Alliance Participation, Treaty Depth, and Military Spending

Joshua Alley

October 15, 2019

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?

Does alliance participation increase military spending? Or decrease it?

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

What Does That Mean?

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

What Does That Mean?

- **Depth**: The extent of military cooperation an alliance treaty promises.
- **Free-riding**: Low defense spending by alliance participants.

What Does That Mean?

- **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.

Why Should You Care?


ALLIES
UNITED
BRUXELLES
NATO
OTAN
CHAIRMAN
SOC
CHAIRMAN MC

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.

Alliance Heterogeneity

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

Alliance Heterogeneity

- Alliances can *increase or decrease* military spending.
- Depends on alliance characteristics.
- **Treaty depth is a key source of differences between alliances.**

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

Outline

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

Outline

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

1. Argument: Treaty Depth and Non-Major Powers

Outline

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

1. Argument: Treaty Depth and Non-Major Powers
2. Statistical Analysis

Outline

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

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

Argument

Opportunism in Alliances

Alliances are a form of international cooperation. There are two connected forms of opportunism:

Opportunism in Alliances

Alliances are a form of international cooperation. There are two connected forms of opportunism:

1. Abandonment.

Opportunism in Alliances

Alliances are a form of international cooperation. There are two connected forms of opportunism:

1. Abandonment.
2. Free-riding.

Free-riding

Free-riding means alliance members:

Free-riding

Free-riding means alliance members:

1. Rely on partners for protection and

Free-riding

Free-riding means alliance members:

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

Deep alliances lead to more free-riding.

Treaty Depth

Deep treaties stipulate extensive defense cooperation.

Treaty Depth

Deep treaties stipulate extensive defense cooperation.

1. Require more policy coordination and defense cooperation among alliance members.
2. **Formal defense cooperation**:

Treaty Depth

Deep treaties stipulate extensive defense cooperation.

1. Require more policy coordination and defense cooperation among alliance members.
2. **Formal defense cooperation**:
    - Bases, policy coordination, military aid, side agreements, formal institutions.

Limits on Free-Riding

There are two ways depth increases alliance members ability to free-ride.

Limits on Free-Riding

There are two ways depth increases alliance members ability to free-ride.

1. Greater alliance credibility: reduces leverage over free-riding.

Limits on Free-Riding

There are two ways depth increases alliance members ability to free-ride.

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.

Non-Major Powers

- Emphasize immediate security.
- Constraint: Opportunity costs of military spending.

Non-Major Powers

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

Hypothesis 1: As 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 the prediction:

Research Design

I need two things to test the prediction:

1. Measure of treaty depth— measurement model.

Research Design

I need two things to test the prediction:

