Alliance Participation, Treaty Depth, and Military Spending

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How does alliance participation affect military spending?

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	
Conybeare & Sandler 1990		X	
Barnett & Levy 1991	X		
Morrow 1993	X		
Sorokin 1994	X		
Chen et al 1996		X	
Pluemper & Neumayer 2015	X		
George & Sandler 2017	X		

Does alliance participation increase military spending?

Does alliance participation increase military spending? Or decrease it?

Alliance Heterogeneity

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- Depends on alliance characteristics and states' foreign policy goals.
- **Treaty depth is a key source of differences between alliances.**

Deep alliances often decrease non-major power military spending, but shallow alliances often increase it.

What Does That Mean?

- **Depth**: The extent of military cooperation an alliance treaty promises.

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- **Depth**: The extent of military cooperation an alliance treaty promises.
- **Non-major powers**: Countries with less capability and ambition in international politics.

Why Should You Care?


ALLIES
UNITED
BRUXELLES
NATO
OTAN
CHAIRMAN
SOC
CHAIRMAN MC

Outline

I make my claim about alliance participation and military spending in three ways:

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1. Argument: Treaty Depth and Non-Major Powers

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2. Statistical Analysis

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1. Argument: Treaty Depth and Non-Major Powers
2. Statistical Analysis
3. Evidence from US alliances

Argument

An Alliance Politics Framework

Alliances are a form of international cooperation.

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1. States use allied support and capability to advance their foreign policy goals.
2. Two potential concerns: abandonment and low military spending.

Non-Major Powers

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- Constraint: Opportunity costs of military spending.

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- Constraint: Opportunity costs of military spending.
- Given the chance, alliance participation *decreases* military spending.

Allies of Non-Major Powers

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4. Tradeoff between credible military support and leverage.

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

Depth, Credibility and Leverage

Treaty depth shapes alliance politics in three ways:

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2. Reduced leverage over allied spending.
3. Efficiency gains in defense spending.

Hypotheses 1 and 2

Hypothesis 1: On average, participation in shallow alliances will increase percentage changes in non-major power military spending.

Hypotheses 1 and 2

Hypothesis 1: On average, participation in shallow alliances will increase percentage changes in non-major power military spending.

Hypothesis 2: On average, participation in deep alliances will decrease percentage changes in non-major power military spending.

Hypothesis 3

Hypothesis 3: As alliance treaty depth increases, the impact of alliance participation on percentage changes in non-major power military spending will decrease.

Empirical Analysis

Research Design

I need two things to test these predictions:

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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 the latent depth 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, subordination of forces, specific contribution.

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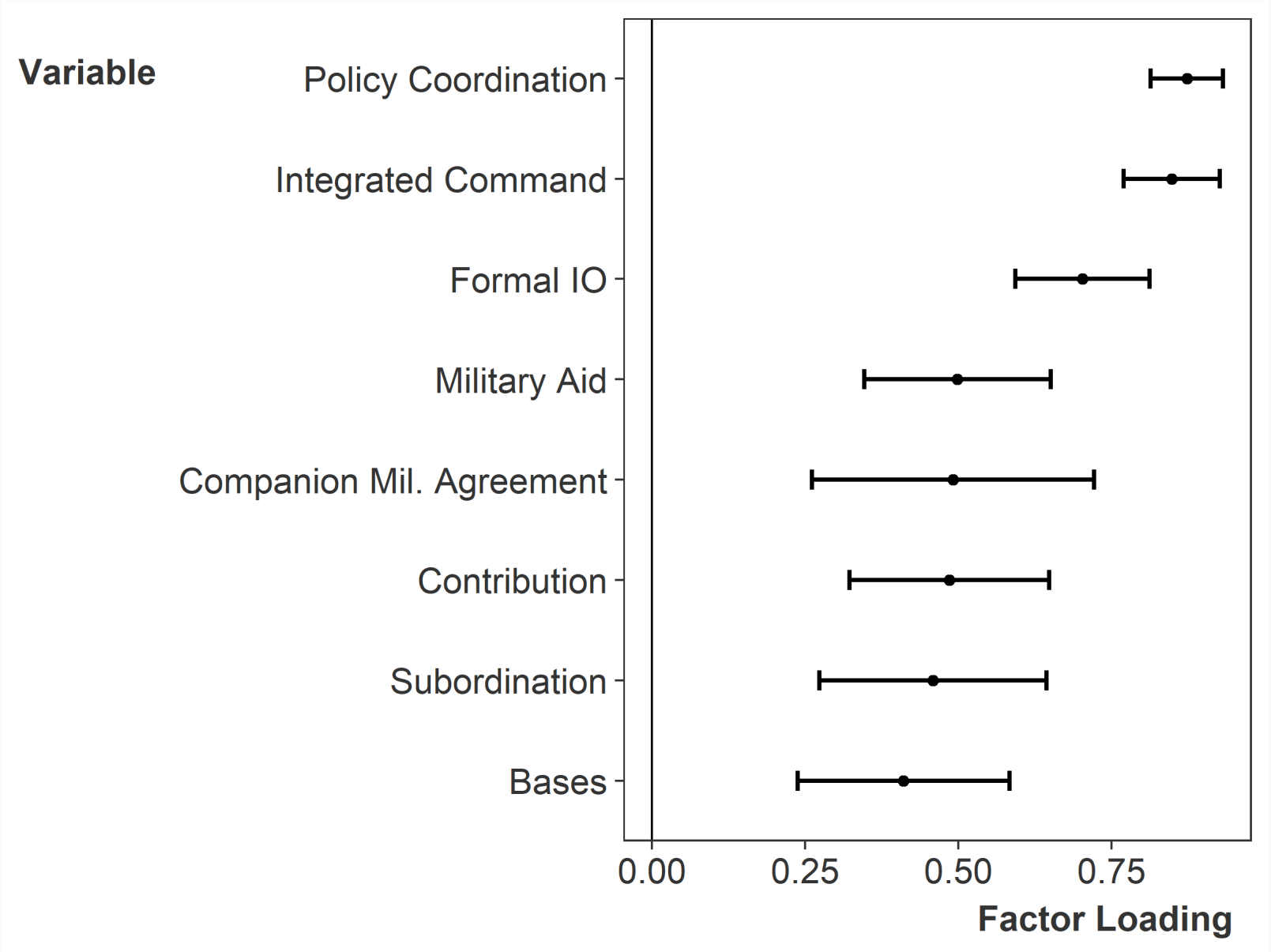
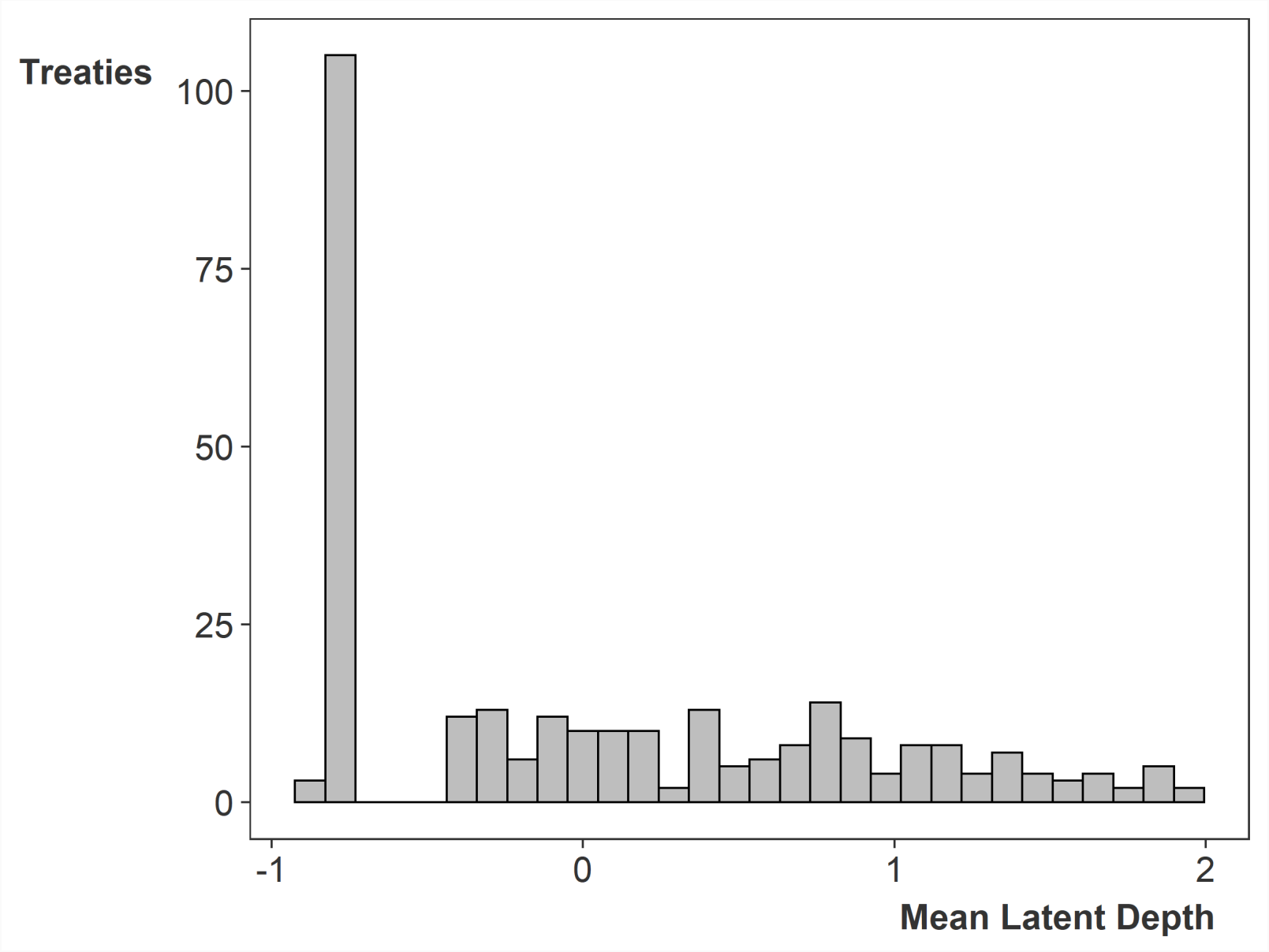
  - *Defense Cooperation*: bases, integrated command, military aid, IO formation, defense policy coordination, other military agreements, subordination of forces, specific contribution.
- Semiparametric mixed factor analysis. (Murray et al 2013)

