association Between Treaty Depth and Changes in Military Spending

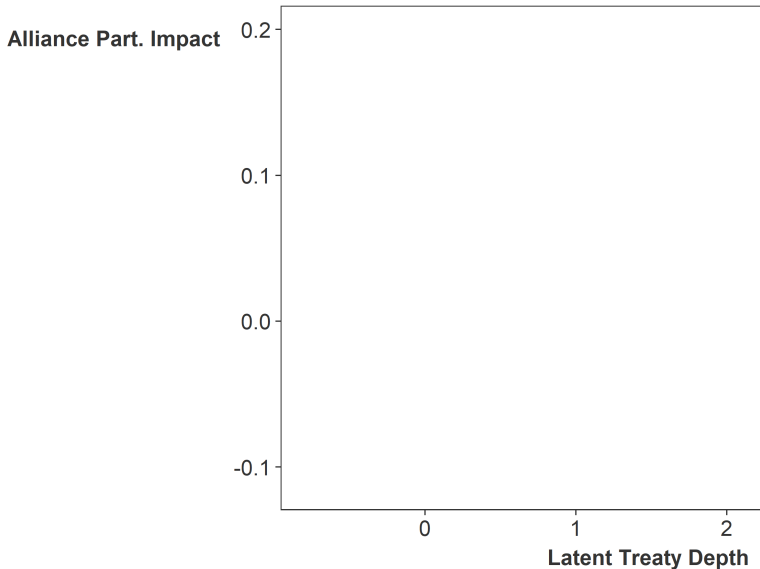


Substantive Importance

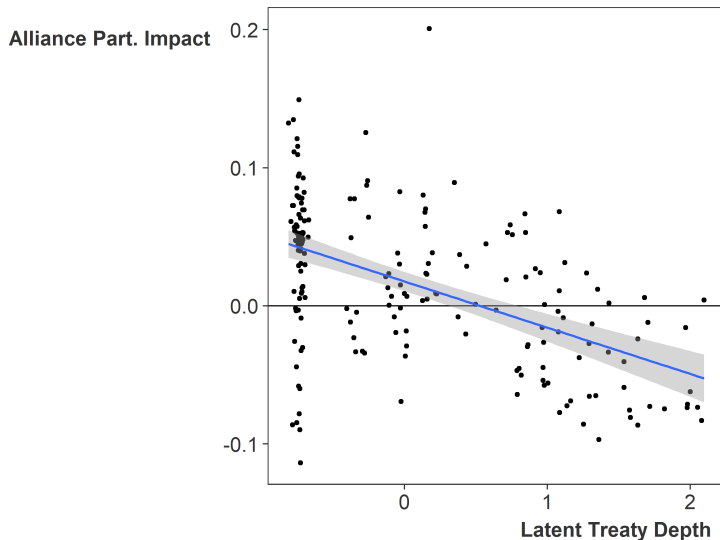
Substantive Importance



How Treaty Depth Modifies Alliance Impact



Treaty Depth and Alliance Impact

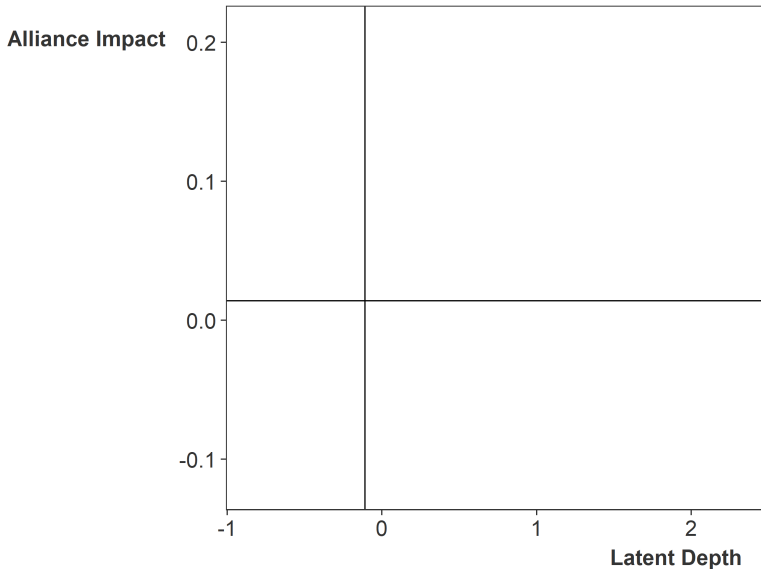


US Alliances

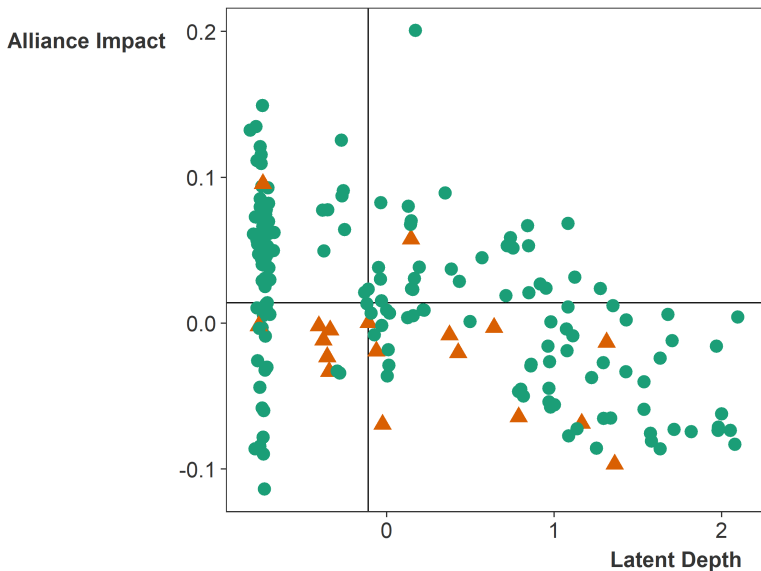
Reassurance



US Alliances in Context



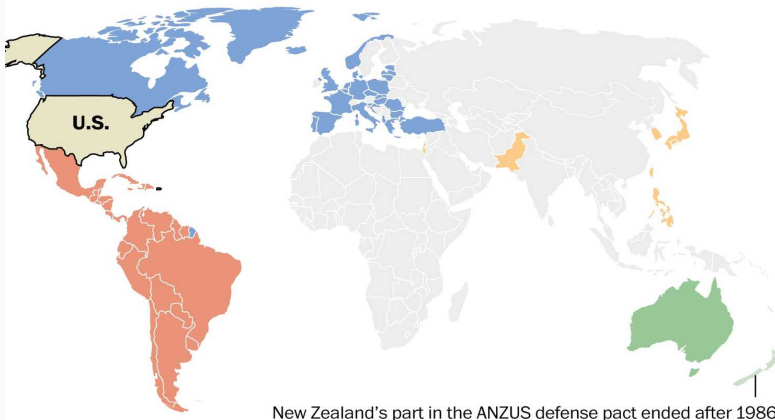
US Alliances in Context



Implication: What to do with US alliances?

US defense pacts, 1947–2014

● OAS ● NATO ● ANZUS ● Bilateral



Note: OAS stands for Organization of American States; NATO for North Atlantic Treaty Organization; and ANZUS for Australian, New Zealand, United States Security Treaty.

Source: Belfer Center of Harvard University, CIA

THE WASHINGTON POST

Conclusion

**How alliance participation affects
military spending depends on treaty
depth.**

**Deep alliances often reduce non-major
power military spending but shallow
alliances often increase military
spending.**

**There is a tradeoff between
reassurance and free-riding in alliance
treaty design.**

Looking Ahead