1. Measure of treaty depth— measurement model.
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.

Measuring Treaty Depth

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

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

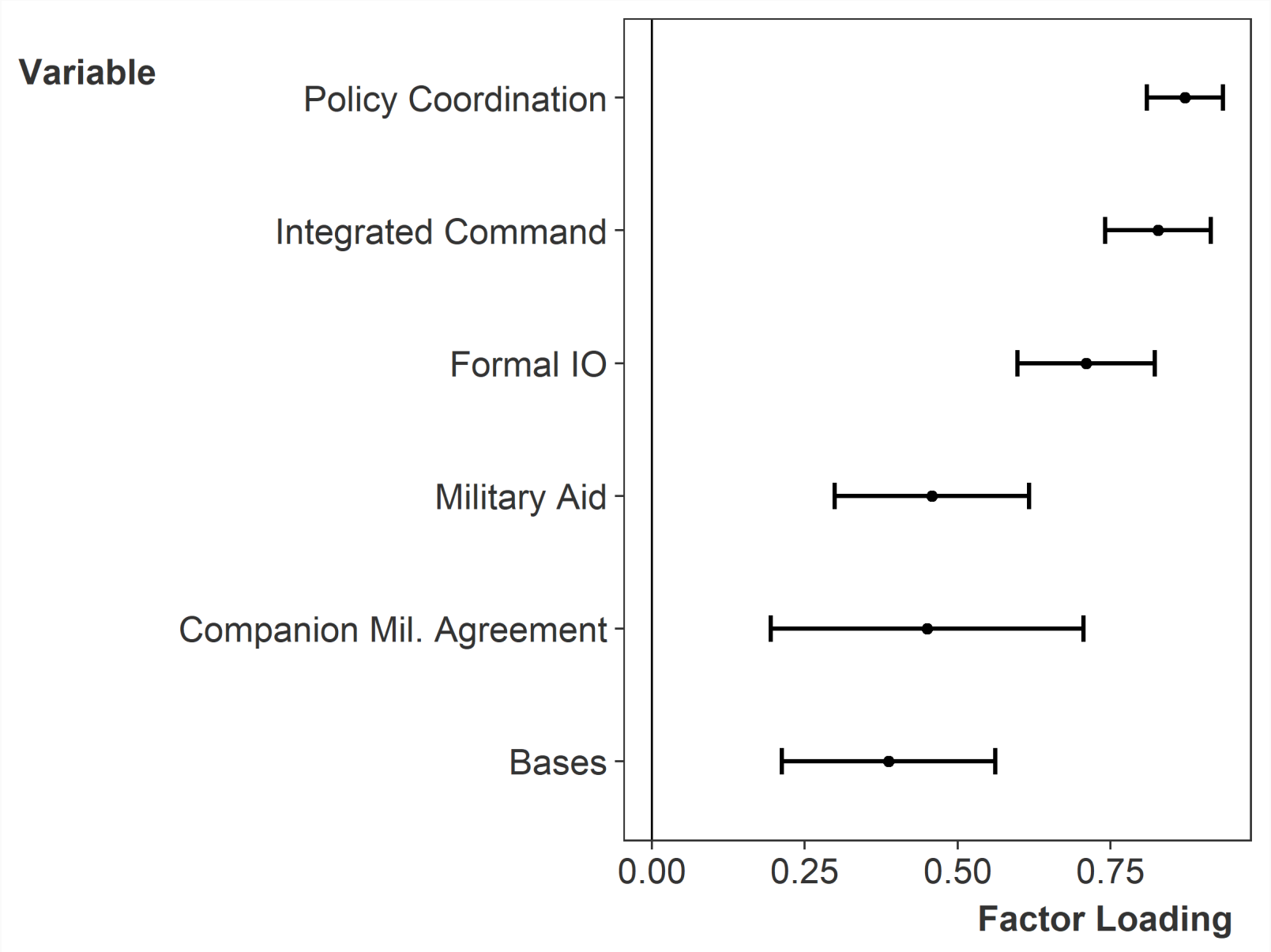
Details of Measure

- 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.