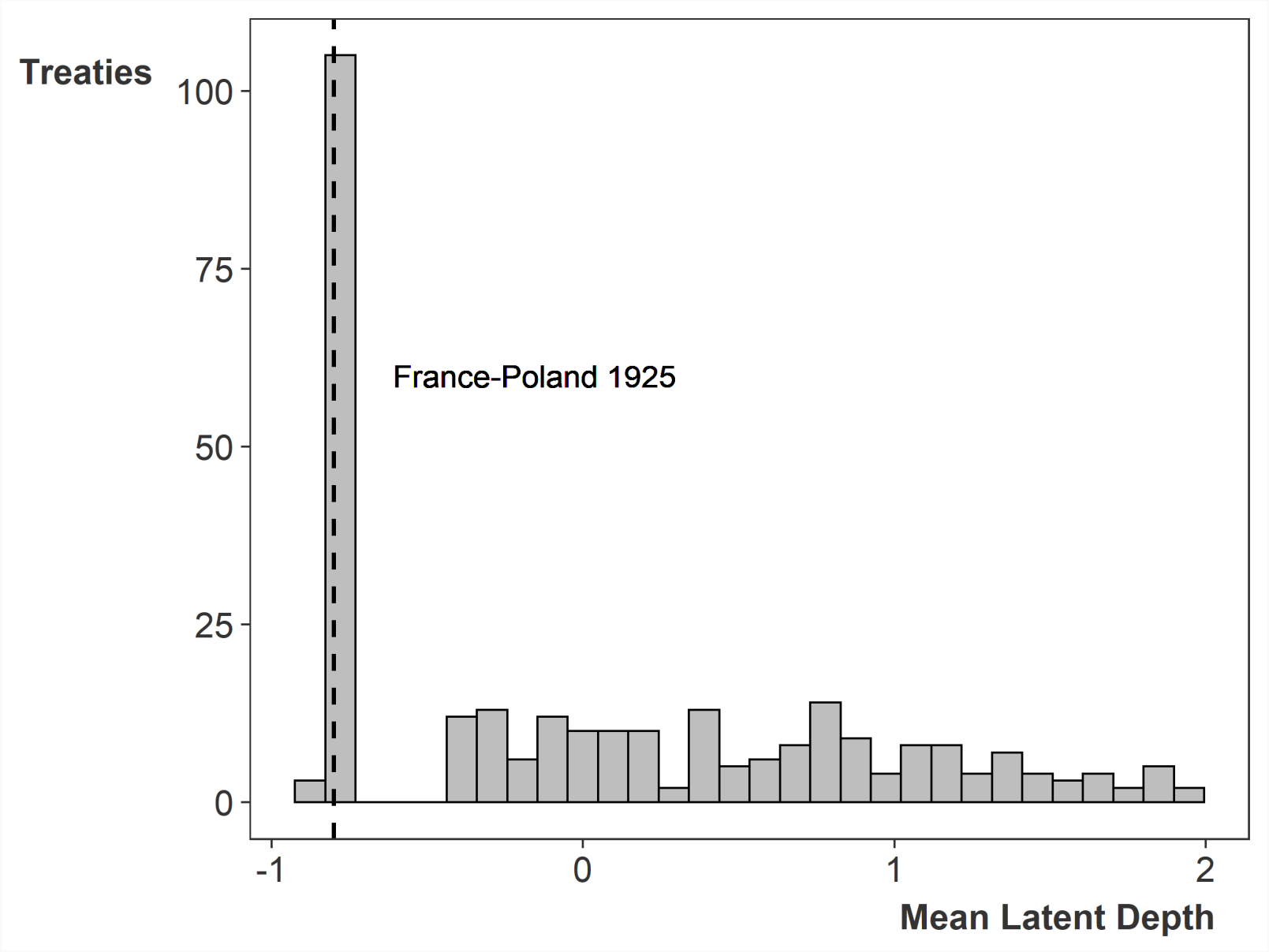
Factor Loadings



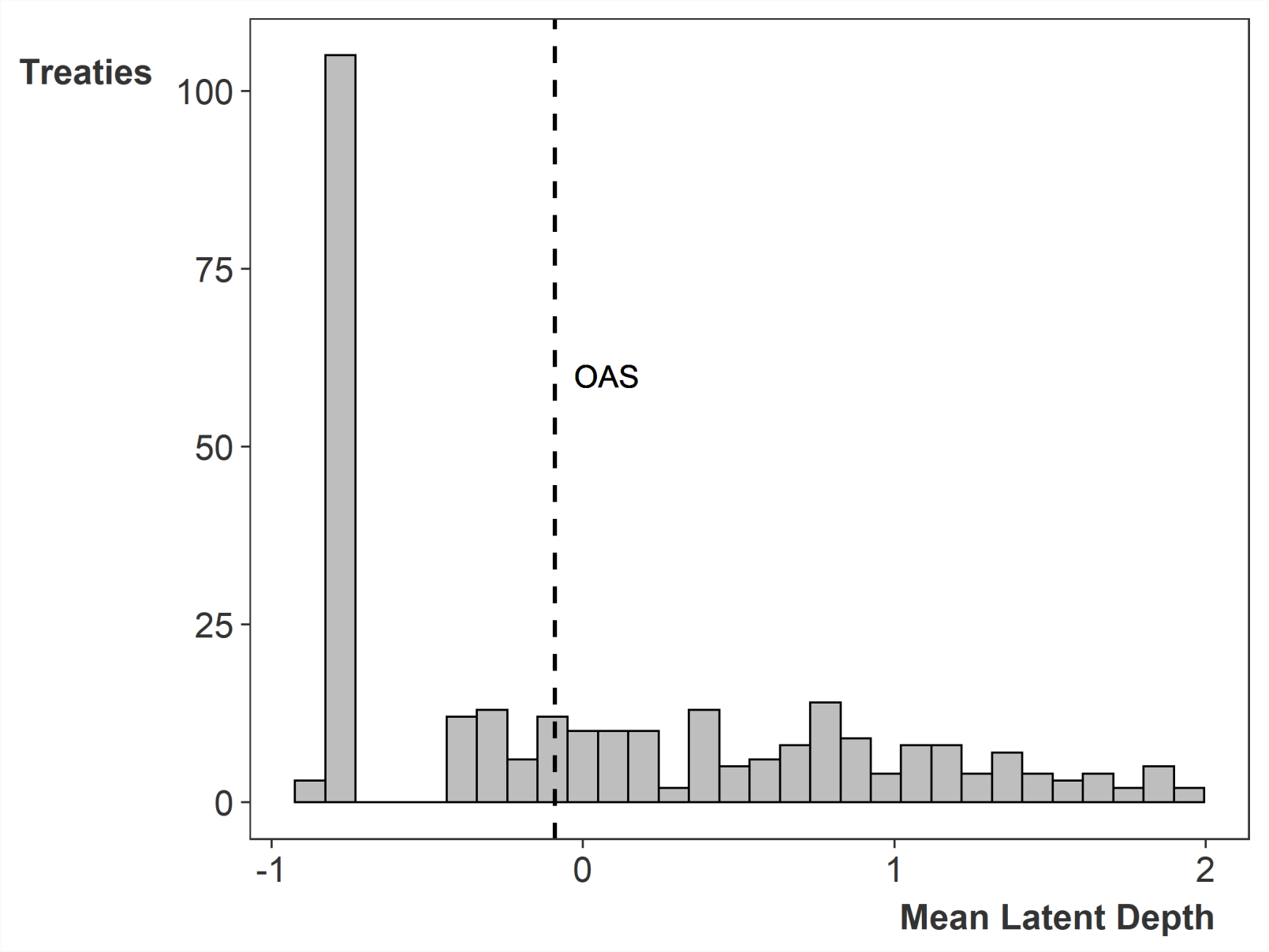
Latent Measure of Treaty Depth



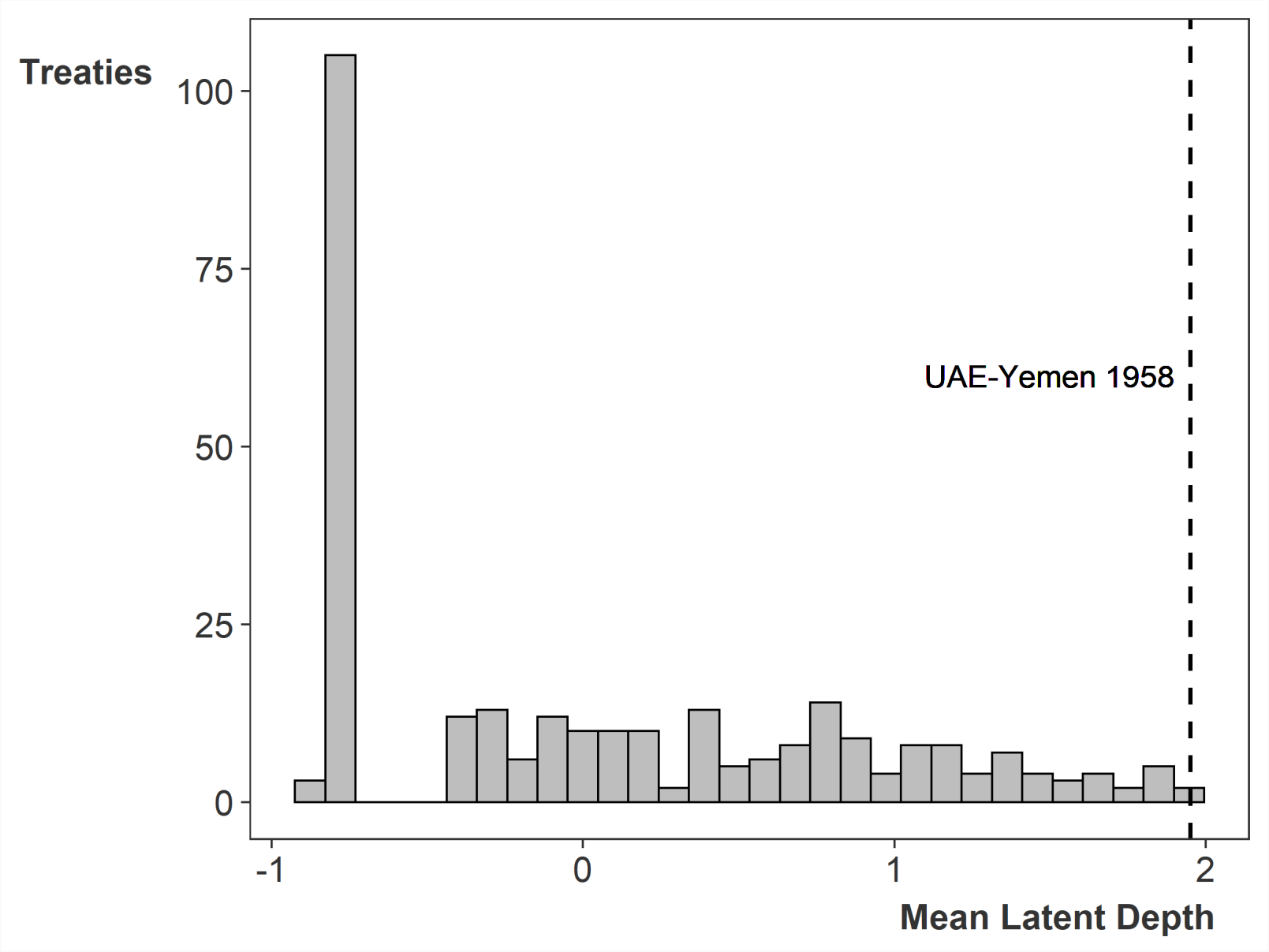
Latent Measure of Treaty Depth: Shallow



Latent Measure of Treaty Depth: Typical



Latent Measure of Treaty Depth: Deep



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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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2. Explicitly model heterogeneous effects of alliances.
3. States are members of multiple alliances.
4. Includes multiple salient alliance characteristics.

ML Model

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

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y = & \alpha + \alpha^{st} + \alpha^{yr} & + & \mathbf{W}\gamma & + & \mathbf{Z}\lambda
\end{array}
$$

ML Model

$$\lambda = \begin{array}{c}\text{Alliance} \\ \text{Characteristics} \\ \beta_1 \text{Depth} + \mathbf{X}\beta \\ \downarrow\end{array}$$

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Sample and Key Variables

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

Controls

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

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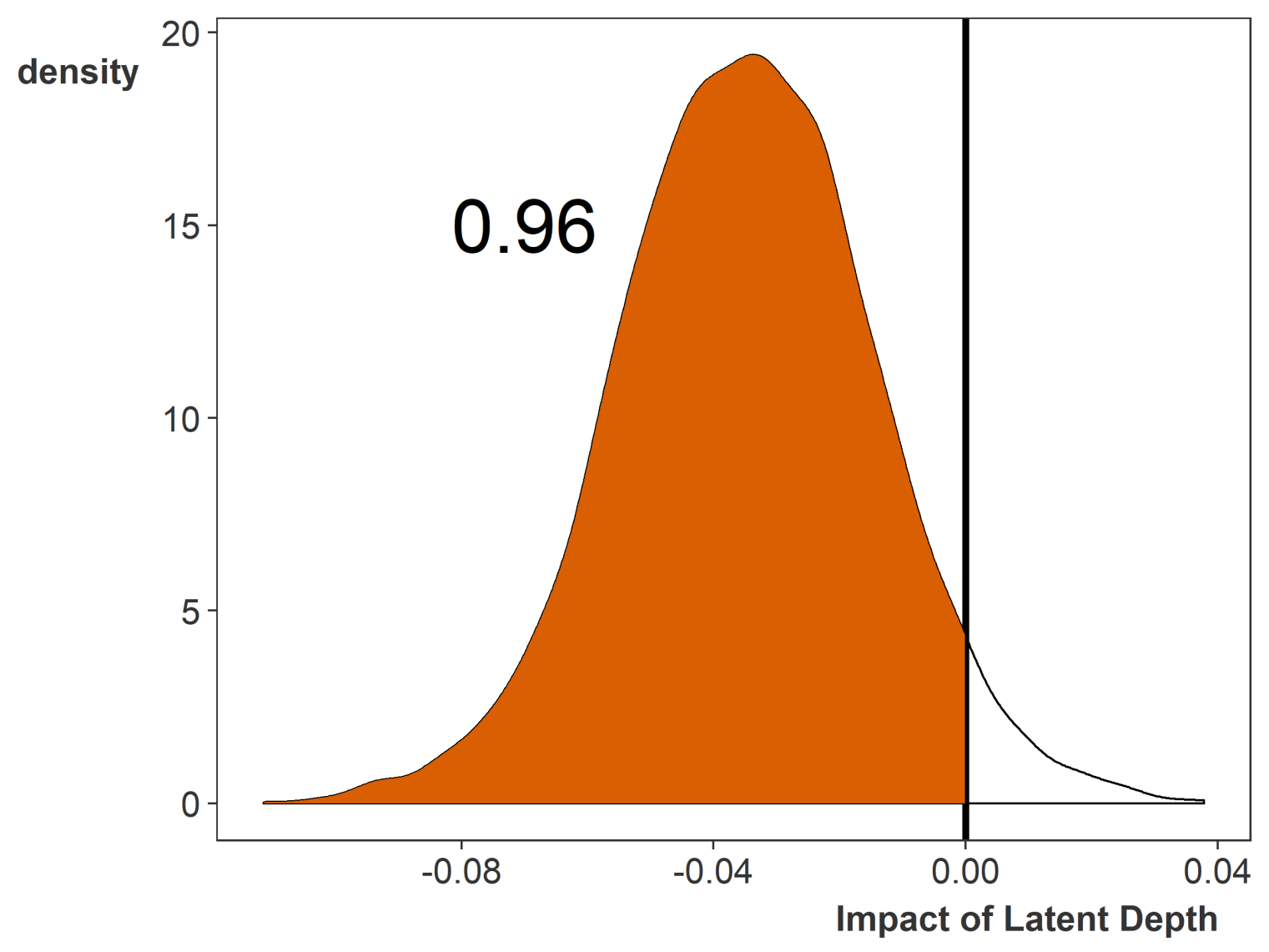
- **Alliance-Level Controls**: Unconditional military support, economic issue linkages, foreign policy concessions, share of democracies, number of members, wartime, asymmetric obligations, US member (Cold War), USSR member.

Treaty Depth and the Impact of Alliance Participation



Substantive Importance

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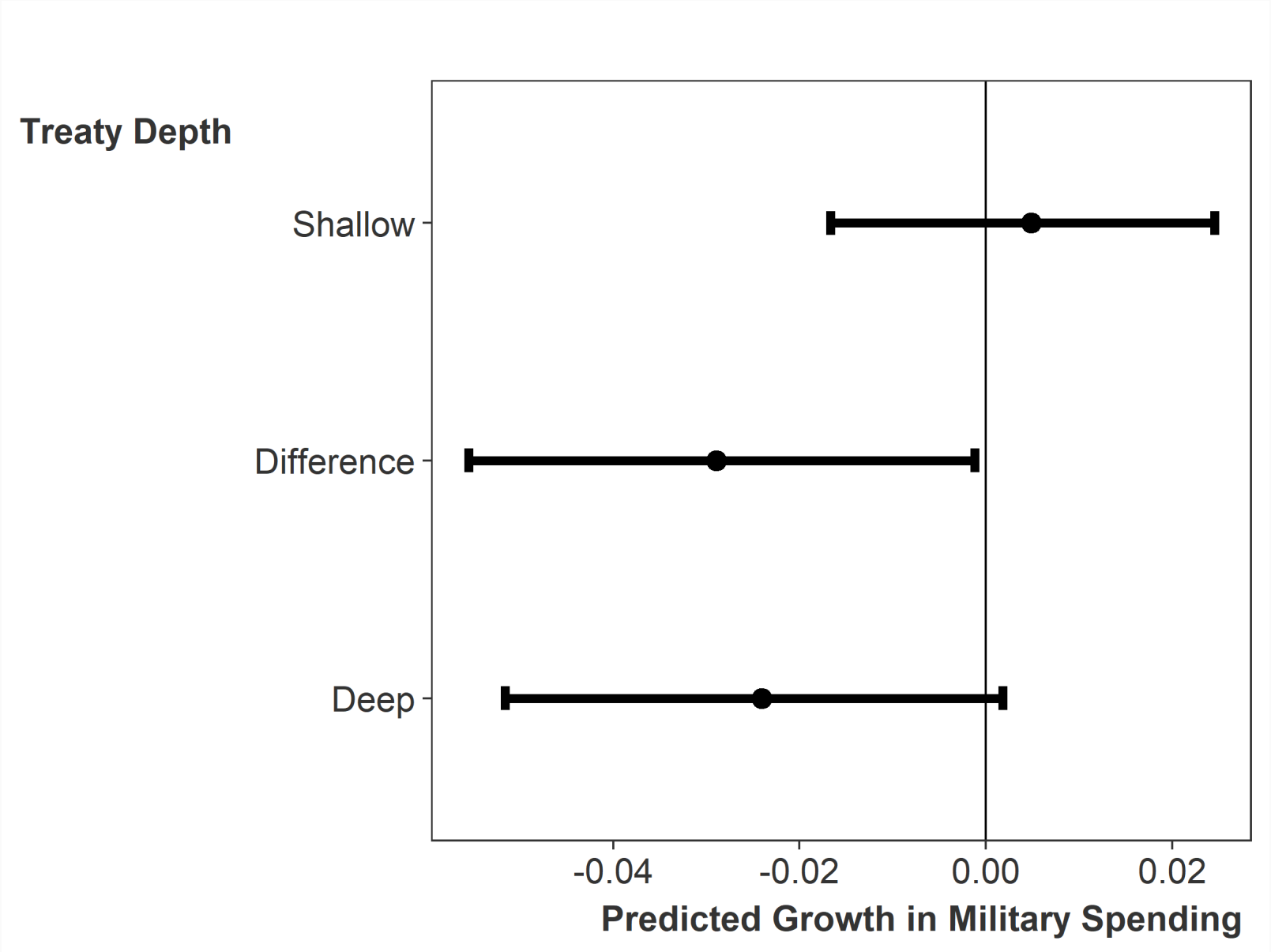
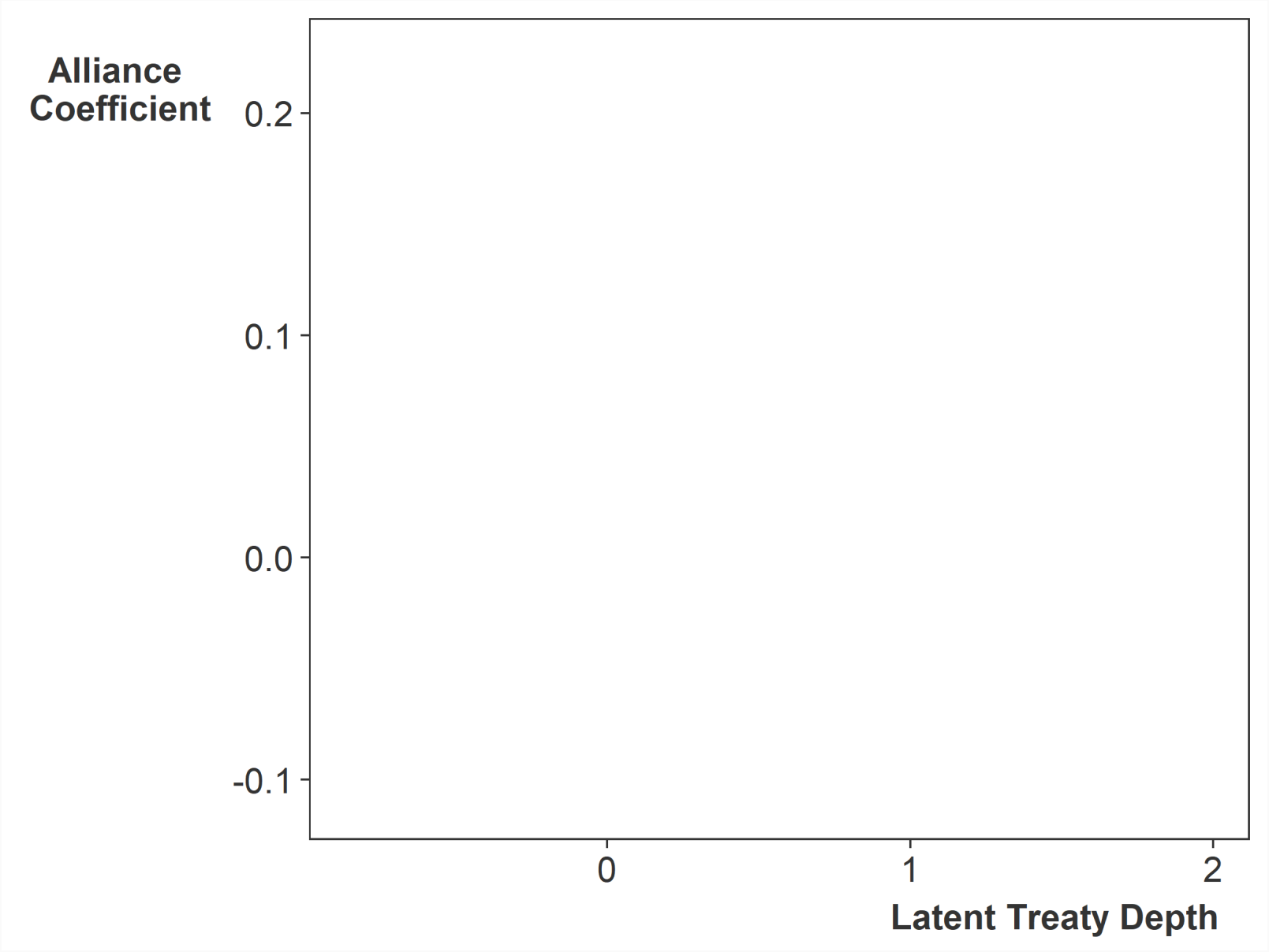
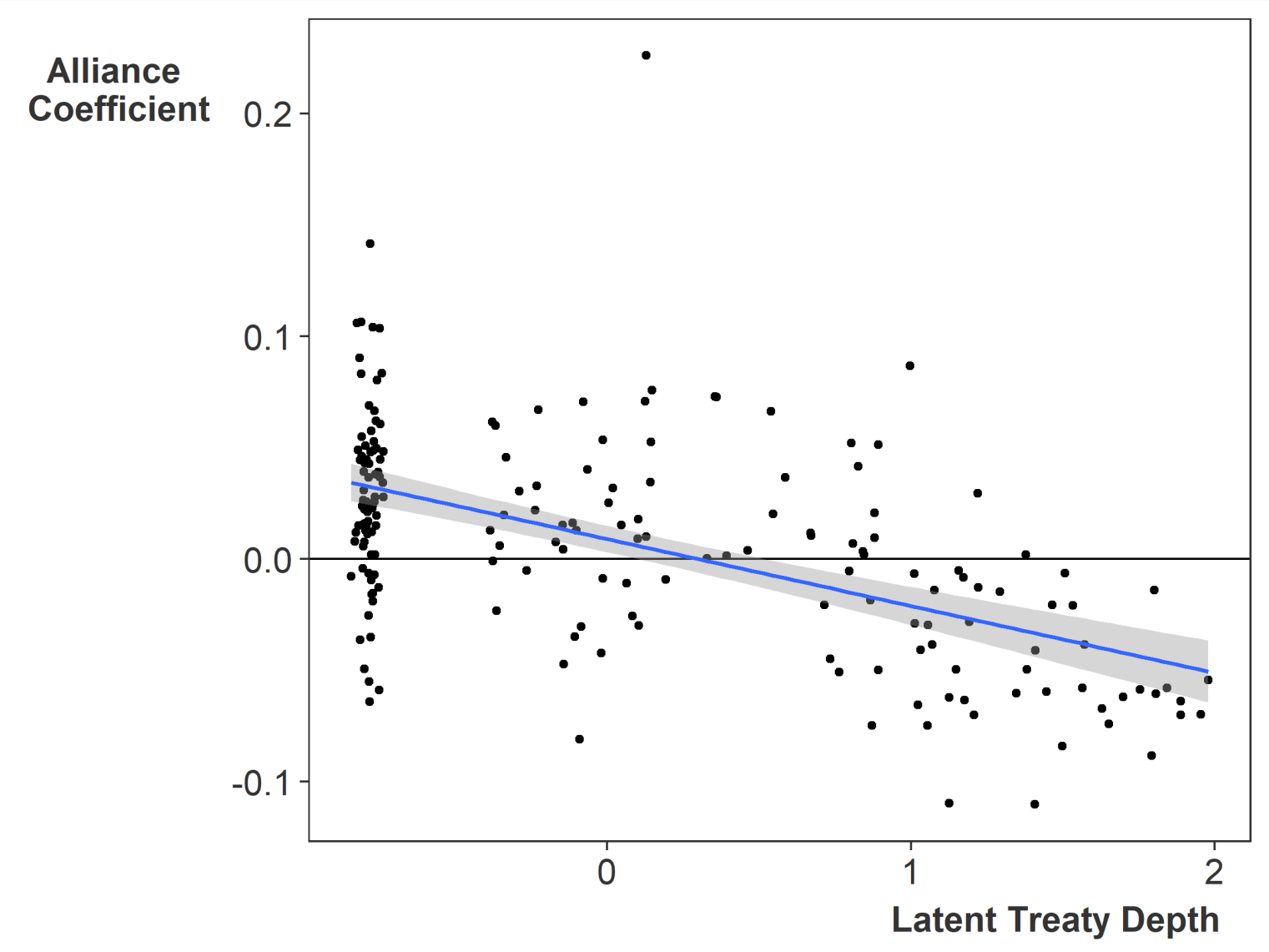