My dissertation articulates and tests a more general theory of alliance participation and military spending.

My Research Agenda

The political economy of security, with a focus on formal institutions.

International Security

- Alliance Participation, Treaty Depth and Military Spending
- Reassessing the Public Goods Theory of Alliances

Intra-State Conflict

- Conflict Management Institutions and FDI
- Sanctioning Terrorist Groups: Can it Work?
- Weapon of the Weak?: Rebel Groups' International Law Talk, 1974-2011

Thank you!

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Limitations

1. Domestic political economy of military spending.
2. Measurement error and missing data.
3. Formal depth only in the measure.
4. Strategic alliance design

Details of Measurement Model

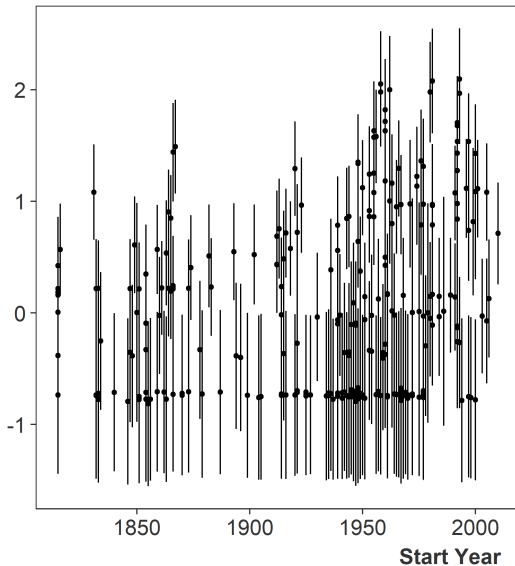
- Bayesian Gaussian Copula Factor Model: for mixed data.
- Uses copulas to break dependence between latent factors and marginal distributions.
- Treats marginals as unknown and keeps them free of dependence.
- IMH proposal, 10,000 iteration warmup, 20,000 samples, thinned every 20 draws.
- Generalized double Pareto prior for the factor loading—flexible generalized Laplace distribution with a spike at zero and heavy tails.