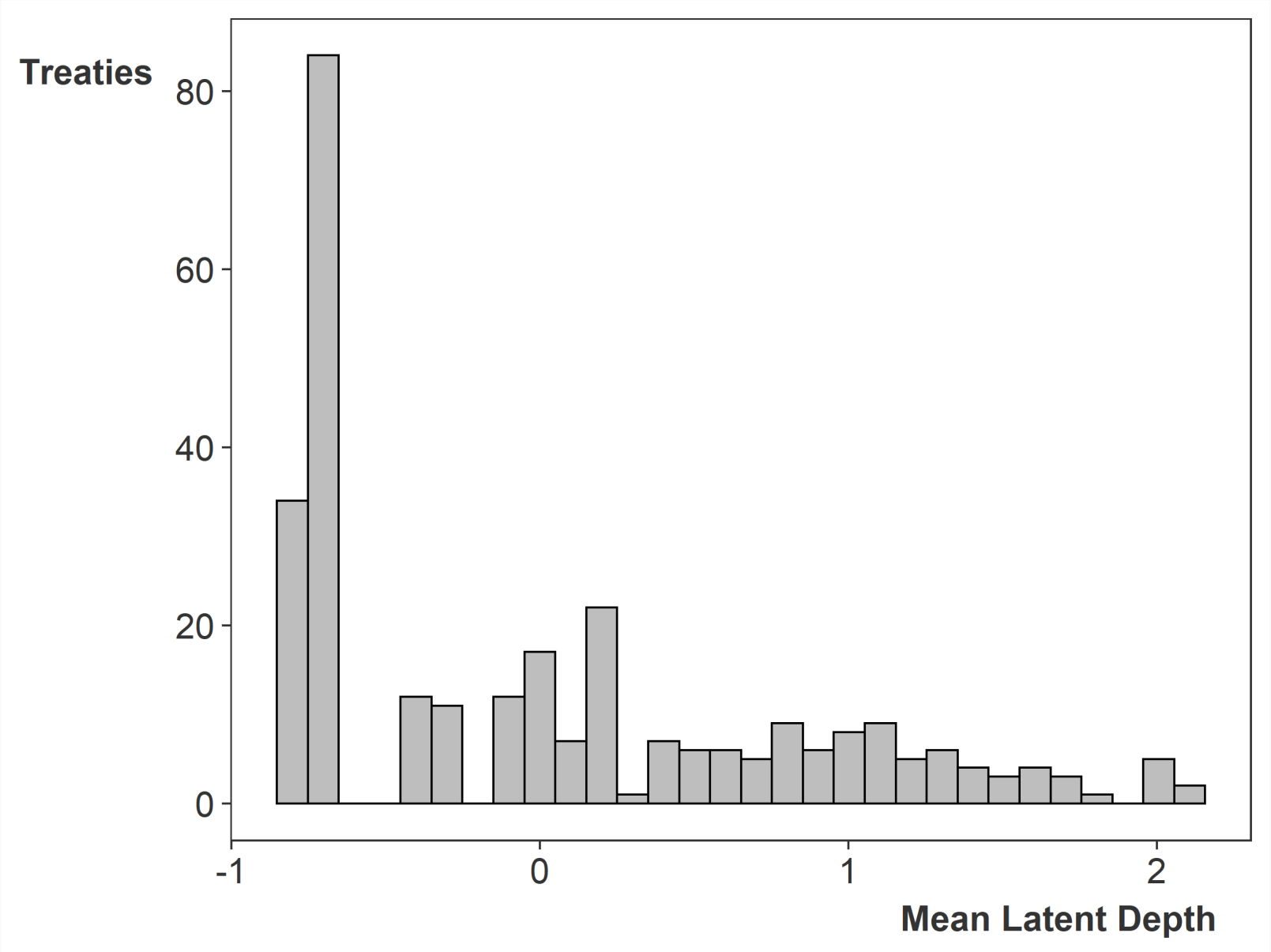
Details of Measure

- 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)