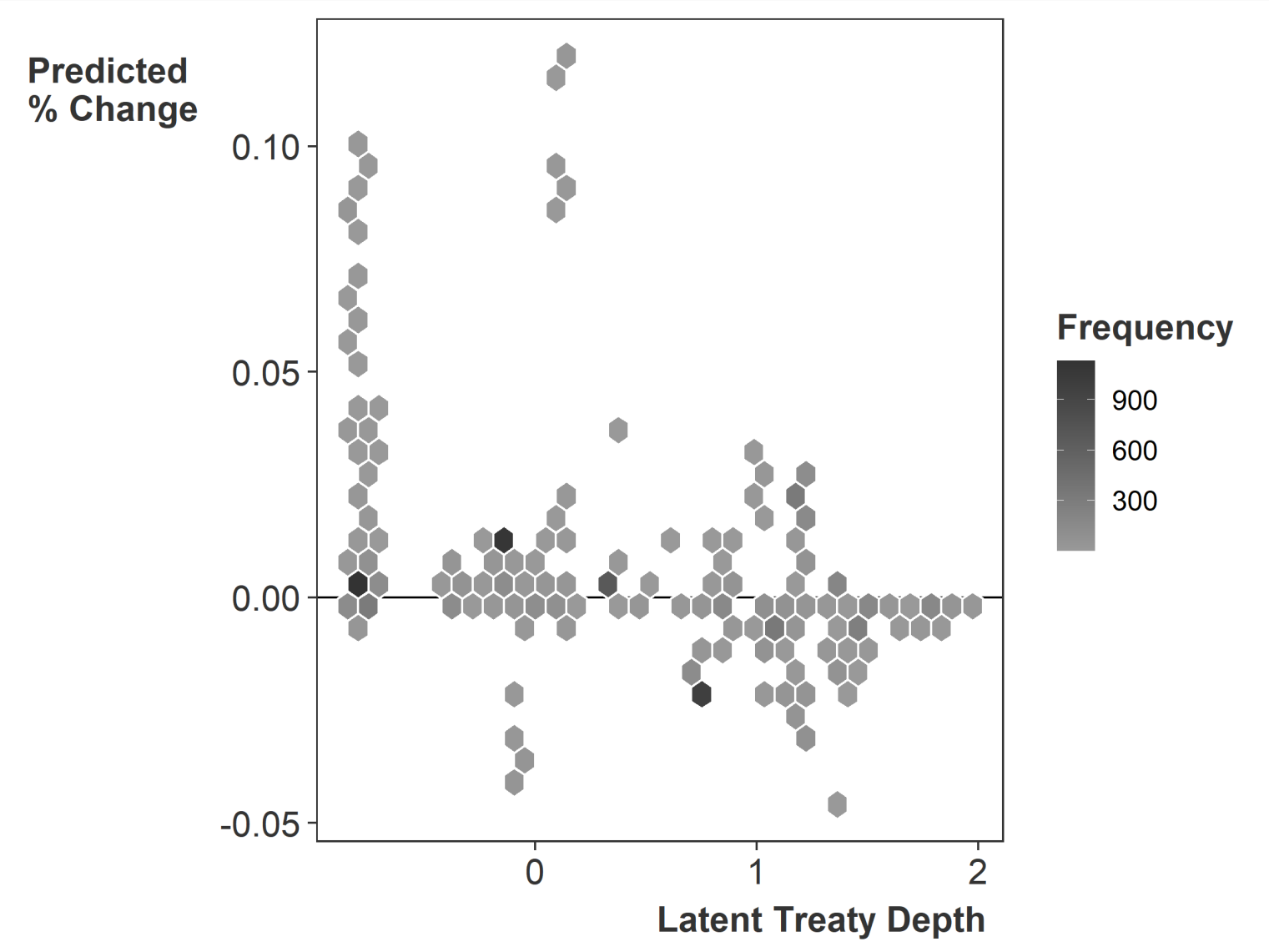
How Treaty Depth Modifies Alliance Coefficients



Treaty Depth and Alliance Coefficients



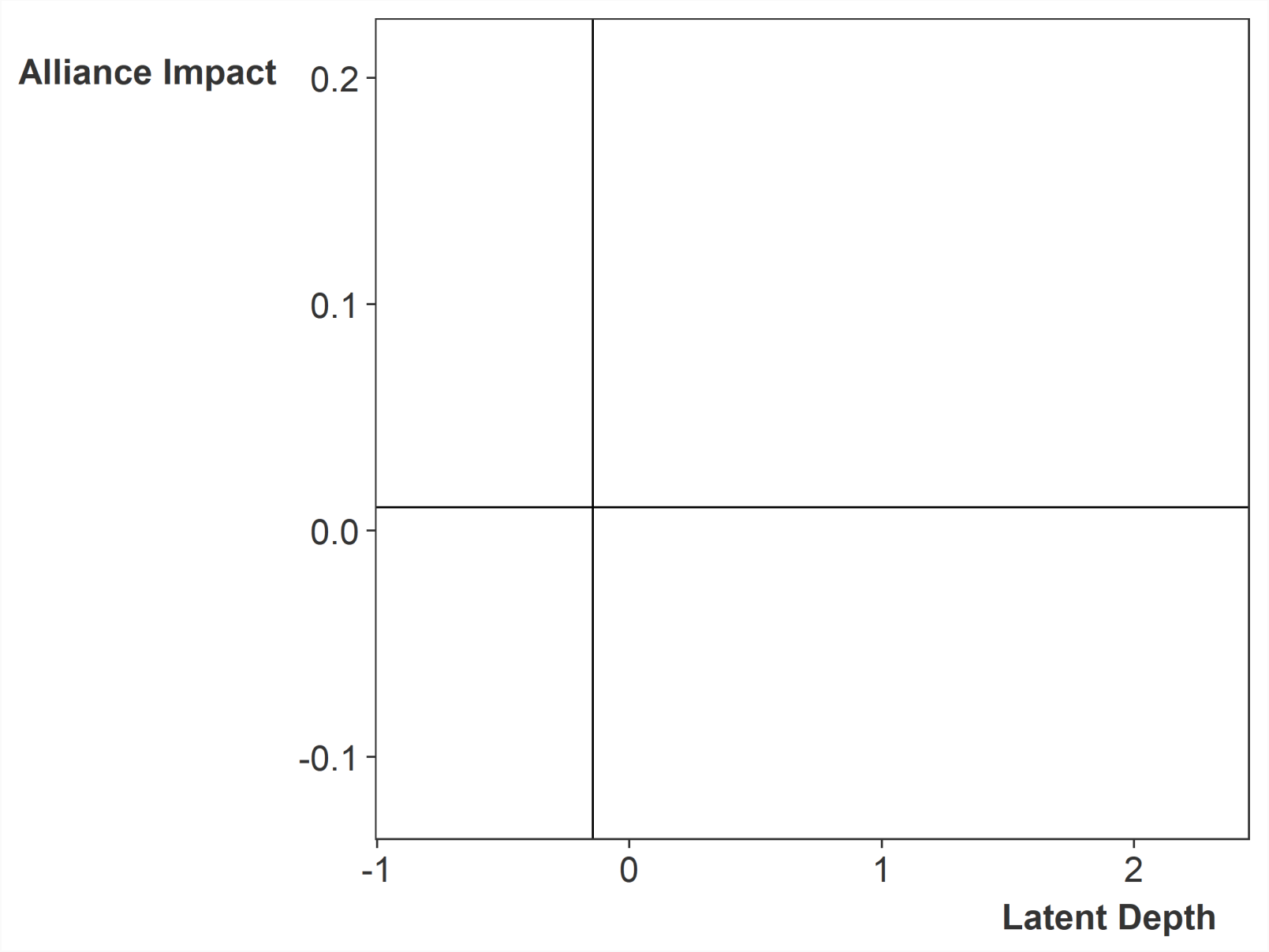
Predicted Military Spending Changes



US Alliances

Reassurance

US Alliances in Context



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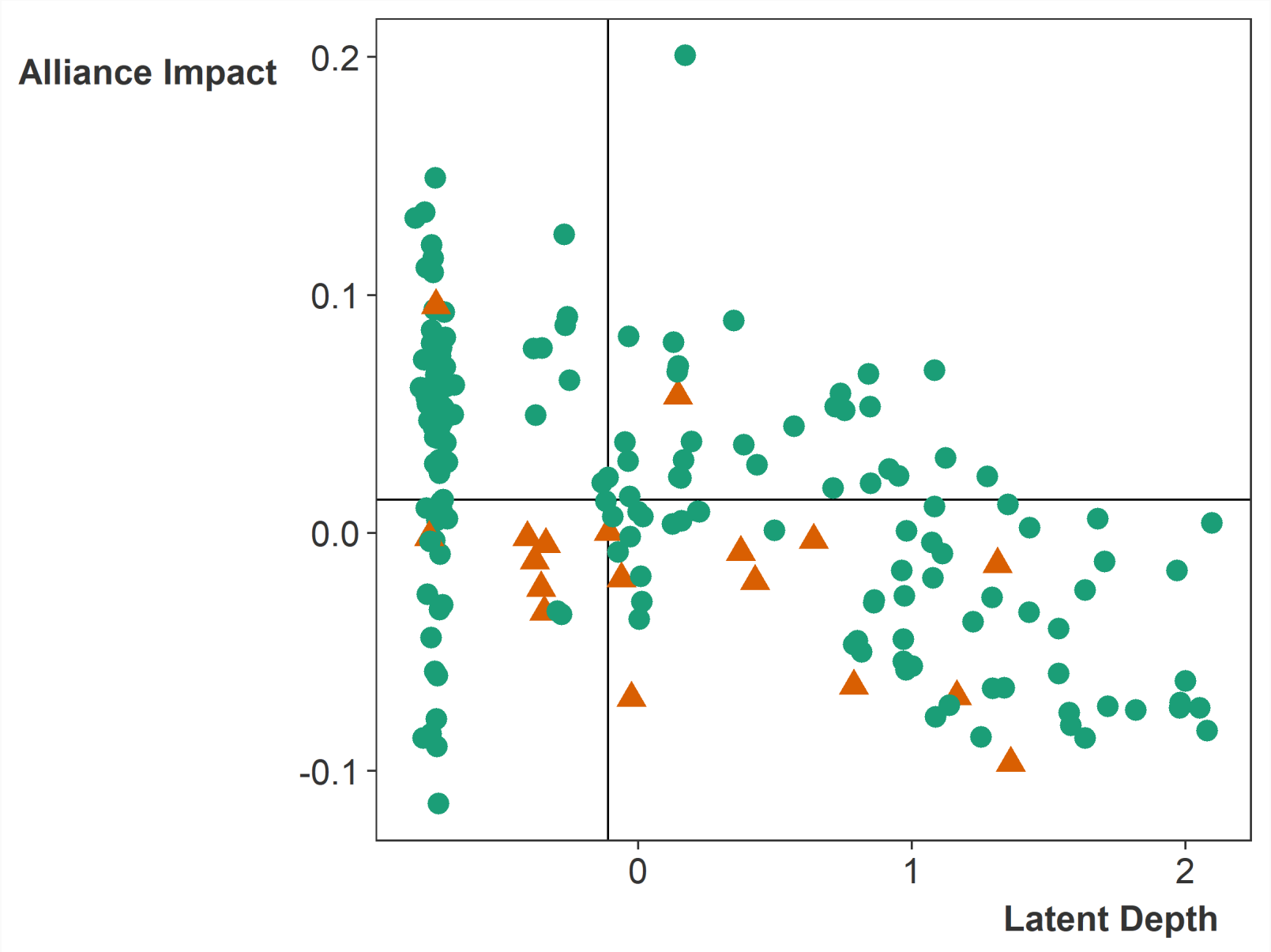
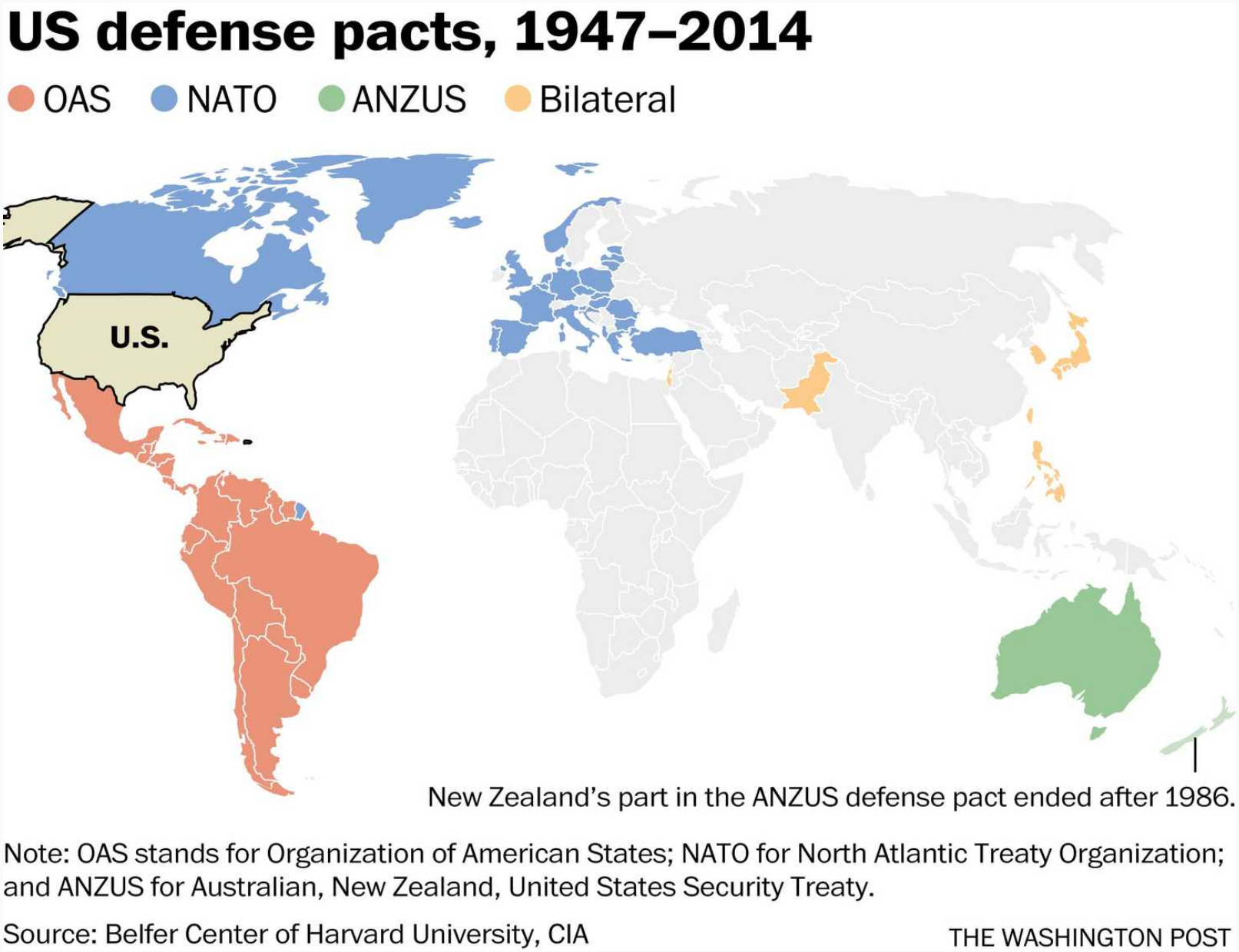


Implication: What to do with US alliances?