Aside: Benson and Clinton 2016

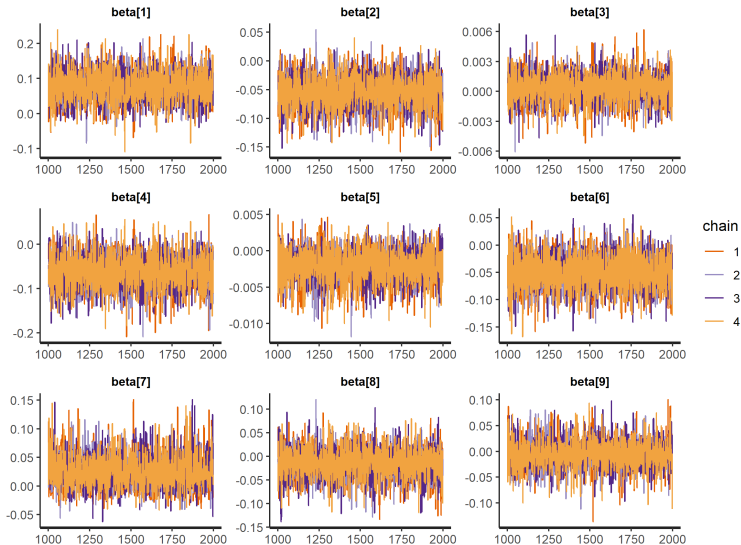
- Use a measurement model to infer alliance scope, depth and capability.
- Identify three separate dimensions, and use three models-explicit constraint.
- I use a different concept, which combines what they call scope and depth.
- Murray et al's model relaxes distributional assumptions in their estimator (Quinn 2004 Factor Analysis).

Depth and First Year of the Alliance

Latent Depth of Treaty



Trace plots: Non-Major



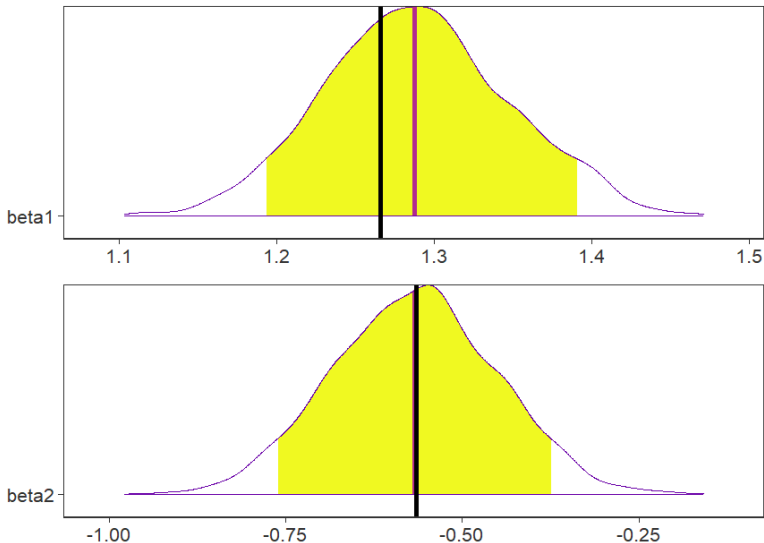
Model Check: Recovering Known Parameters

Another way to check complicated models is simulating fake data with known parameters, then using the model to recover said parameters.

To check my model, I simulated a dataset of 2,000 observations with 50 states, 200 years, 100 alliances and 4 variables: 2 at each level.

The 90% credible intervals contain the known value for all regression parameters. 93 of 100 alliance specific parameter intervals contain the known value.