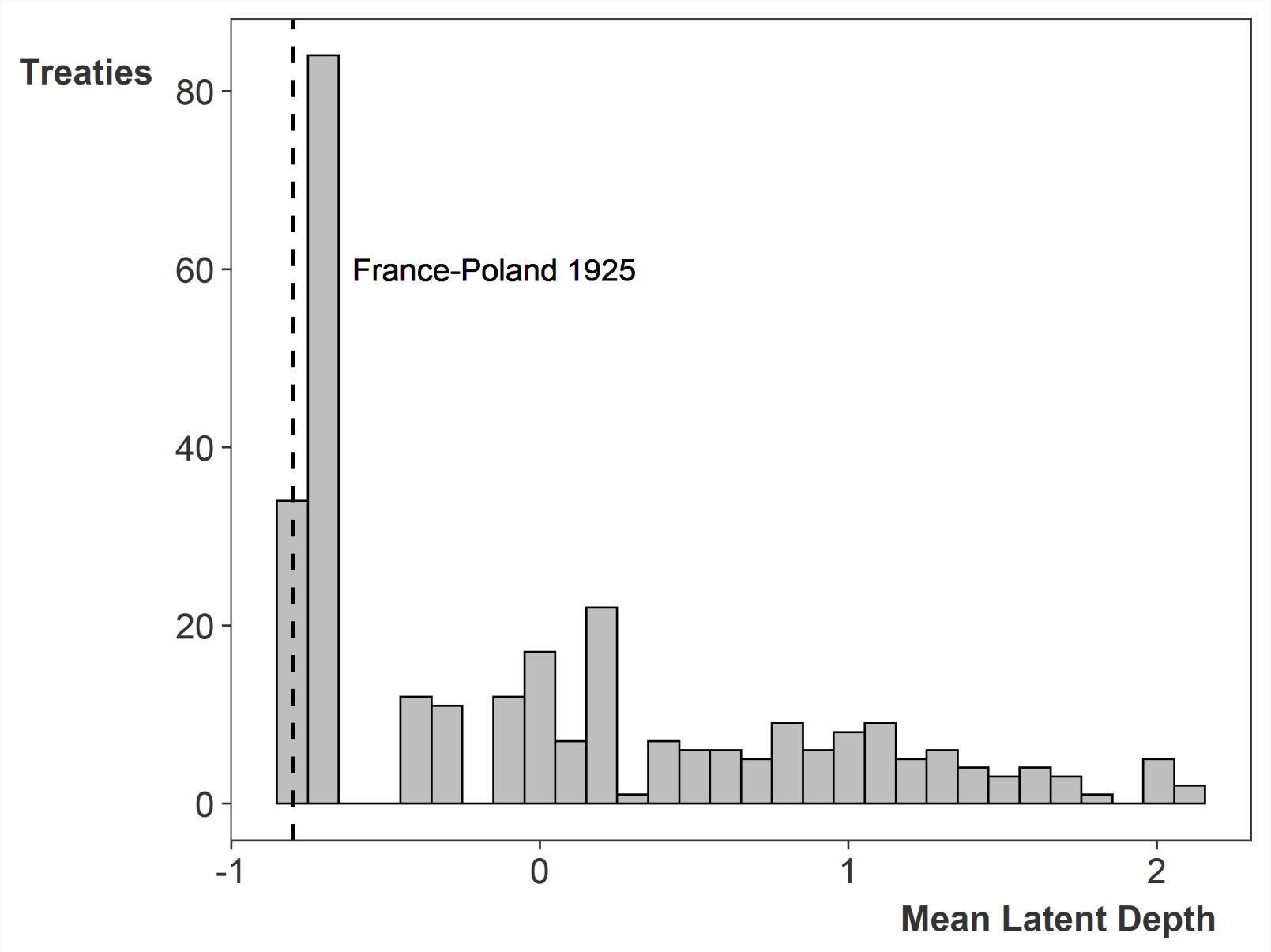
Factor Loadings



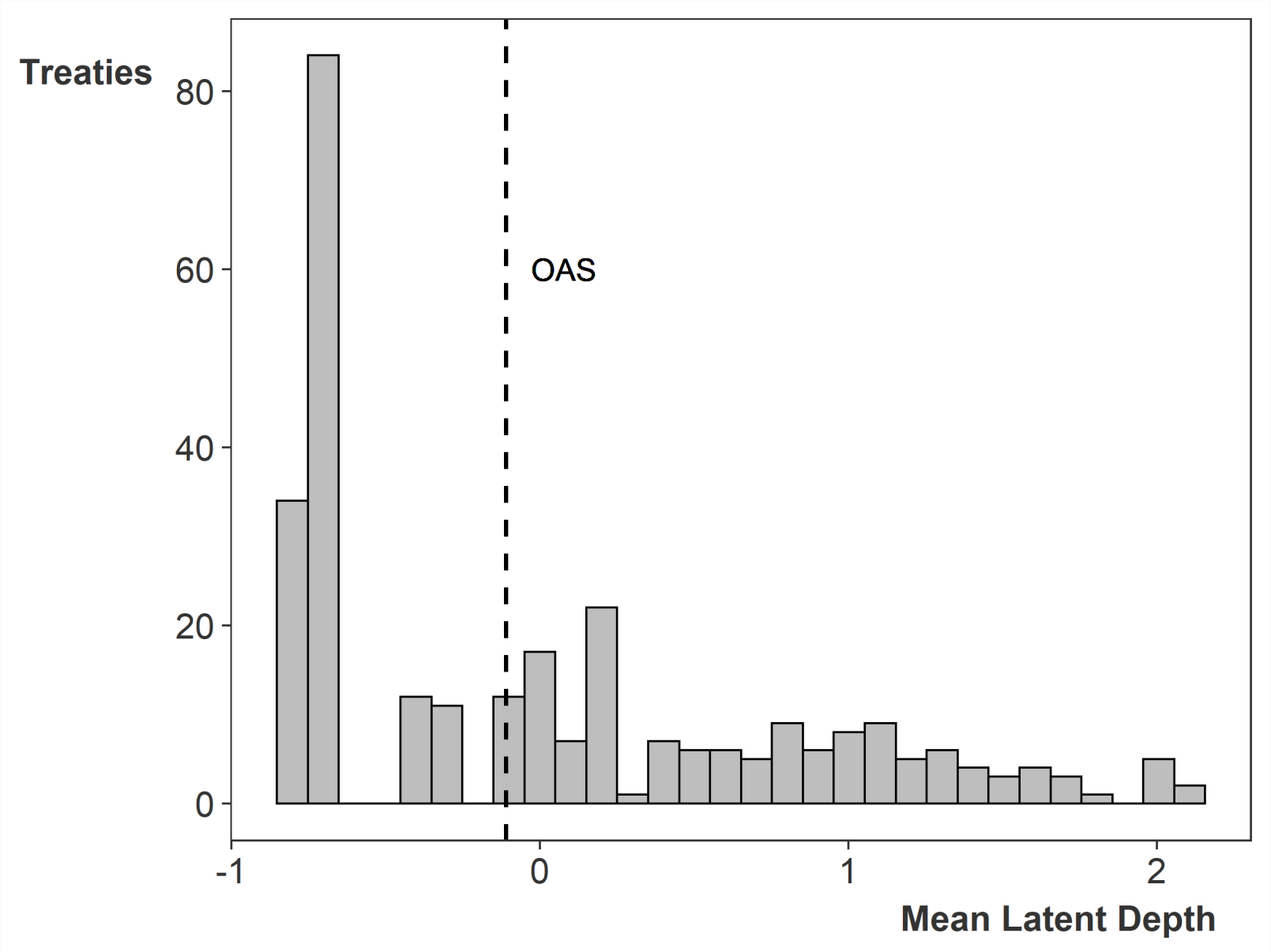
Latent Measure of Treaty Depth



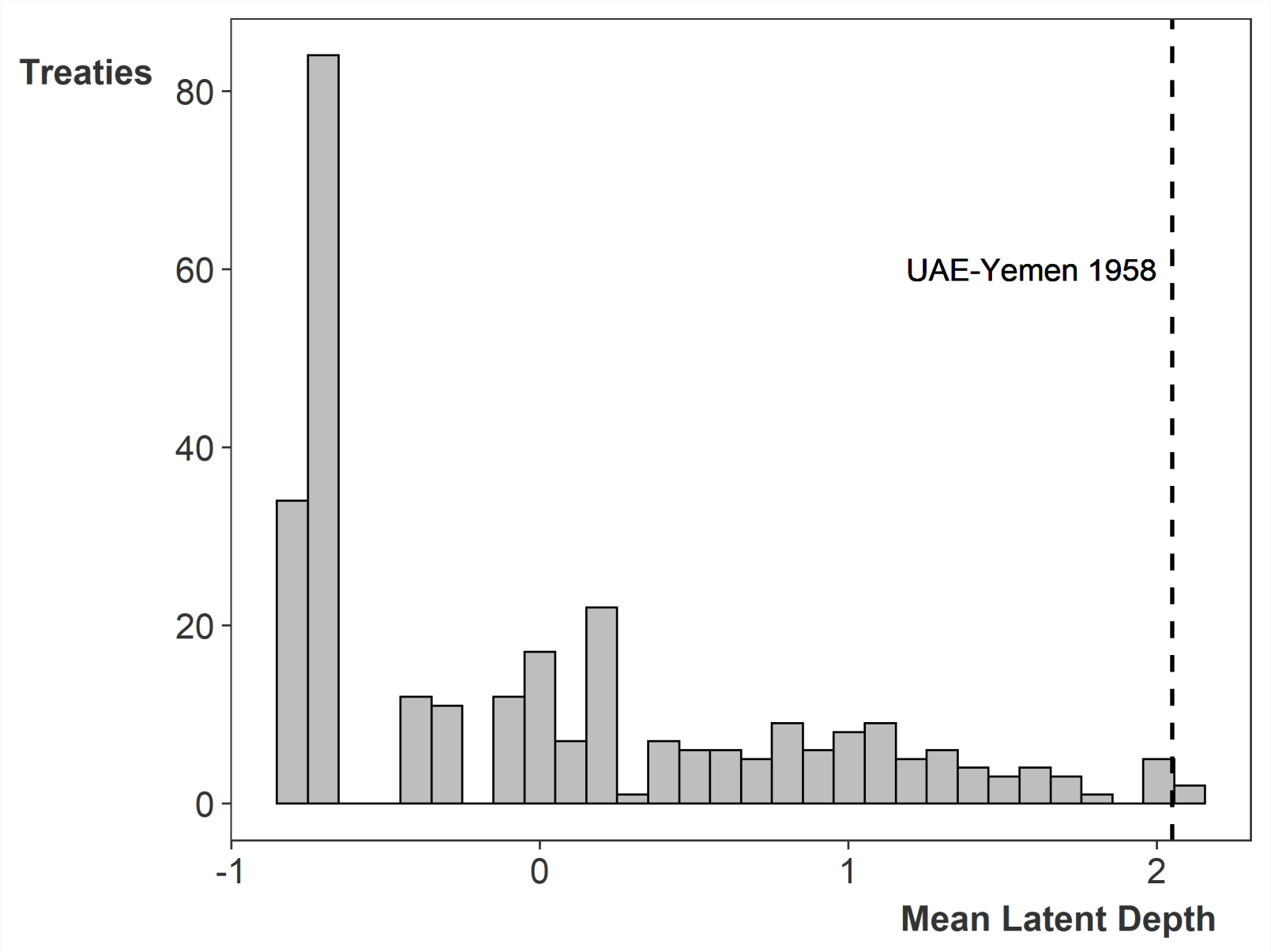
Latent Measure of Treaty Depth: Shallow



Latent Measure of Treaty Depth: Typical



Latent Measure of Treaty Depth: Deep



Empirical Analysis: Multilevel Model

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

Empirical Analysis: Multilevel Model

- Link alliance-level variation with state-level outcomes.
- Two connected regressions: alliance and state-level.

Empirical Analysis: Multilevel Model

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

Why Multilevel?

1. Matches the theoretical argument by comparing alliances.

Why Multilevel?

1. Matches the theoretical argument by comparing alliances.
2. Explicitly model heterogeneous effects of alliances.

Why Multilevel?