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 non-major power military spending in alliance treaty design.

Looking Ahead

My Research Agenda: Political Economy of Security

International Security

1. Alliance Participation and Military Spending
2. Democracy, Electoral Competition and Alliance Treaty Depth
3. Collective Action or Exchange?: Framing Cooperation in International Alliances
4. Reassessing the Public Goods Theory of Alliances

Intra-State Conflict

1. Post-Civil War Conflict Management Institutions and FDI
2. U.S. Foreign Terrorist Organization (FTO) List and Terrorist Attacks
3. International Engagement and Rebel Groups Commitment to International Law (*Forthcoming*)

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.

Sources of Alliance Treaty Depth

Democracy, specifically electoral competition, encourages deep alliances.

1. Depth adds credibility, but the costs are not very transparent.
2. Harder for opposition politicians to critique than unconditional support.

Leeds and Anac 2005 Performance Analysis

	Dependent variable:		
	Leeds and Anac		Berkemeier and Fuhrmann
	(1)	(2)	(3)
Military Institutionalization	−0.543		
	(−1.306, 0.221)		
Latent Depth		0.173	0.373
		(−0.583, 0.929)	(−0.384, 1.131)
Alliance Formality	−1.161	−1.512	
	(−2.082, −0.240)	(−2.466, −0.558)	
Capability Change	−1.841	−1.928	
	(−3.135, −0.547)	(−3.251, −0.604)	
Process Change	−1.802	−1.462	
	(−3.336, −0.269)	(−2.886, −0.039)	
Original Target	−0.723	−0.788	
	(−1.849, 0.403)	(−1.942, 0.366)	
Note:	95% Confidence Intervals in Parentheses. Controls in Model 3 ommitted.		

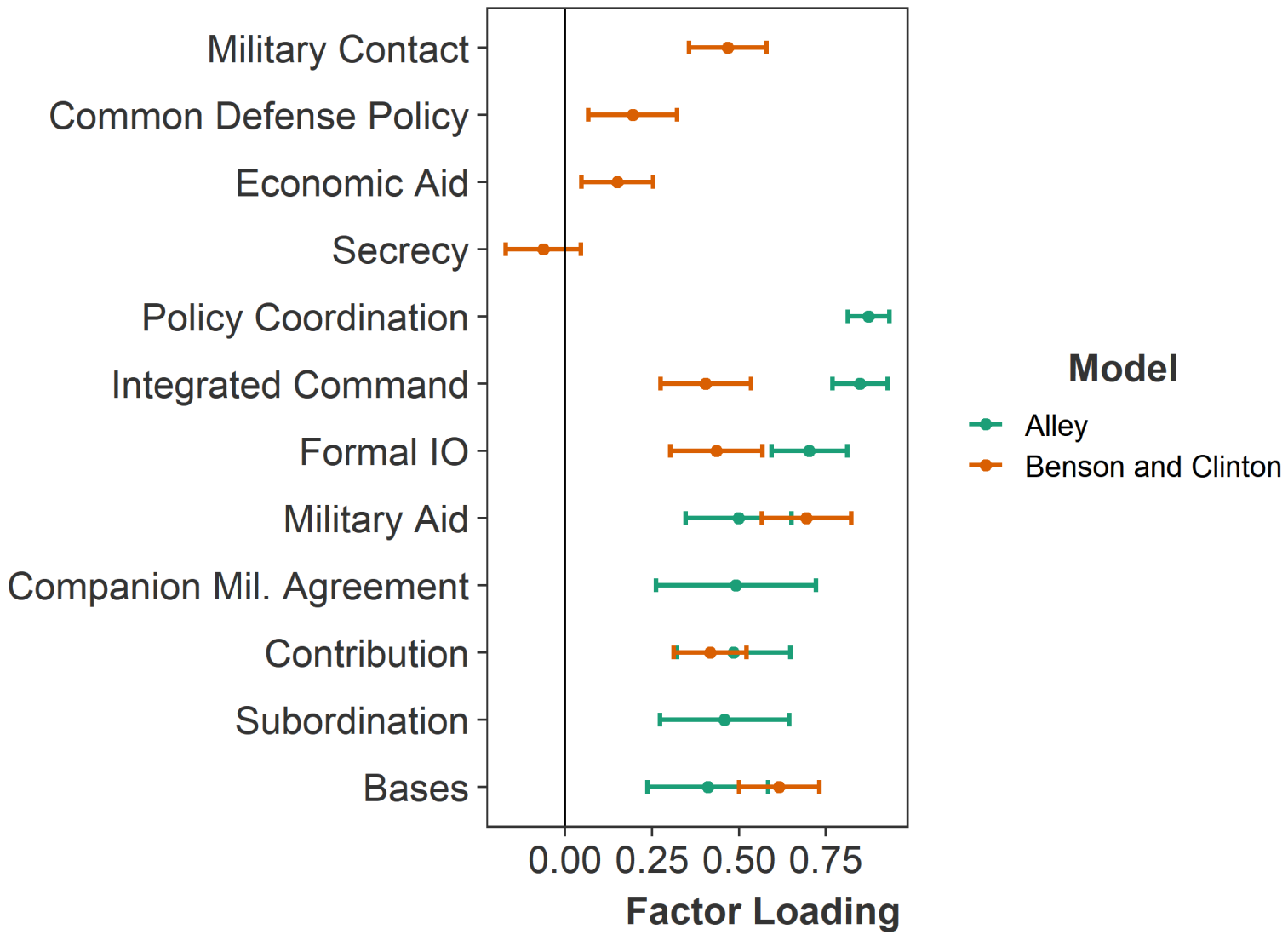
Details of Measurement Model

- 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.

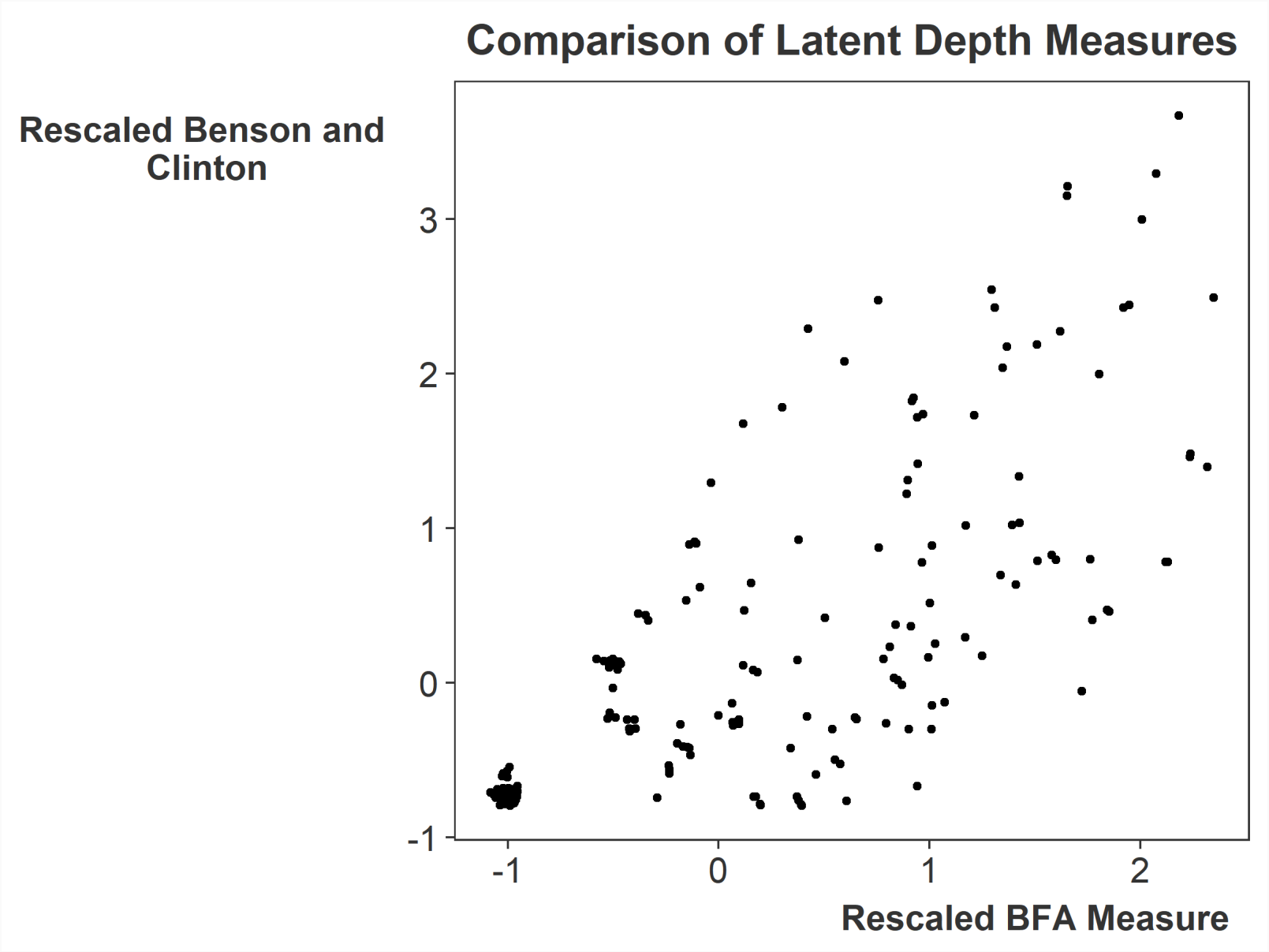
Alternative Measure: Benson and Clinton 2016

- Use a measurement model to infer alliance scope, depth and capability.
- Identify three separate dimensions, and use three models-explicit constraint.
- Their depth measure includes issue linkages.
- Murray et al's model relaxes distributional assumptions in their estimator (Quinn 2004 Factor Analysis).