Simulated Parameters and Credible Intervals

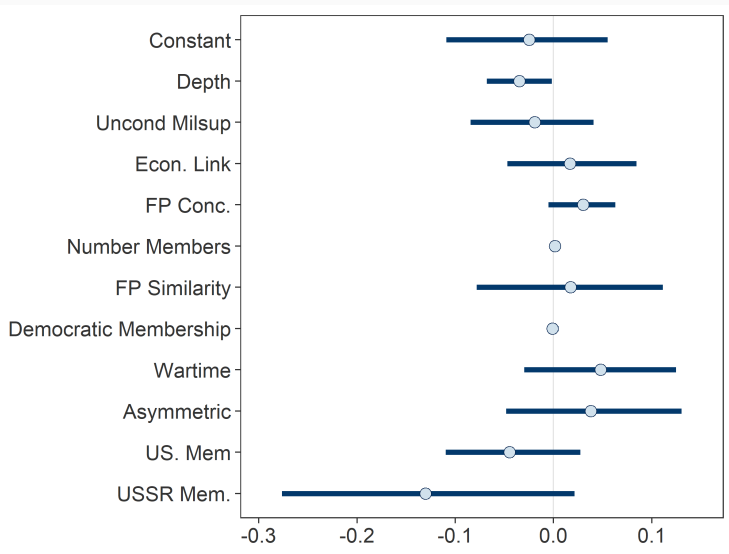


Alliance-Level Regression Table: Non-Major Powers

8,668 observations and 192 alliances.

	mean	sd	5%	95%	n_eff	\hat{R}
Constant	-0.03	0.03	-0.08	0.02	1677.92	1.00
Depth	0.02	0.02	-0.00	0.05	2521.36	1.00
Econ. Link	-0.02	0.02	-0.04	0.01	2997.70	1.00
FP Conc.	0.01	0.01	-0.00	0.03	4019.10	1.00
Number Members	0.00	0.00	-0.00	0.00	3820.06	1.00
FP Similarity	0.00	0.03	-0.04	0.05	2254.34	1.00
Democratic Membership	-0.00	0.00	-0.00	0.00	4412.89	1.00
Wartime	0.04	0.03	-0.01	0.08	3474.44	1.00
Asymmetric	-0.03	0.02	-0.07	0.01	3474.45	1.00
US. Mem	0.02	0.02	-0.01	0.05	2330.47	1.00
USSR Mem.	0.04	0.05	-0.03	0.12	3859.50	1.00
σ Alliances	0.02	0.01	0.00	0.03	1201.91	1.01

Treaty Depth and Other Alliance Characteristics



Priors

4 Chains with 2,000 samples and 1,000 warmup iterations.

$$p(\alpha) \sim N(0, 1)$$

$$p(\sigma) \sim \text{half-}N(0, 1)$$

$$p(\alpha^{yr}) \sim N(0, \sigma^{yr})$$

$$p(\sigma^{yr}) \sim N(0, 1)$$

$$p(\alpha^{st}) \sim N(0, \sigma^{st})$$

$$p(\sigma^{st}) \sim \text{half-}N(0, .5)$$

$$p(\sigma^{all}) \sim \text{half-}N(0, .5)$$

$$p(\beta) \sim N(0, .5)$$

$$p(\gamma) \sim N(0, .5)$$

$$p(\nu) \sim \text{gamma}(2, 0.1)$$

ML Model Specification

$$y \sim \text{student}_t(\nu, \mu, \sigma) \quad (1)$$

$$\mu = \alpha + \alpha^{st} + \alpha^{yr} + \mathbf{W}_{n \times k} \gamma + \mathbf{Z}_{n \times a} \lambda \quad (2)$$

$$\lambda_a \sim N(\theta_a, \sigma_{all}) \quad (3)$$

$$\theta_a = \alpha_{all} + \beta_1 \text{Treaty Depth} + \mathbf{X}_{a \times l} \beta \quad (4)$$