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

Why Multilevel?

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.

ML Model

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

ML Model

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

ML Model

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

ML Model

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

ML Model

					Alliance Characteristics
					$\downarrow$
% Change = Mil. Ex.	Varying Intercepts	+	State Vars.	+	Alliance Participation
y =	$\alpha + \alpha^{st} + \alpha^{yr}$	+	$\mathbf{W}\gamma$	+	$\mathbf{Z}\lambda$

ML Model

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

$$\begin{array}{ccccccc} \% \text{ Change} = & \text{Varying} & + & \text{State} & + & \text{Alliance} \\ \text{Mil. Ex.} & \text{Intercepts} & & \text{Vars.} & & \text{Participation} \\ y = & \alpha + \alpha^{st} + \alpha^{yr} & + & \mathbf{W}\gamma & + & \mathbf{Z}\lambda \end{array}$$

Sample and Key Variables

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

Sample and Key Variables

- **Sample**: Non-major power states (COW)— 1816-2007.
- 193 Alliances with military support: symmetric and asymmetric.

Sample and Key Variables

- **Sample**: Non-major power states (COW)— 1816-2007.
- 193 Alliances with military support: symmetric and asymmetric.
- **DV**: Percentage change in military spending (COW)
  $= \frac{\Delta \text{Mil. Expend}_t}{\text{Mil. Expend}_{t-1}}$

Sample and Key Variables

- **Sample**: Non-major power states (COW)— 1816-2007.
- 193 Alliances with military support: symmetric and asymmetric.
- **DV**: Percentage change in military spending (COW)
  $= \frac{\Delta \text{Mil. Expend}_t}{\text{Mil. Expend}_{t-1}}$
  - Transformed with Inverse Hyperbolic Sine.