Factors Comparison

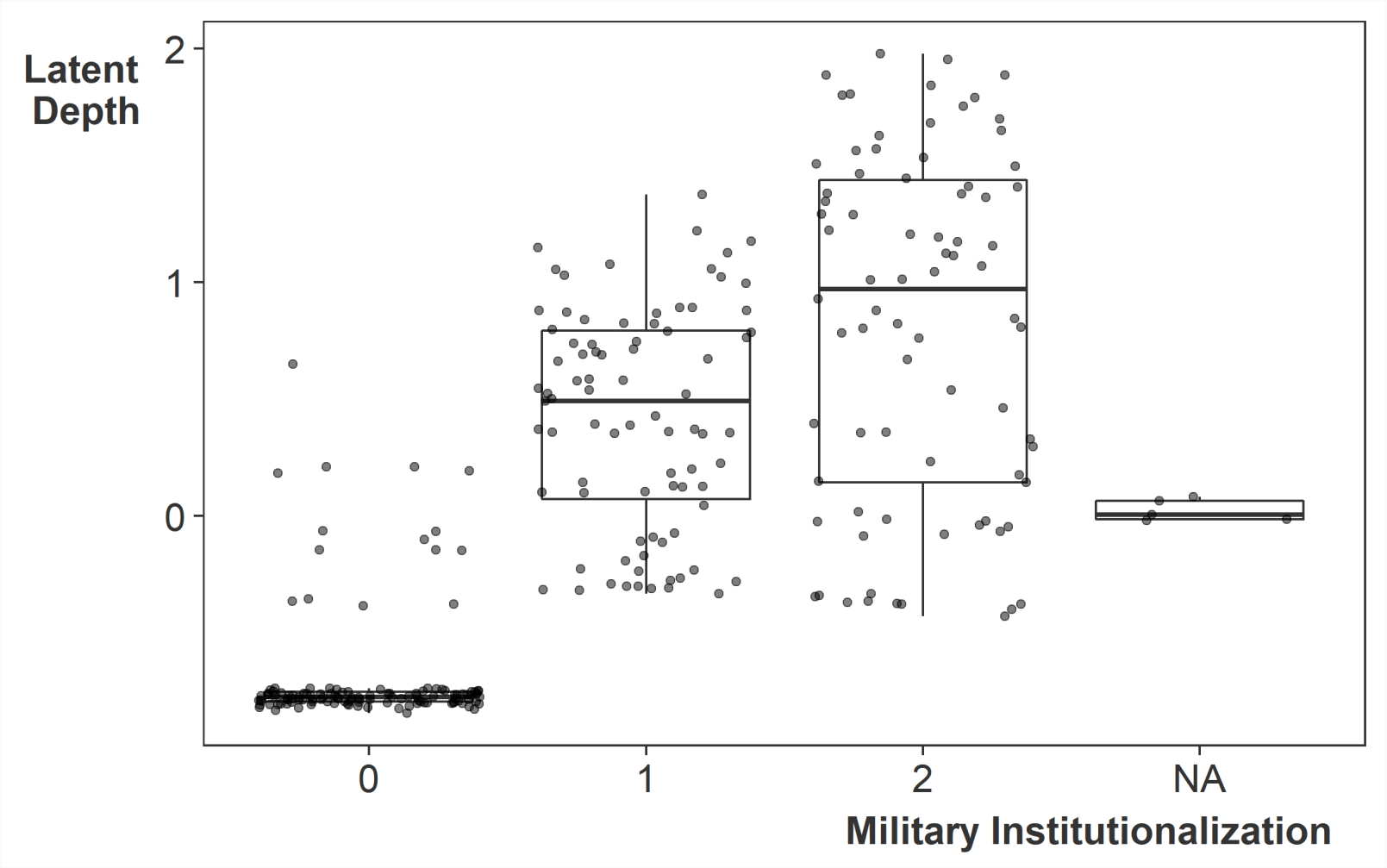


Latent Score Comparison

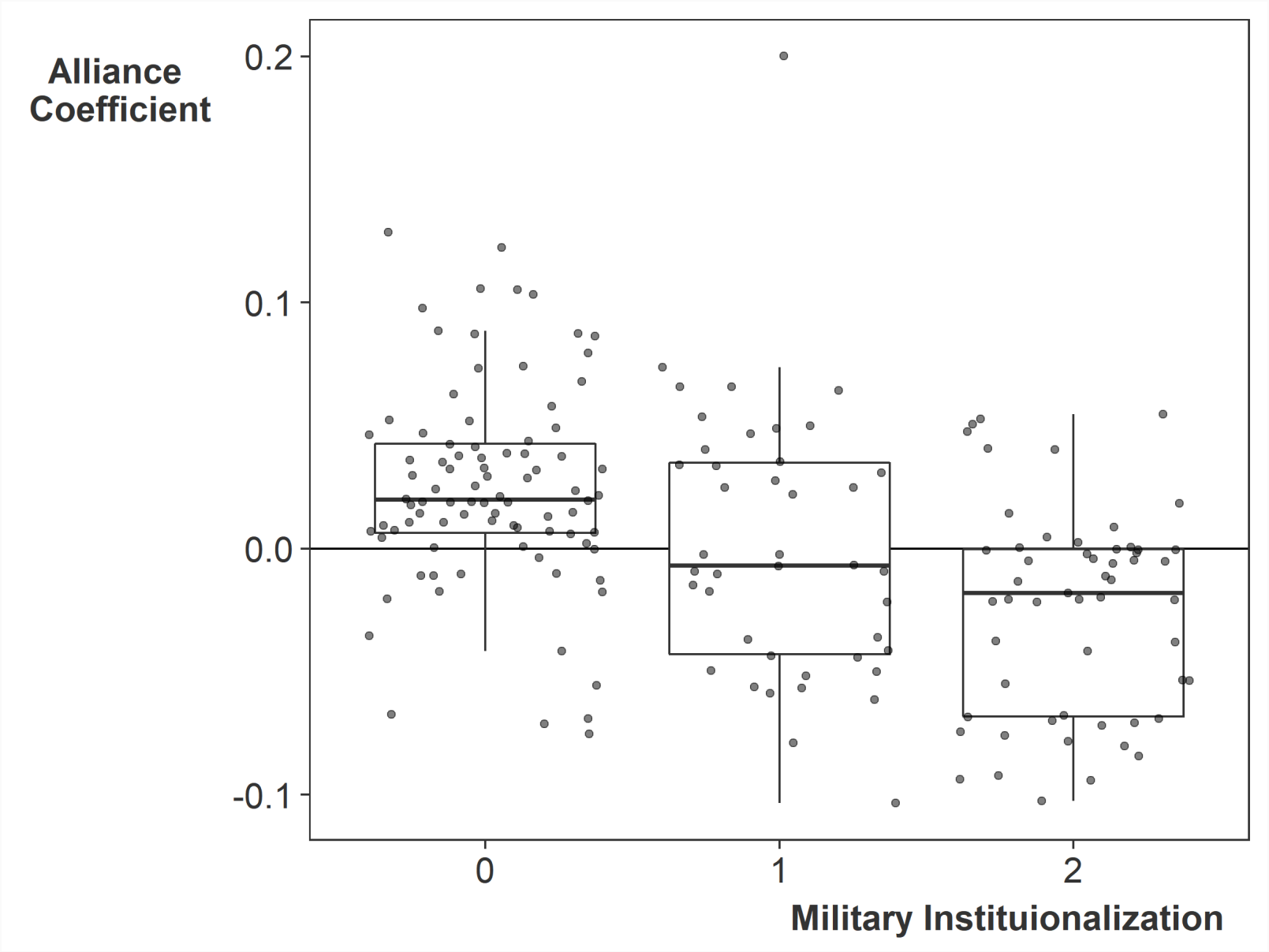


Alternative Measure #2: Leeds and Anac 2005

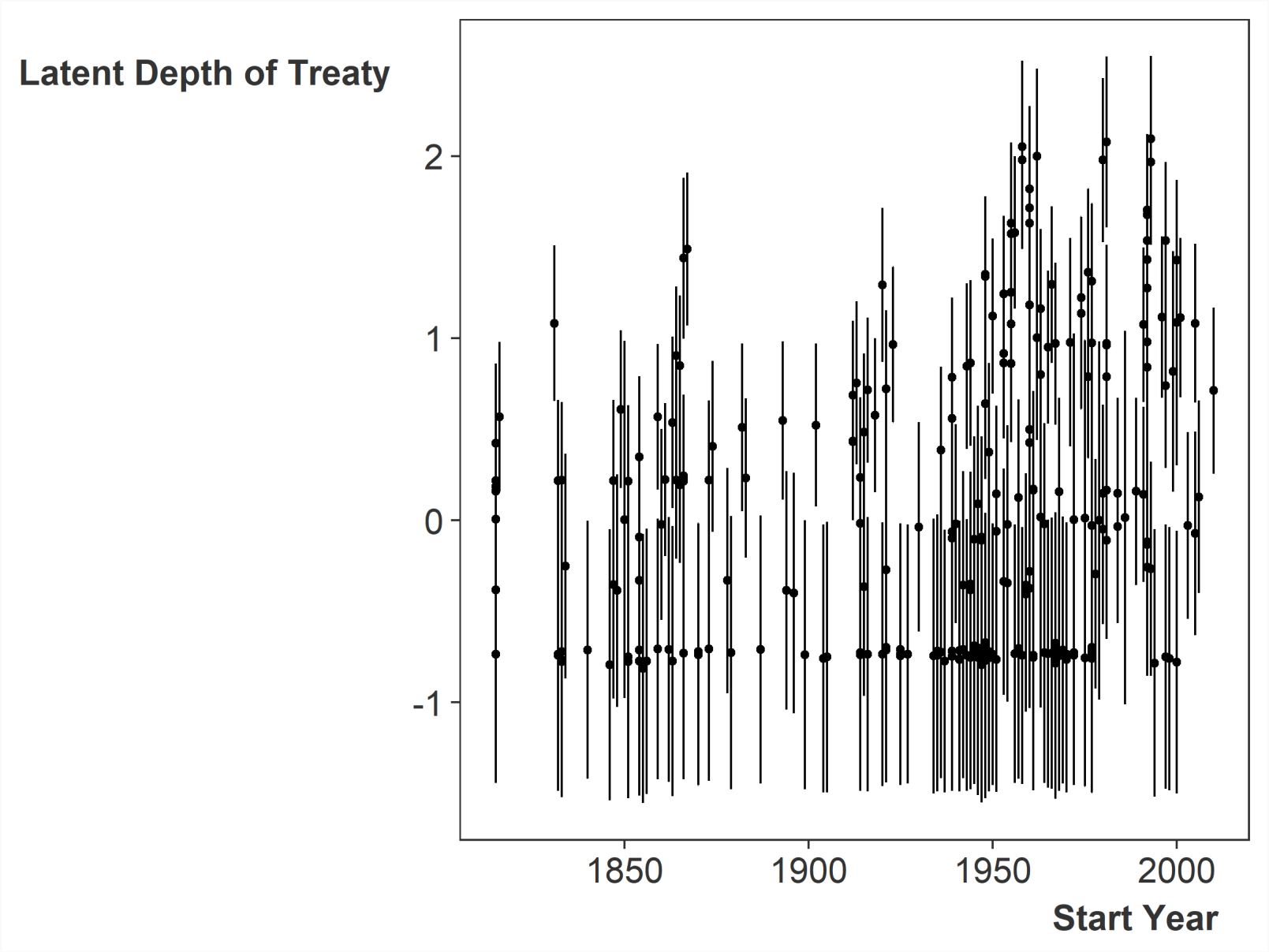
Ordinal measure of alliance institutionalization.



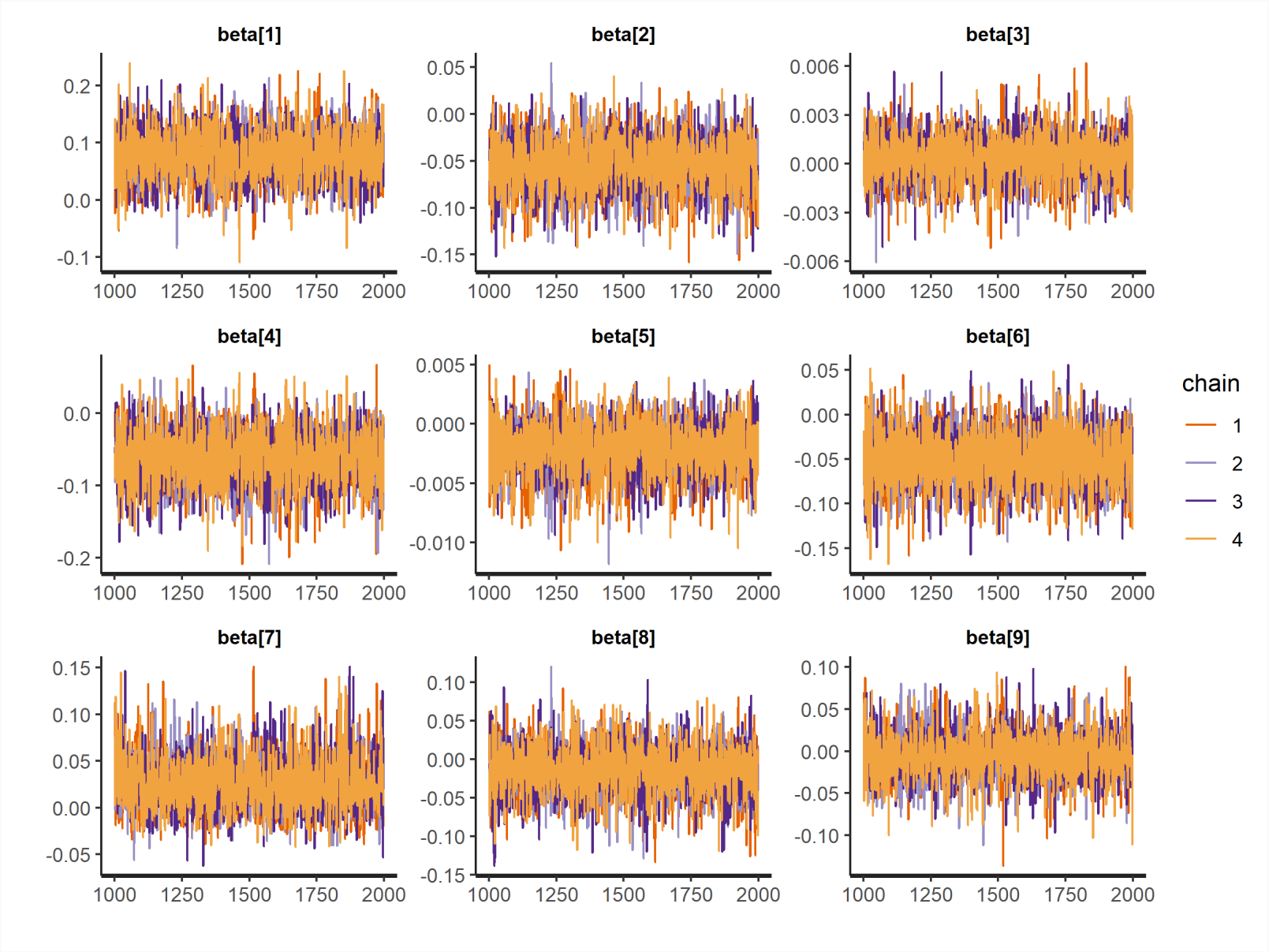
Leeds and Anac Ordinal Measure Results



Depth and First Year of the Alliance



Trace plots: Non-Major



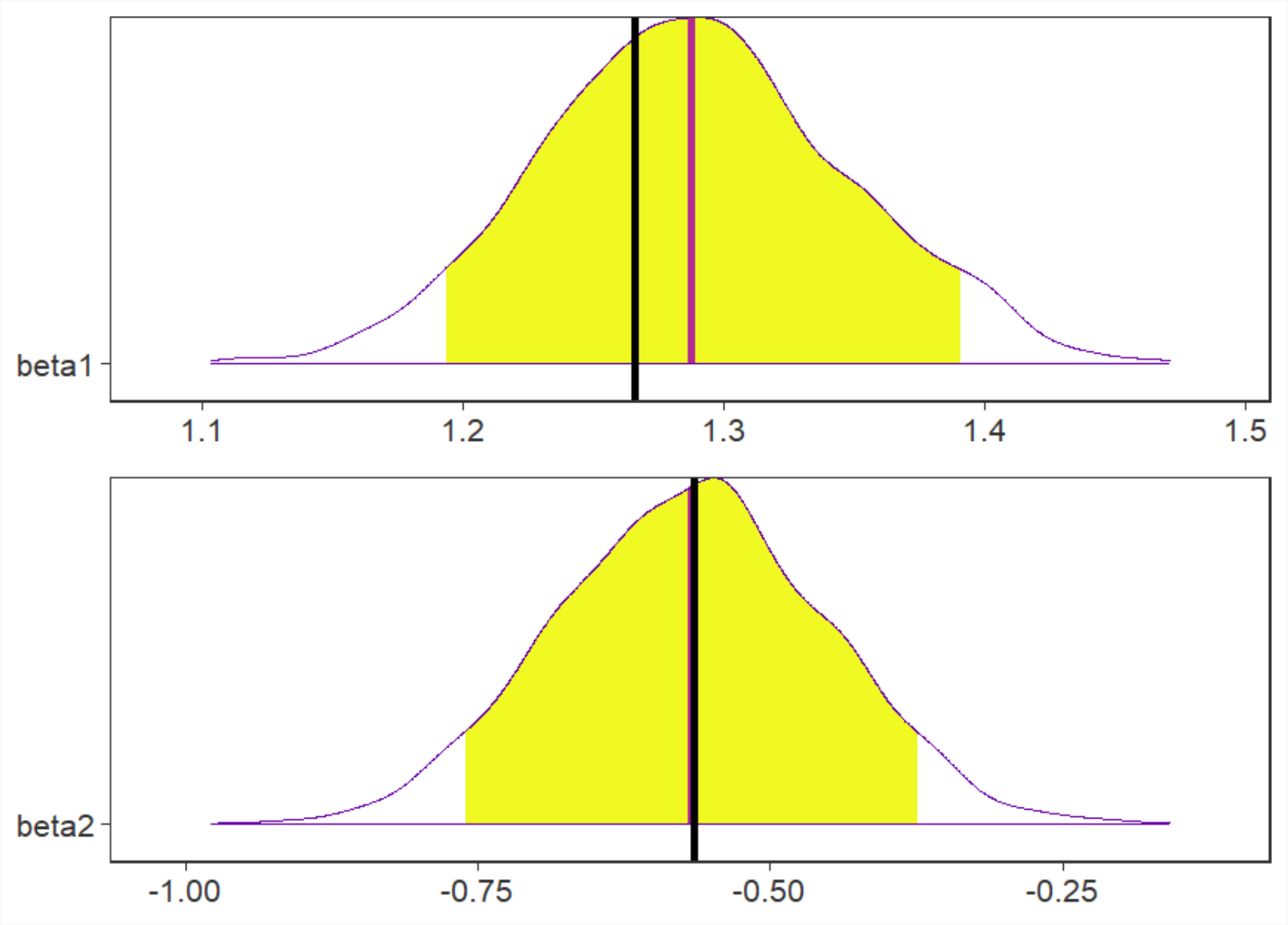
Model Check: Recovering Known Parameters

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.

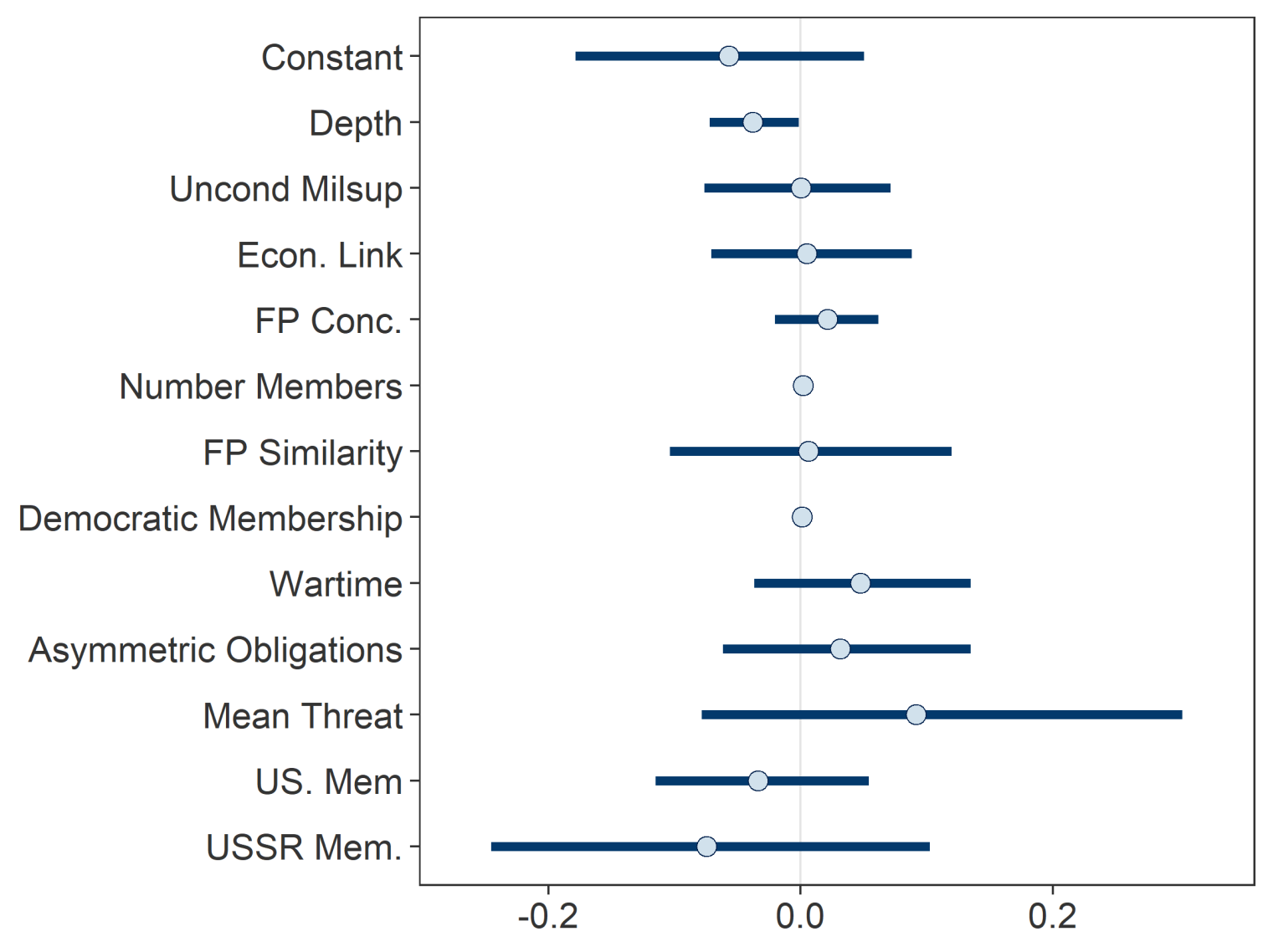
Simulated Parameters and Credible Intervals