Example

$$\mu_{it} = \alpha + \alpha^{st} + \alpha^{yr} + W_{it}\gamma + Z_{it}\lambda$$

Example year: Argentina 1955

1955 % Change Milex. = Overall mean

+ Argentine Intercept + 1955 Intercept

+ Argentine Characteristics

+ λ_{OAS} * OAS Expenditure + λ_{Rio} * Rio Pact Expenditure

$$\lambda_{OAS} = \alpha_{all} + \beta_1 - 0.11 + \text{Controls}$$

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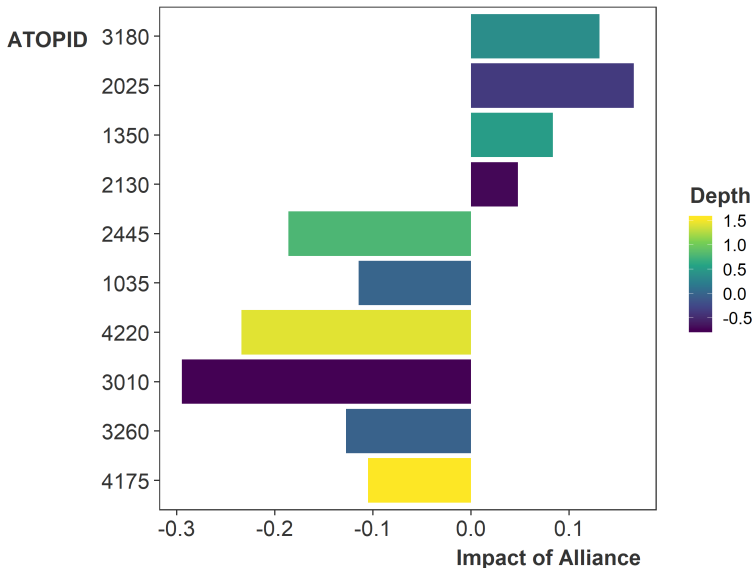
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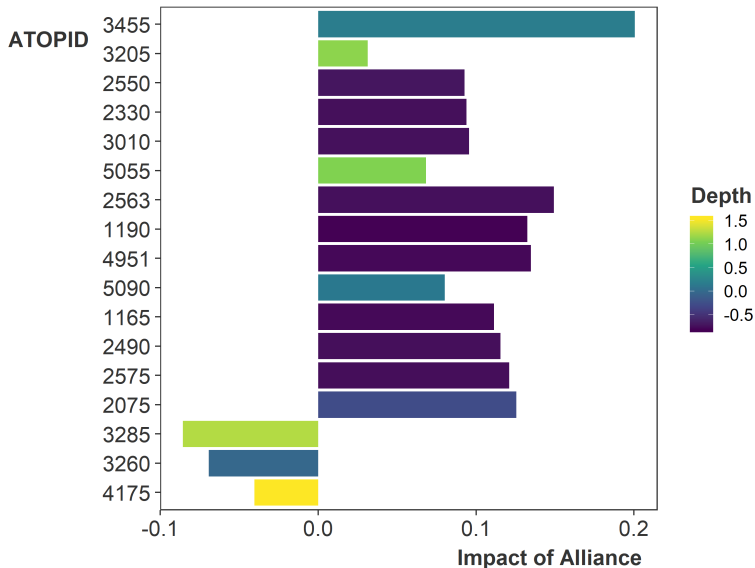
Z

State-Year	Rio Pact	Warsaw Pact
Argentina 1954	.347	0
Argentina 1955	.418	0
⋮	⋮	⋮