Sample and Key Variables

- **Sample**: Non-major power states (COW)— 1816-2007.
- 193 Alliances with military support: symmetric and asymmetric.
- **DV**: Percentage change in military spending (COW)
  $= \frac{\Delta \text{Mil. Expend}_t}{\text{Mil. Expend}_{t-1}}$
  - Transformed with Inverse Hyperbolic Sine.
- **Alliance-Level IV**: Mean treaty depth

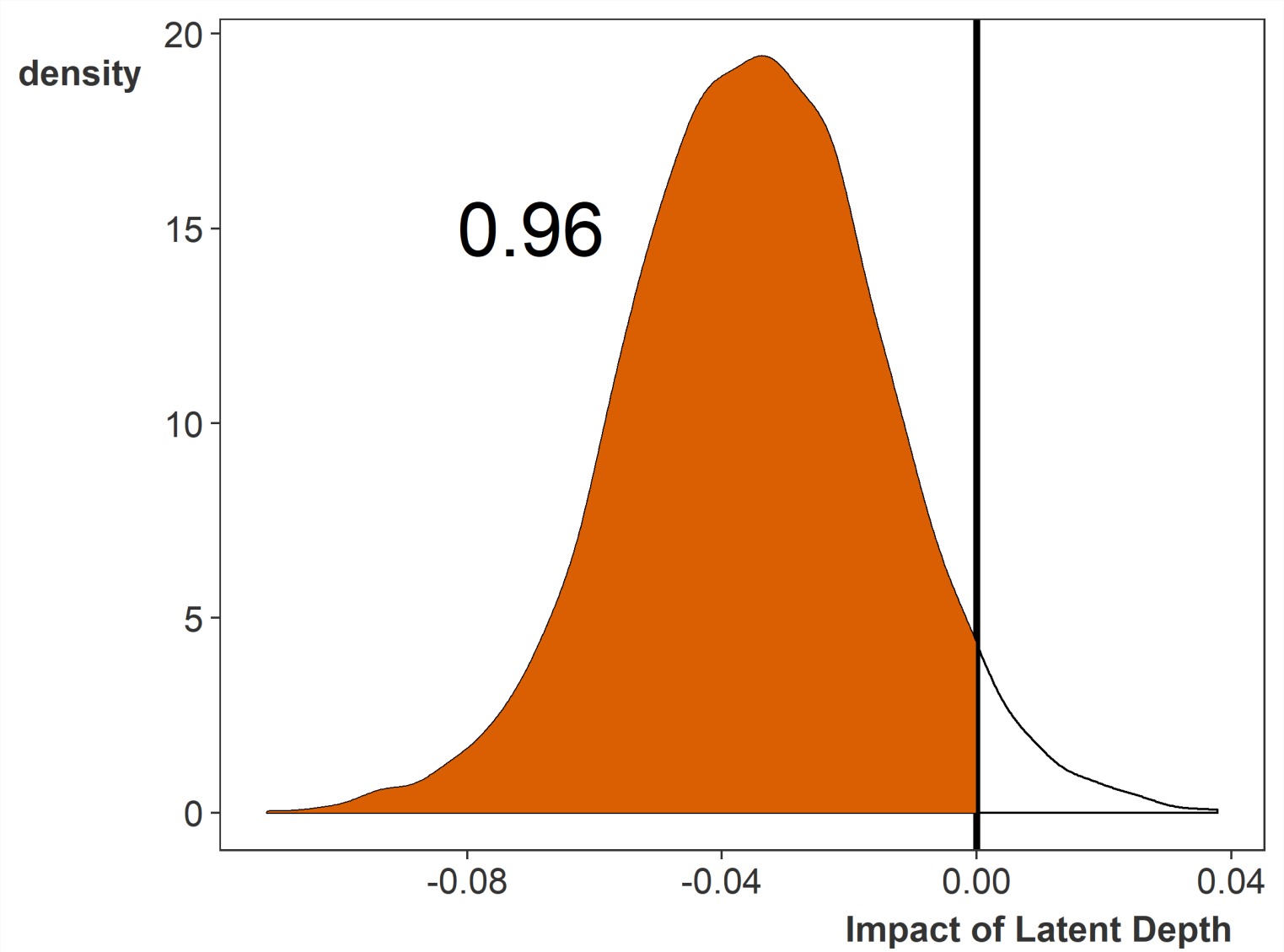
Controls

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

Controls