Alliance-Level Regression Table: Non-Major Powers

	mean	sd	5%	95%	n_eff	$\hat{R}$
Constant	-0.025	0.049	-0.109	0.055	2332.133	1.000
Depth	-0.035	0.020	-0.068	-0.002	3566.248	1.000
Uncond Milsup	-0.020	0.038	-0.084	0.041	3369.350	1.001
Econ. Link	0.018	0.041	-0.047	0.084	2597.771	1.002
FP Conc.	0.030	0.021	-0.005	0.063	3251.107	1.000
Number Members	0.001	0.002	-0.001	0.004	4309.891	1.001
FP Similarity	0.017	0.058	-0.078	0.111	2523.621	1.000
Democratic Membership	-0.001	0.004	-0.007	0.005	2843.301	1.002
Wartime	0.047	0.048	-0.030	0.125	3921.848	1.002
Asymmetric	0.039	0.055	-0.048	0.130	3165.178	1.001
US. Mem	-0.044	0.043	-0.110	0.027	2603.217	1.000
USSR Mem.	-0.129	0.091	-0.276	0.021	2826.512	1.001
σ Alliances	0.118	0.050	0.037	0.203	746.918	1.004

Treaty Depth and Other Alliance Characteristics



Priors

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

$$p(\alpha) \sim N(0, 1)$$
$$p(\sigma) \sim \text{half-}N(0, 1)$$
$$p(\alpha^{yr}) \sim N(0, \sigma^{yr})$$
$$p(\sigma^{yr}) \sim N(0, 1)$$
$$p(\alpha^{st}) \sim N(0, \sigma^{st})$$
$$p(\sigma^{st}) \sim \text{half-}N(0, .5)$$
$$p(\sigma^{all}) \sim \text{half-}N(0, .5)$$
$$p(\beta) \sim N(0, .5)$$
$$p(\gamma) \sim N(0, .5)$$
$$p(\nu) \sim gamma(2, 0.1)$$

ML Model Specification

$$y \sim \mathit{student}_t(\nu, \mu, \sigma) \tag{1}$$

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

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

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

Example

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

Example year: Argentina 1955

$$\begin{aligned}
&\text{1955 \% Change Milex.} = \text{Overall mean} \\
&+ \text{Argentine Intercept} + \text{1955 Intercept} \\
&+ \text{Argentine Characteristics} \\
&+ \lambda_{OAS} * \text{OAS Expenditure} + \lambda_{Rio} * \text{Rio Pact Expenditure}
\end{aligned}$$

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

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
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+ $\lambda_{OAS} *$ OAS Expenditure + $\lambda_{Rio} *$ Rio Pact Expenditure

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Example year: Argentina 1955

1955 % Change Milex. = Overall mean

$+$ Argentine Intercept $+$ 1955 Intercept

$+$ Argentine Characteristics

$+ \lambda_{OAS} *$ OAS Expenditure $+ \lambda_{Rio} *$ Rio Pact Expenditure

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Z

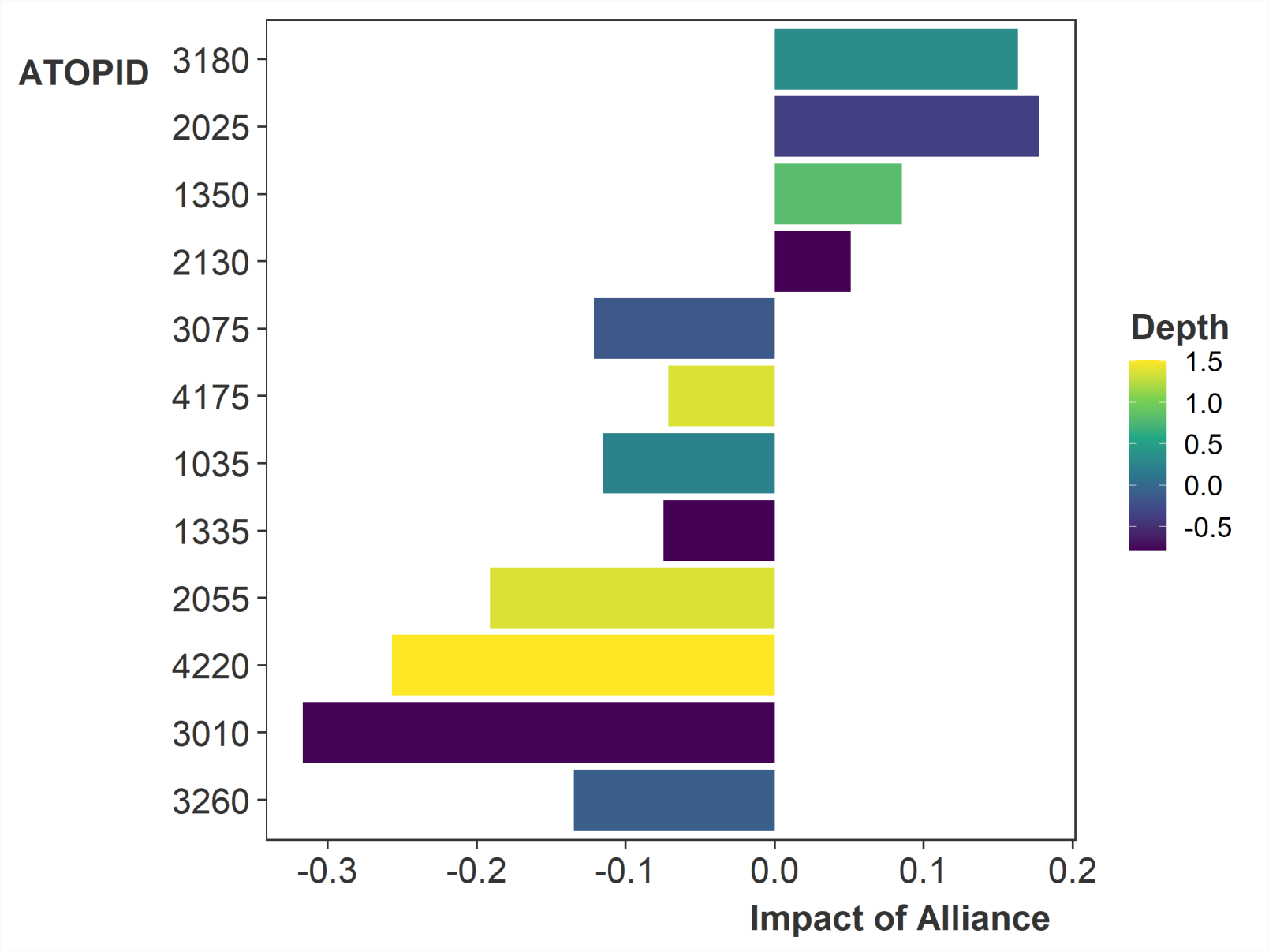
State-Year	Rio Pact	Warsaw Pact
Argentina 1954	.347	0
Argentina 1955	.418	0
⋮	⋮	⋮

Choice of Capability in Z

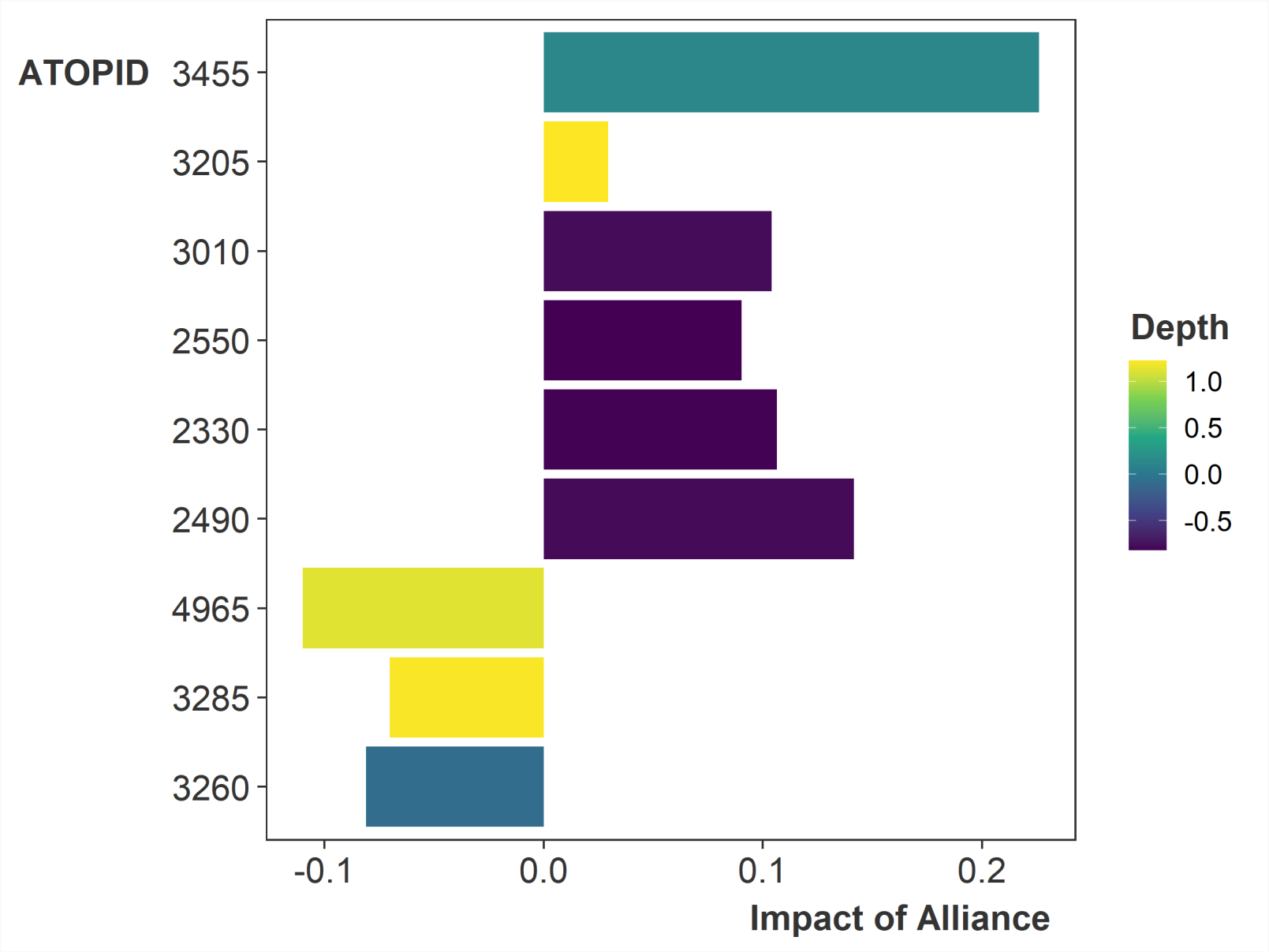
Used leave-one-out cross validation to assess model fit with different codings of **Z**.

Allied Capability	elpd_diff	se_diff	elpd_loo	se_elpd_loo
Normalized by Year	0.000	0.000	-1159.513	184.714
Rescaled by Maximum	-3.165	2.643	-1162.679	184.723
Recaled by 2SD	-10.749	6.116	-1170.262	184.741
Total Allied CINC	-12.308	5.576	-1171.821	184.683