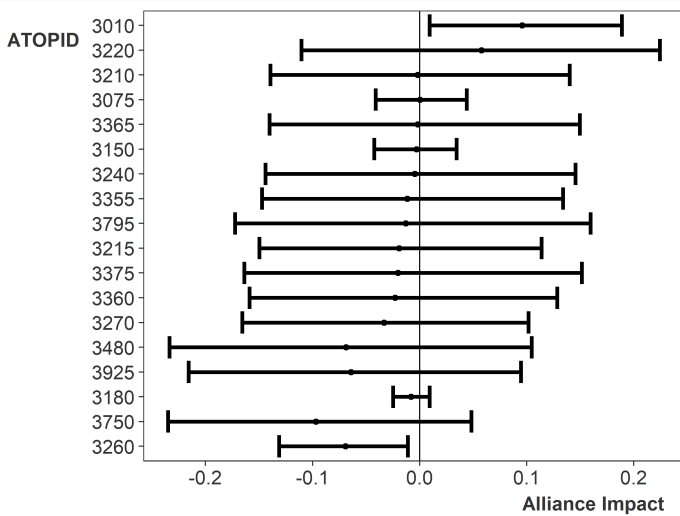
Notable Major Power Alliances



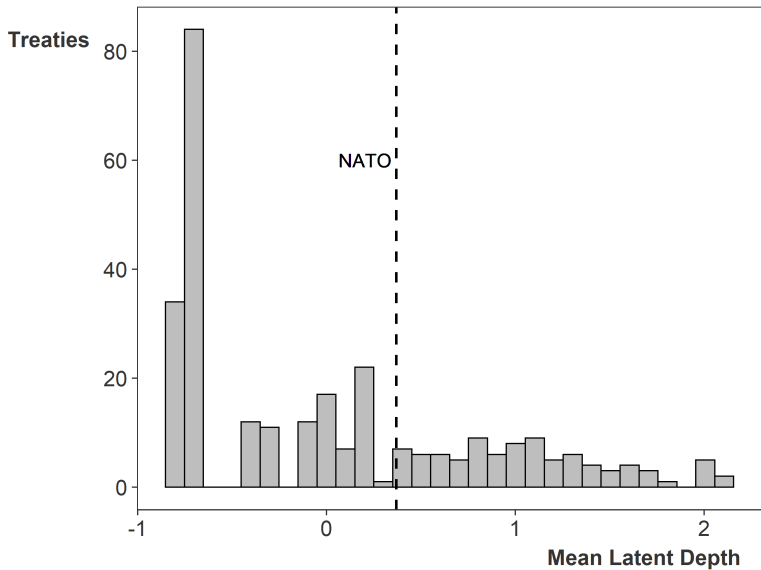
Notable Non-Major Power Alliances



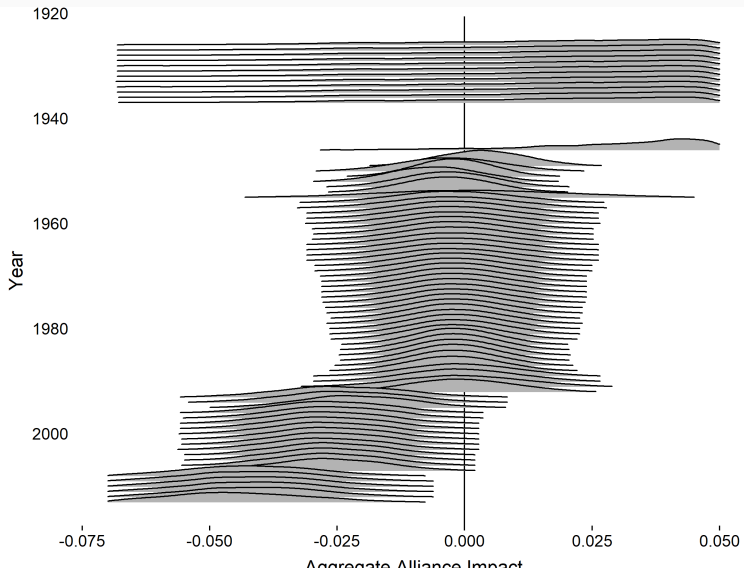
Impact of US Alliance on Non-major Power Military Spending



NATO

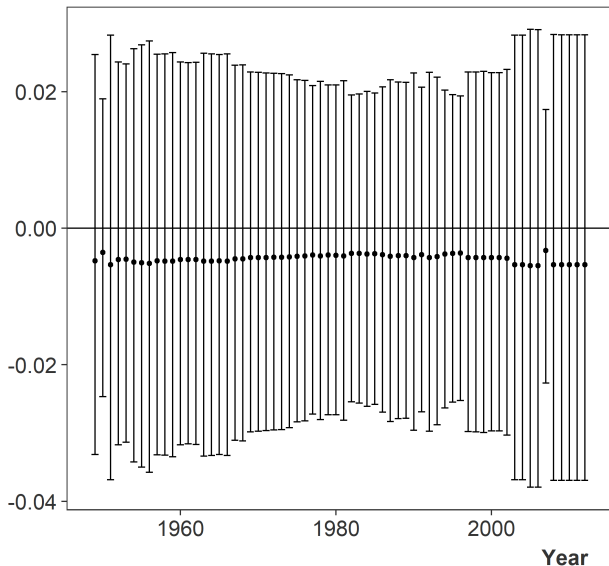


Alliance Participation and Military Spending: Belgium

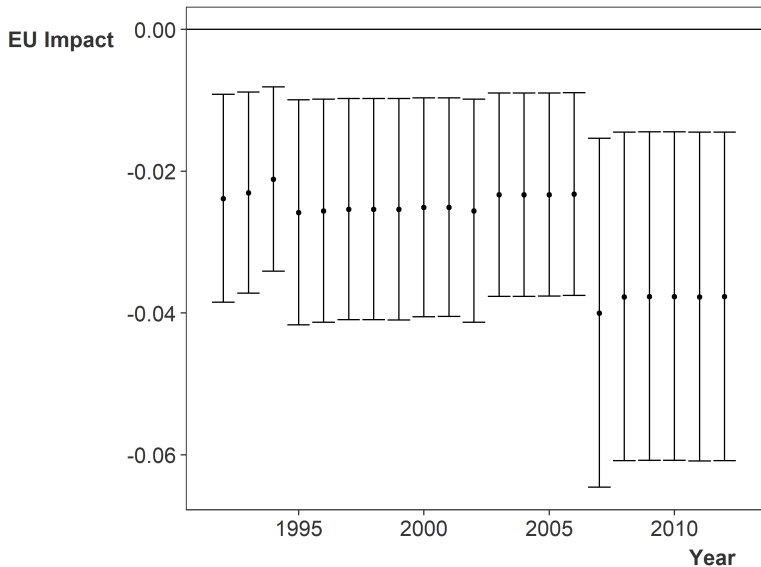


Impact of NATO on Belgium

NATO Impact



Impact of EU on Belgium



Varying Slopes Model

Within each of the j groups of state capability, for i in $1 \dots n_j$:

$$y_i \sim \text{student}_t(\nu_j, \alpha_j + \alpha^{st} + \alpha^{yr} + \mathbf{W}_i \gamma + \mathbf{Z}_{ji} \lambda_j, \sigma_j)$$

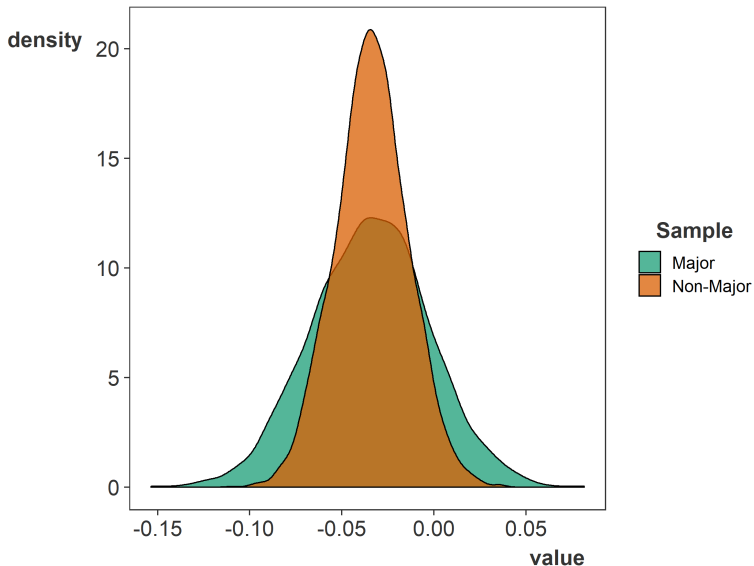
$$\lambda_j \sim N(\theta_j, \sigma_j^{all})$$

$$\theta_j = \alpha_j^{all} + \mathbf{X} \beta_j$$

I give β_j a multivariate normal prior with prior scale τ :

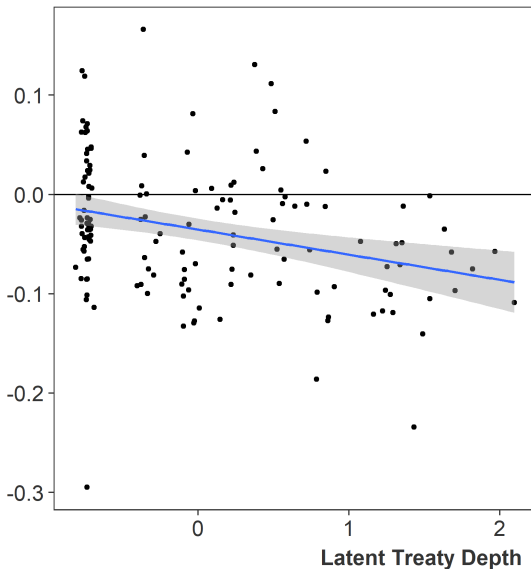
$$\beta_j \sim \text{MVN}(\mu_{\beta_j}, \Sigma_{\beta})$$