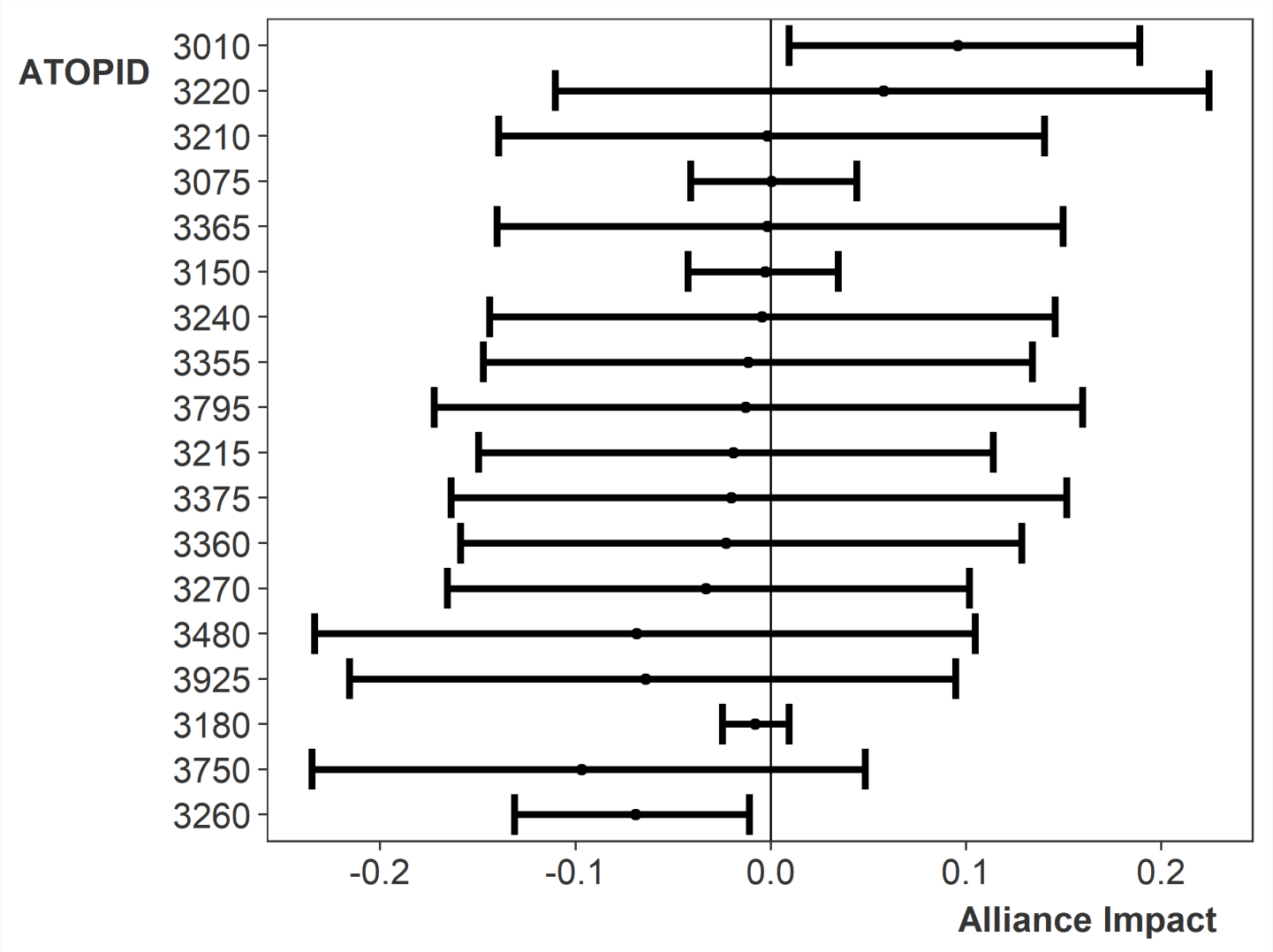
Notable Major Power Alliances



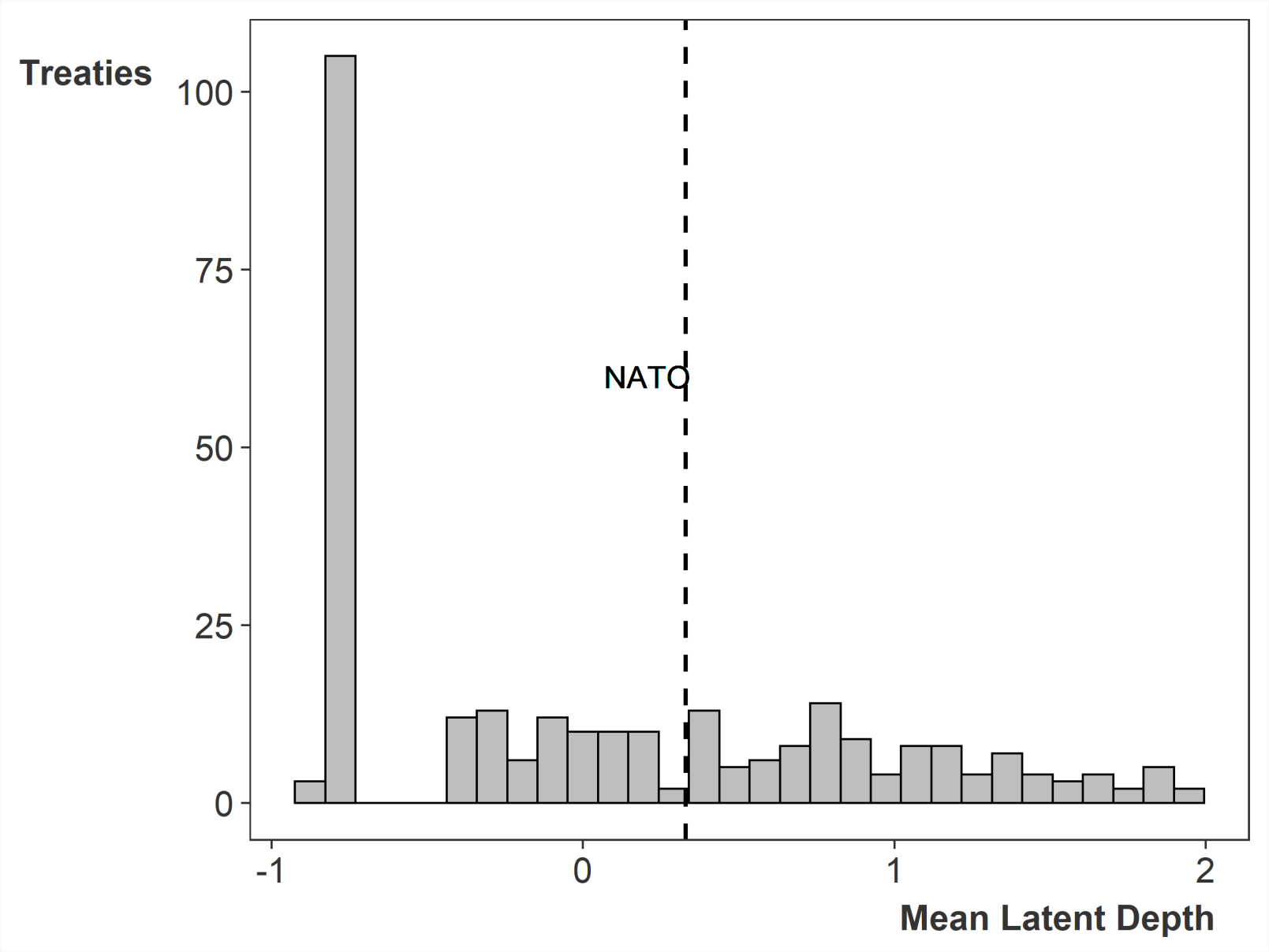
Notable Non-Major Power Alliances



Impact of US Alliance on Non-major Power Military Spending



NATO



Varying Slopes Model

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

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

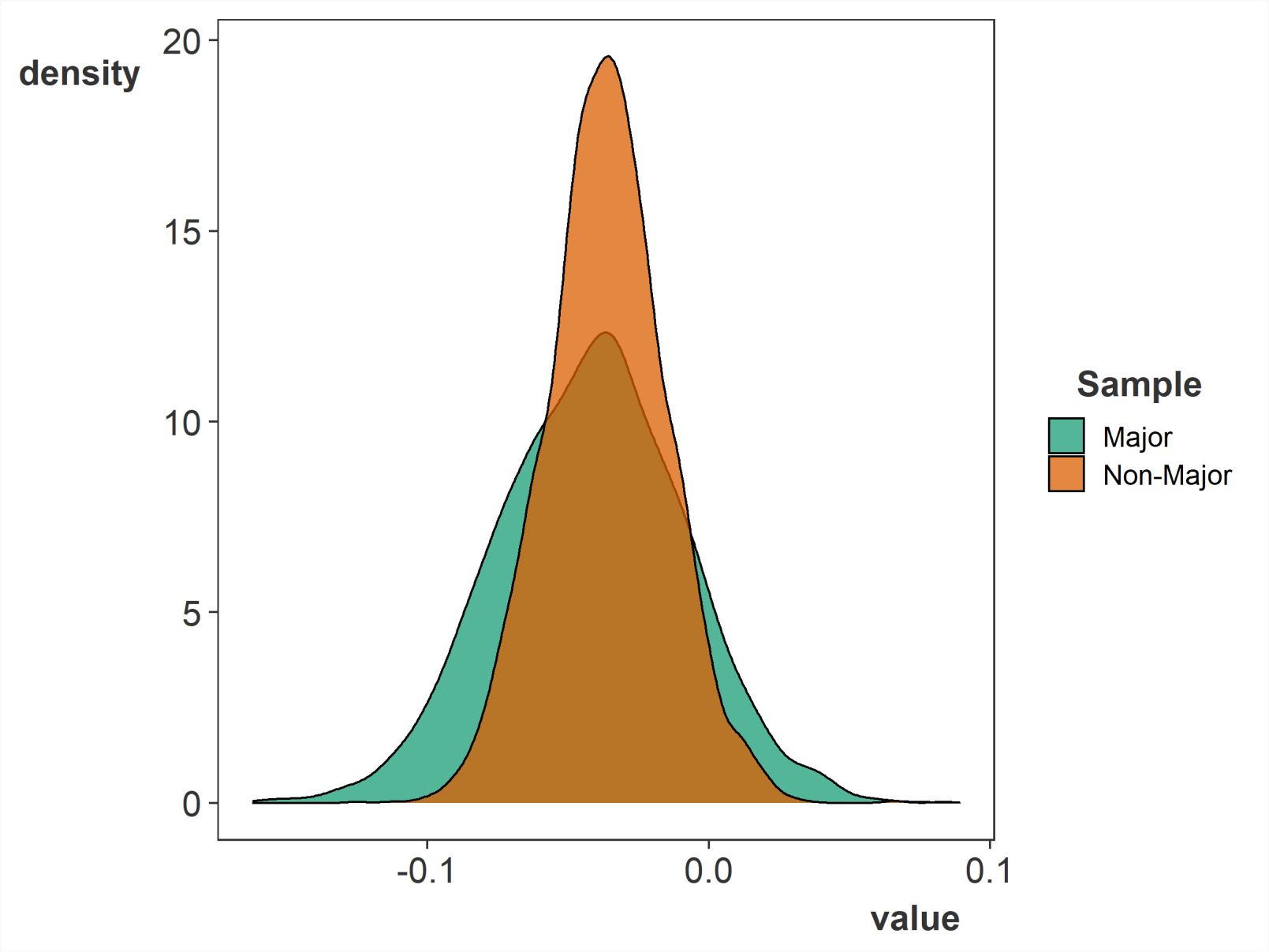
$$\lambda_j \sim N(\theta_j, \sigma_j^{all})$$

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

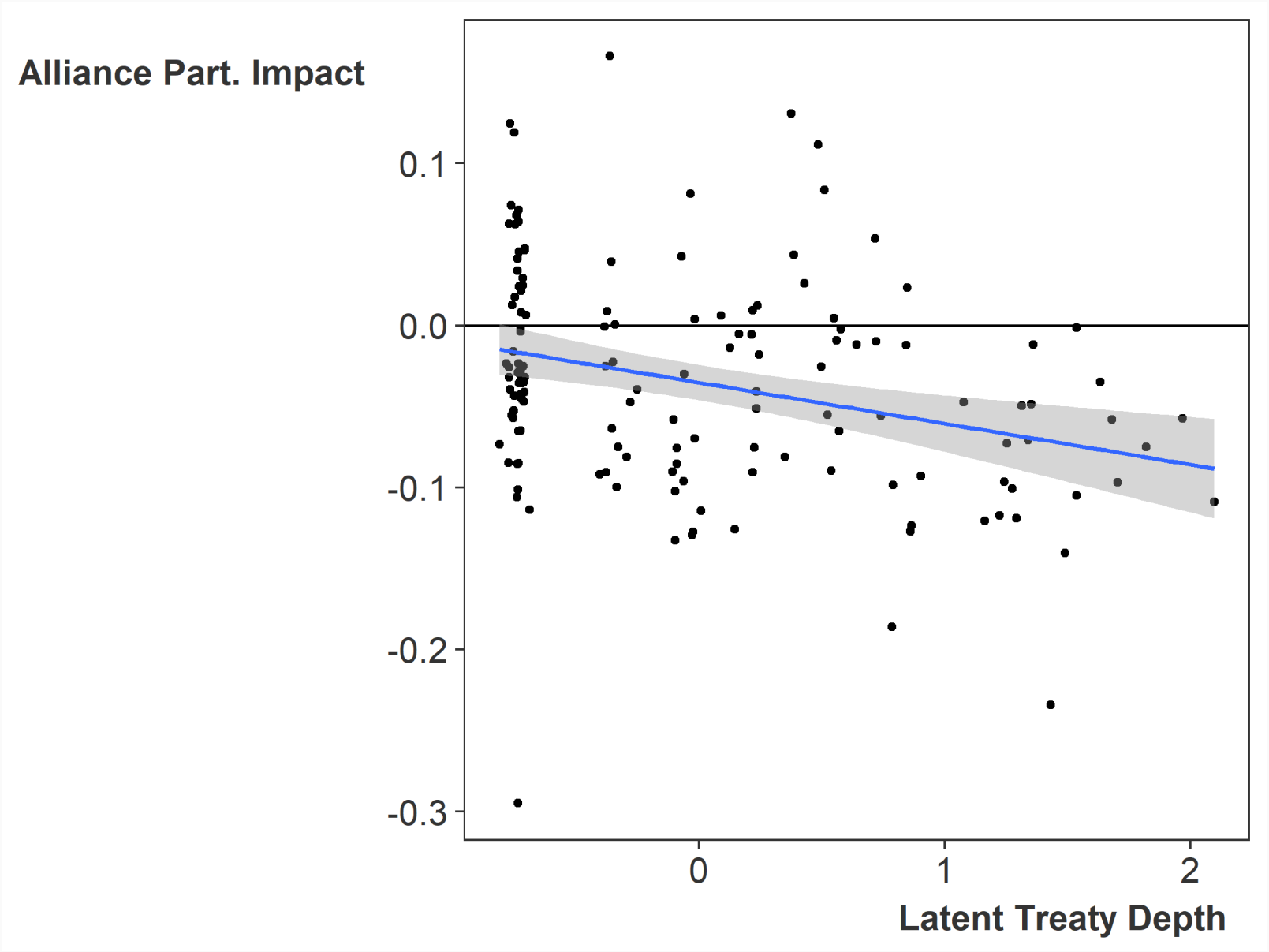
I give β_j a multivariate normal prior with prior scale τ:

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

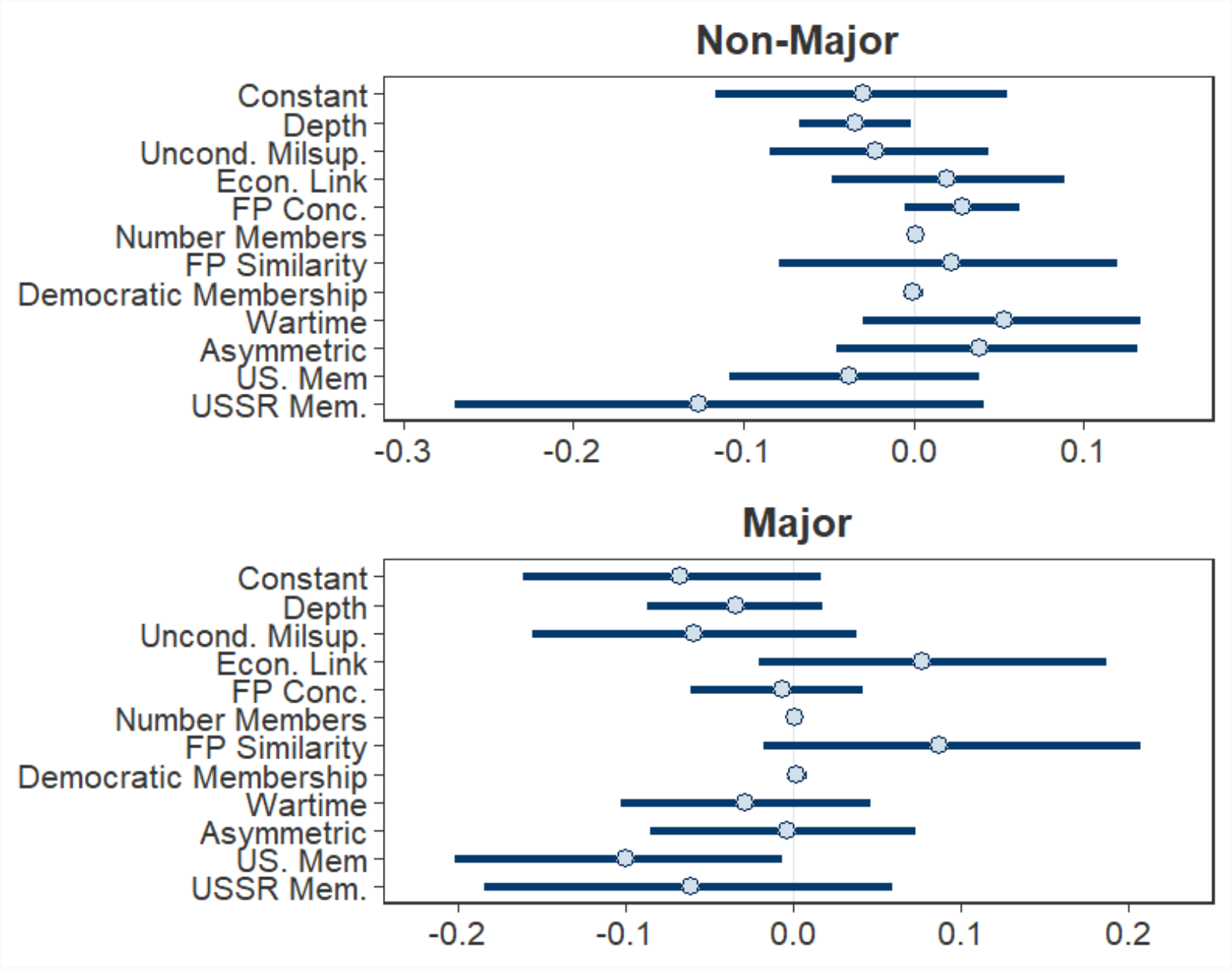
Varying Slopes Results: Depth



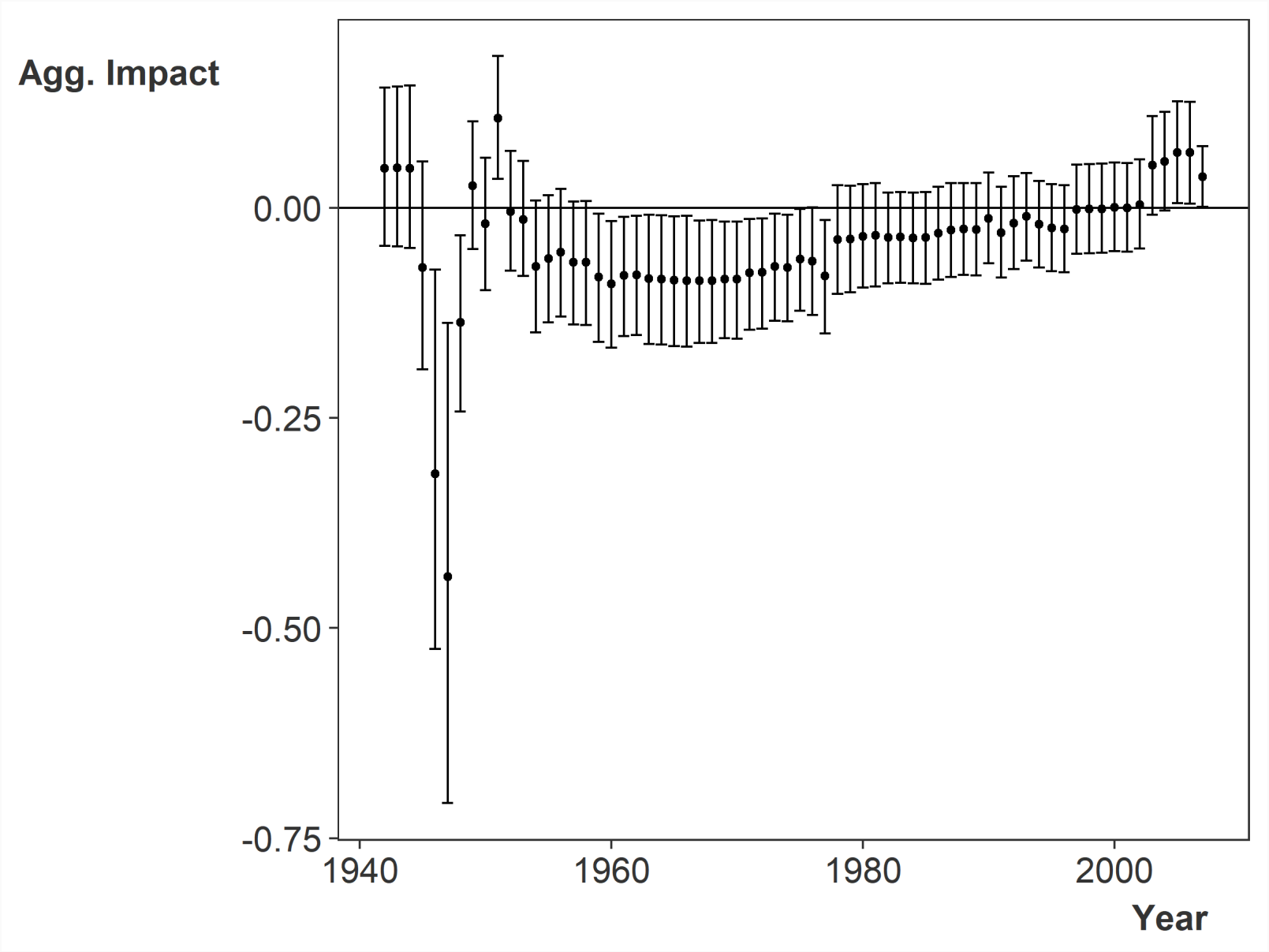
Treaty depth and λ: Major Powers



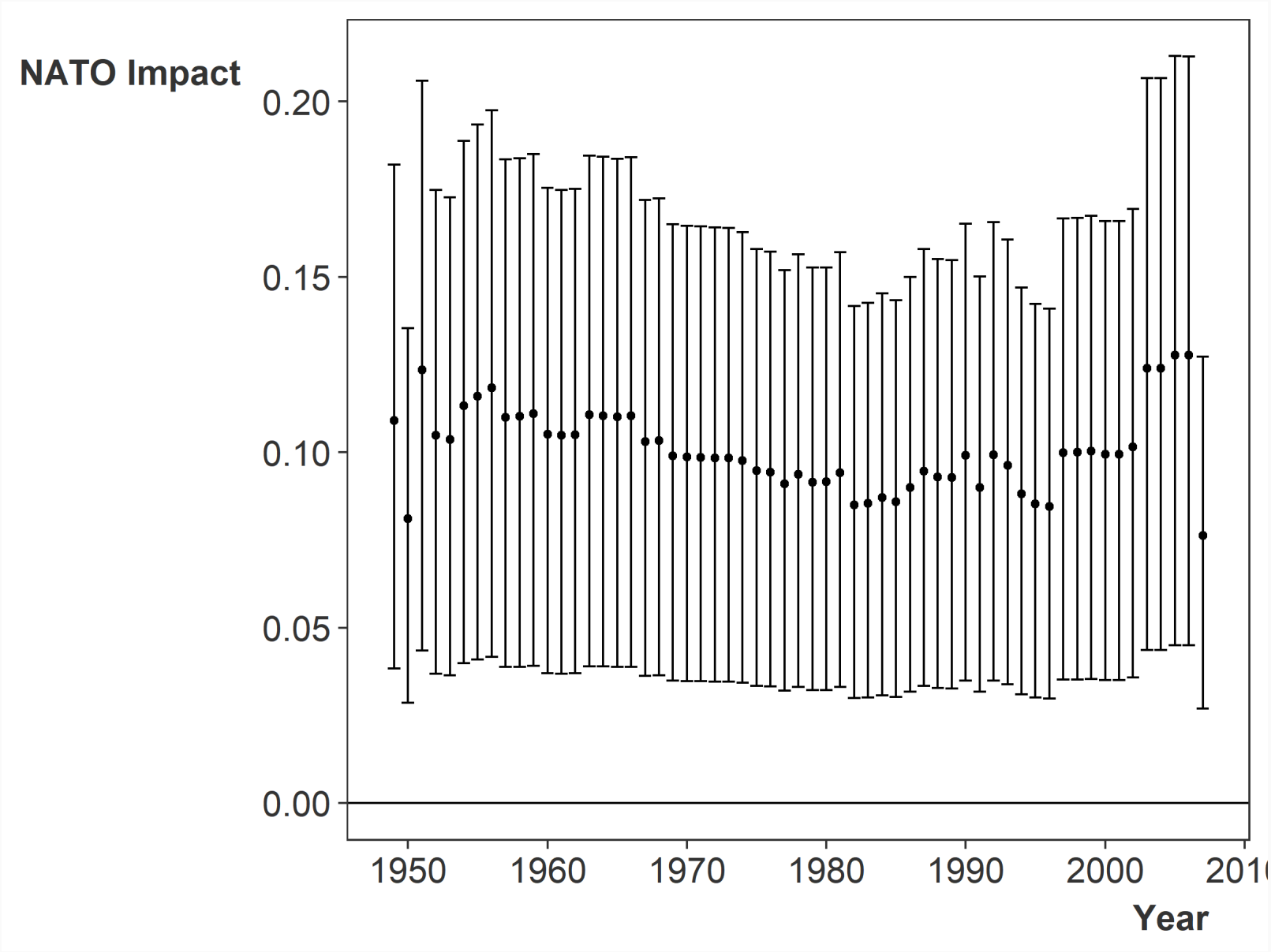
Full Varying Slopes Results



Impact of Alliances on US



Impact of NATO on US



Correlates of War Spending Data

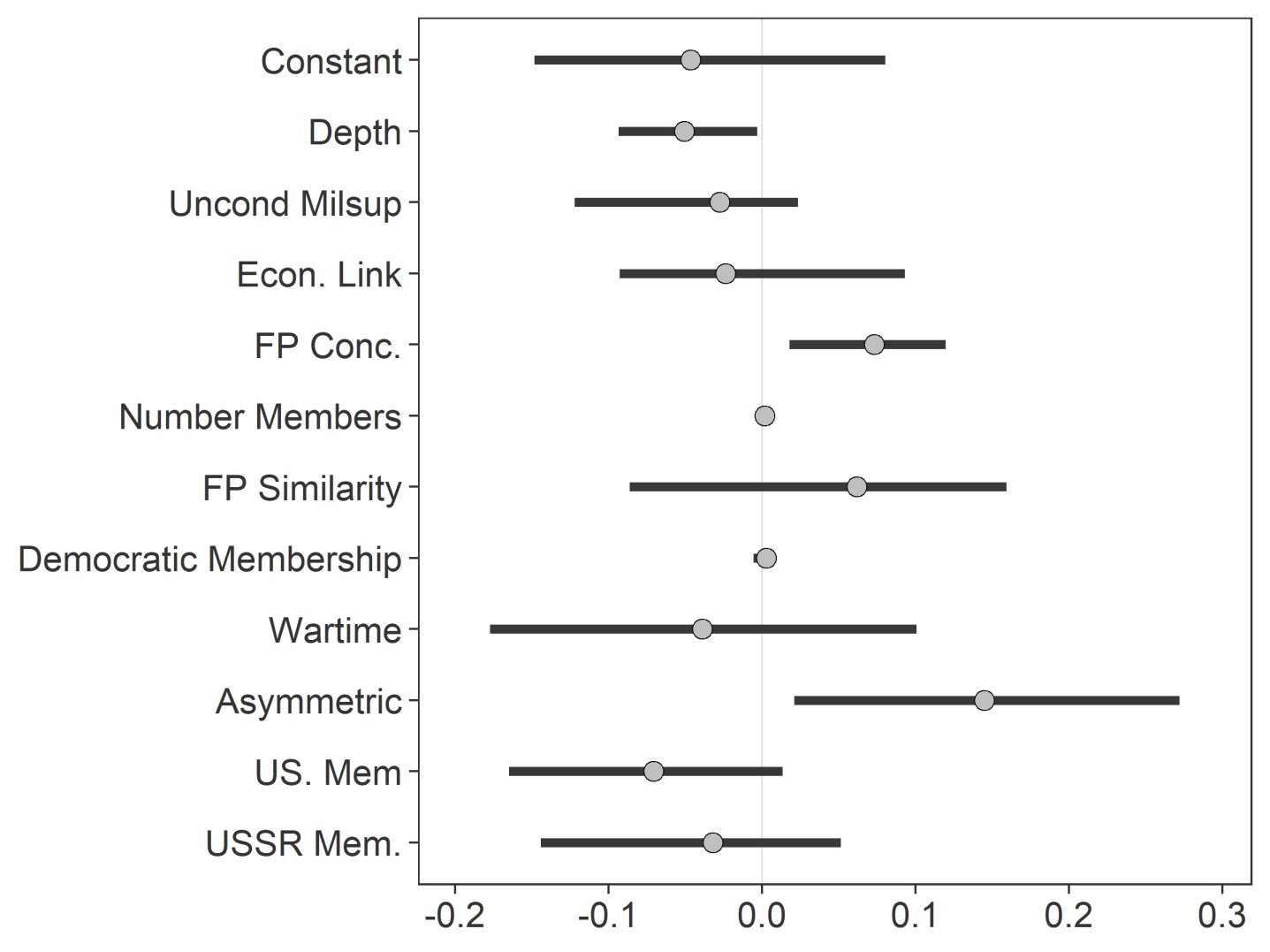
Is messy...

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

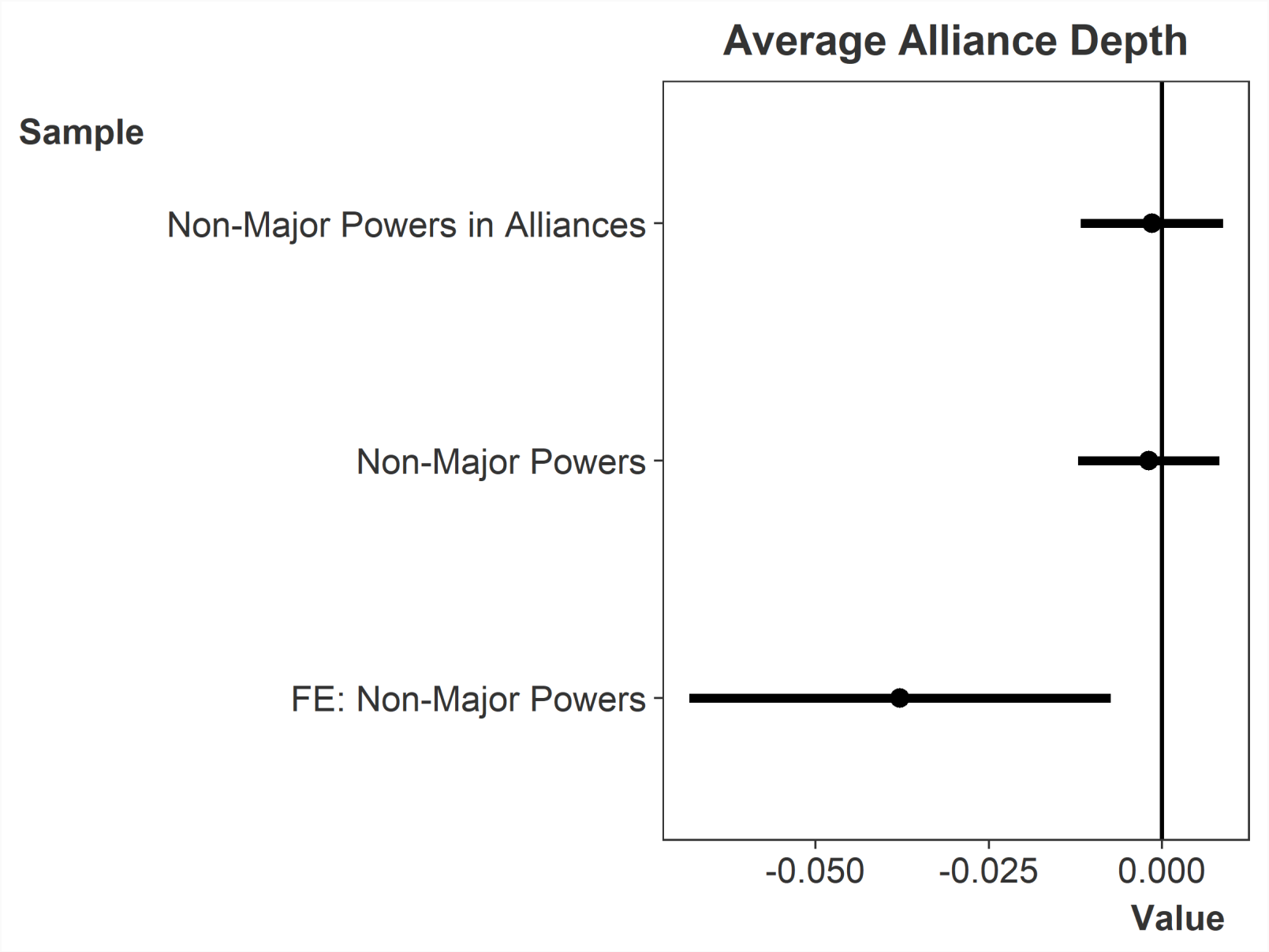
Alternative Measure of Military Spending

- 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.

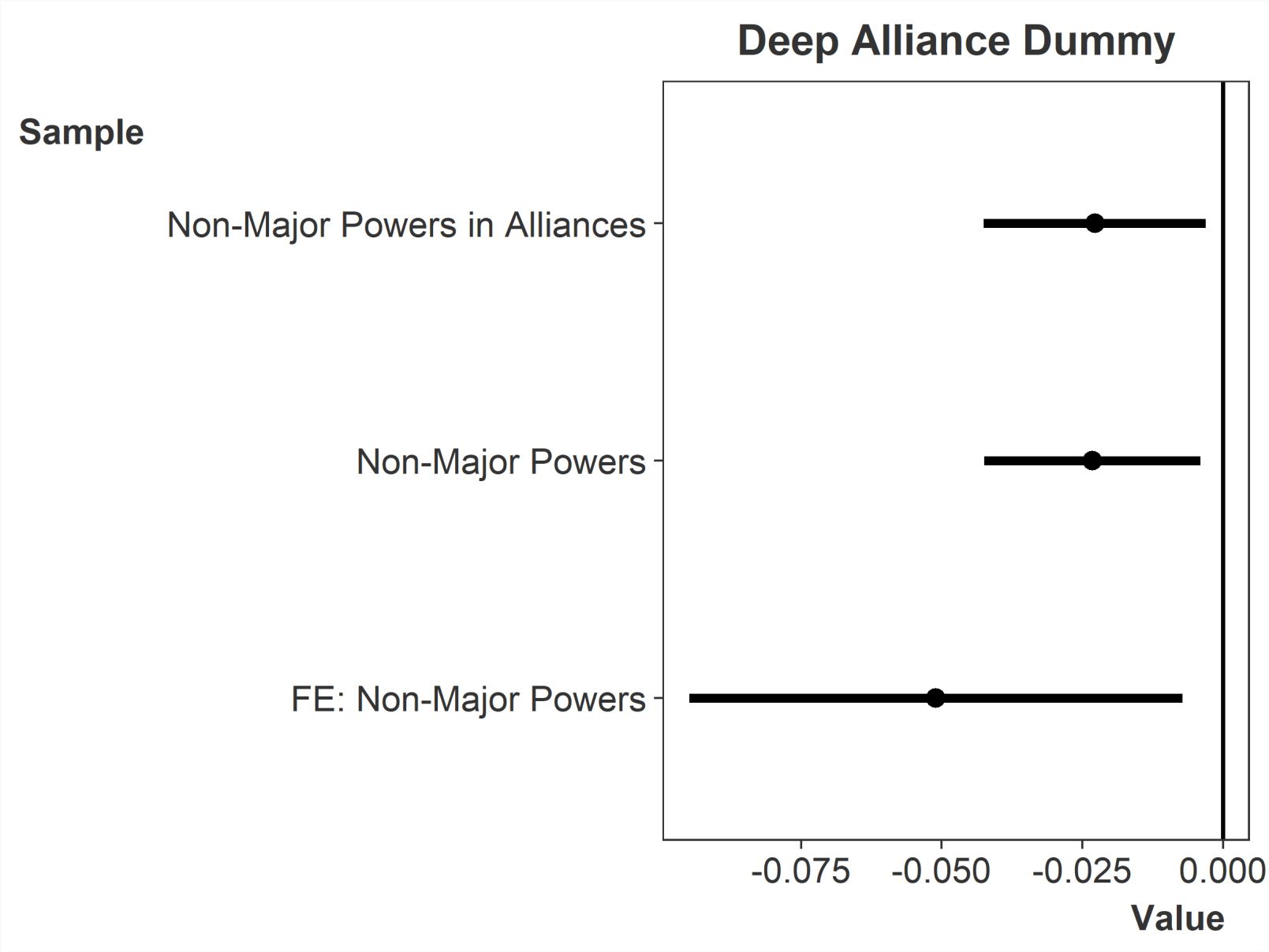
Alternative Measure of Military Spending: Results



Single-Level Regression: Average Depth



Single-Level Regression: Deep Alliance Dummy



Bounds Analysis of Single-Level Regression