Varying Slopes Results: Depth

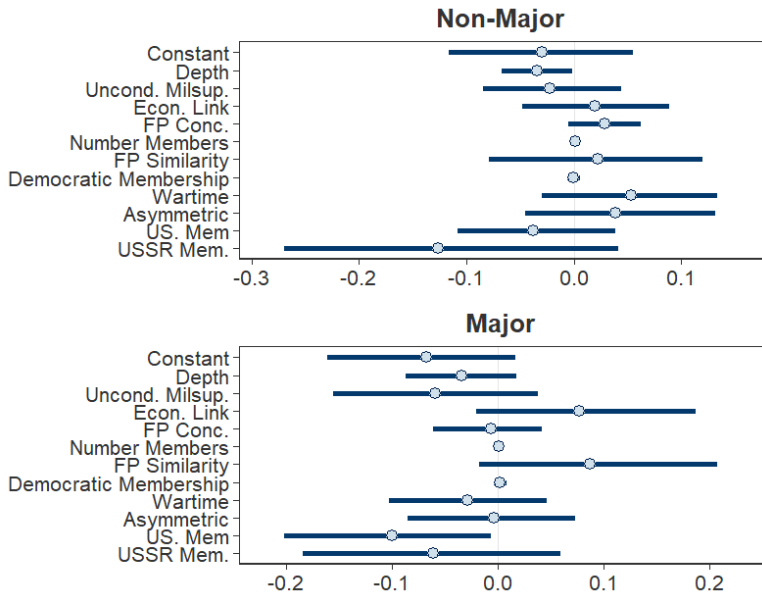


Treaty depth and λ : Major Powers

Alliance Part. Impact



Full Varying Slopes Results



Correlates of War Spending Data

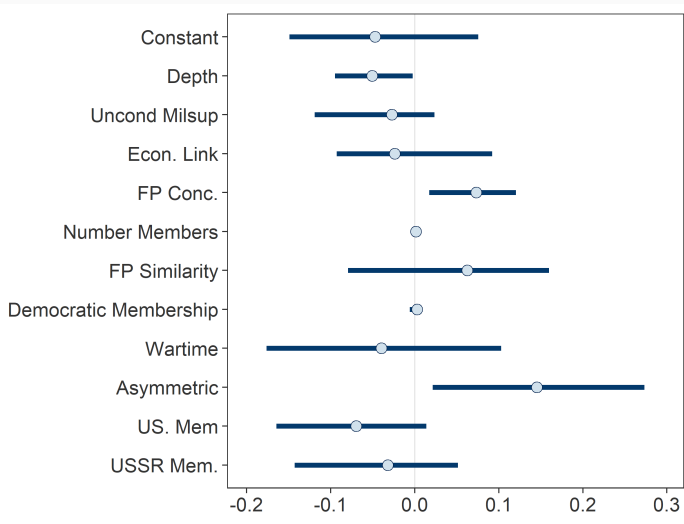
Is messy...

- Converted to standard units (British Pounds prior to 1914, US dollars thereafter).
- Occasionally smoothed with a seven-year moving average.
- Interpolation with stable currency.

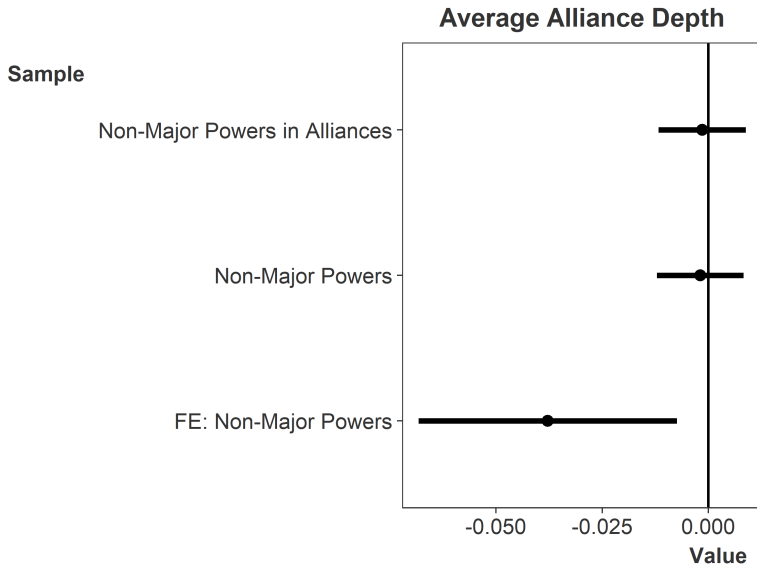
Alternative Measure of Military Spending

- Nordhaus et al 2012 data: mix of COW and SIPRI- fully rebased
- 1949 to 2001
- Same model: use changes in spending instead of percentage changes.

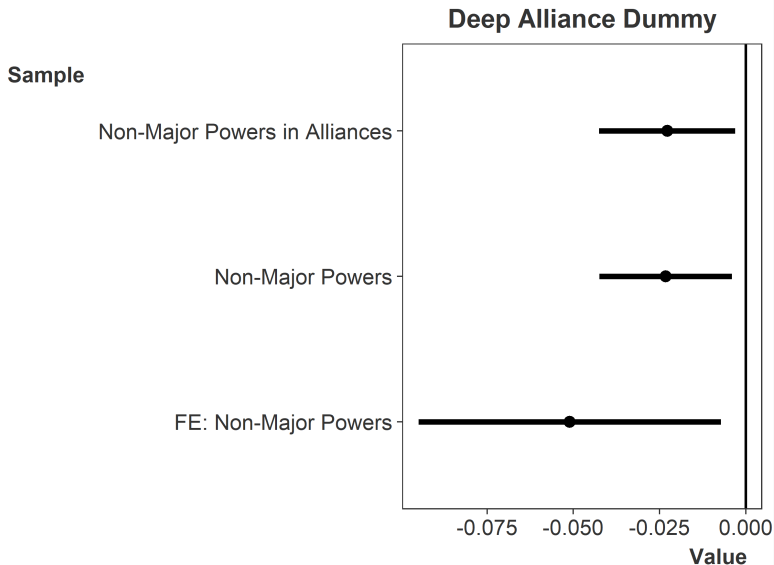
Alternative Measure of Military Spending: Results



Single-Level Regression: Average Depth



Single-Level Regression: Deep Alliance Dummy



Bounds Analysis of Single-Level Regression