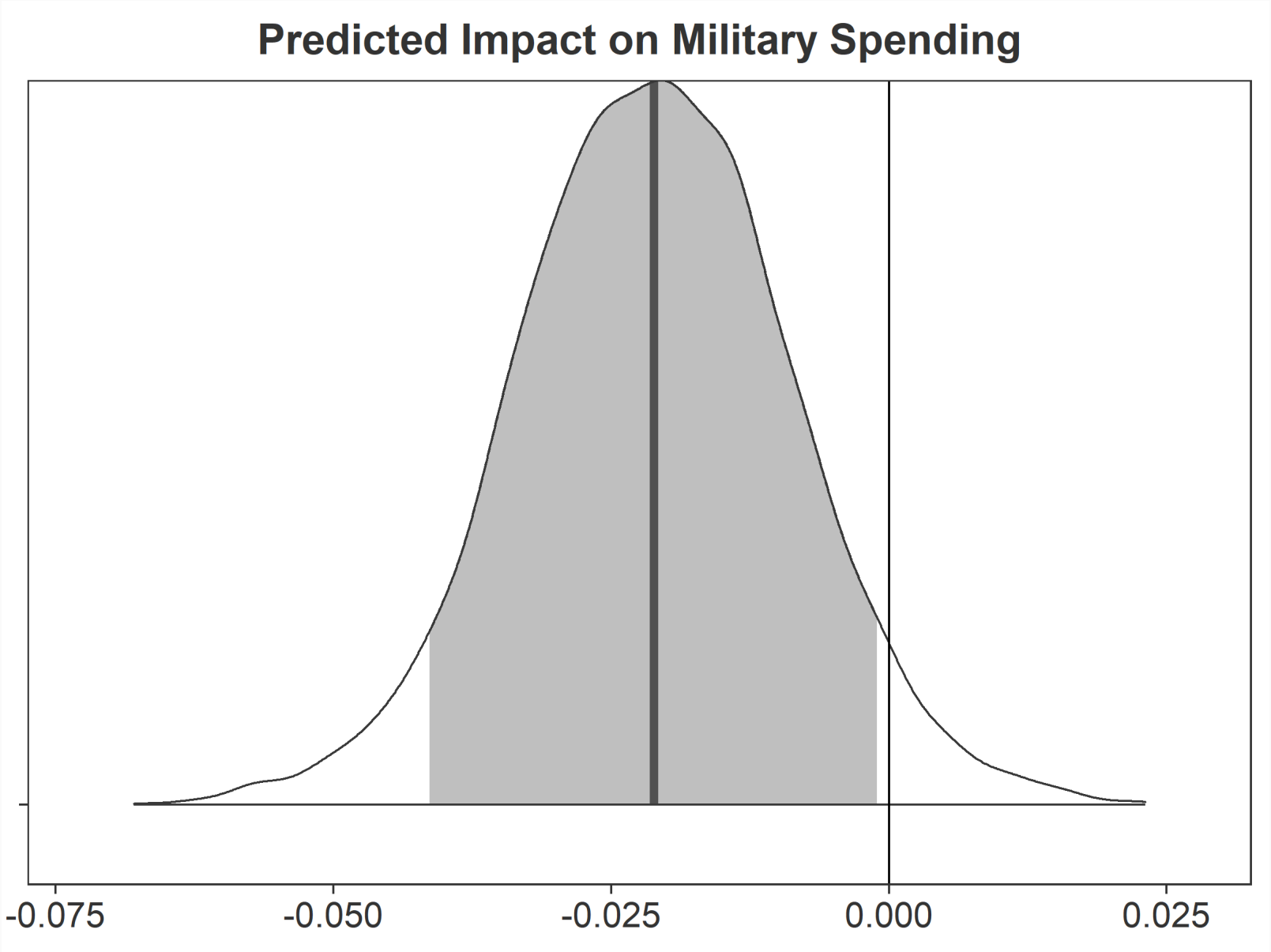
- **State-Level Controls**: Interstate war, civil War, annual MIDs, GDP growth, POLITY, Cold War, rival military expenditures.
- **Alliance-Level Controls**: Unconditional military support, economic issue linkages, foreign policy concessions, share of democracies, number of members, wartime, asymmetric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

Association Between Treaty Depth and Changes in Military Spending

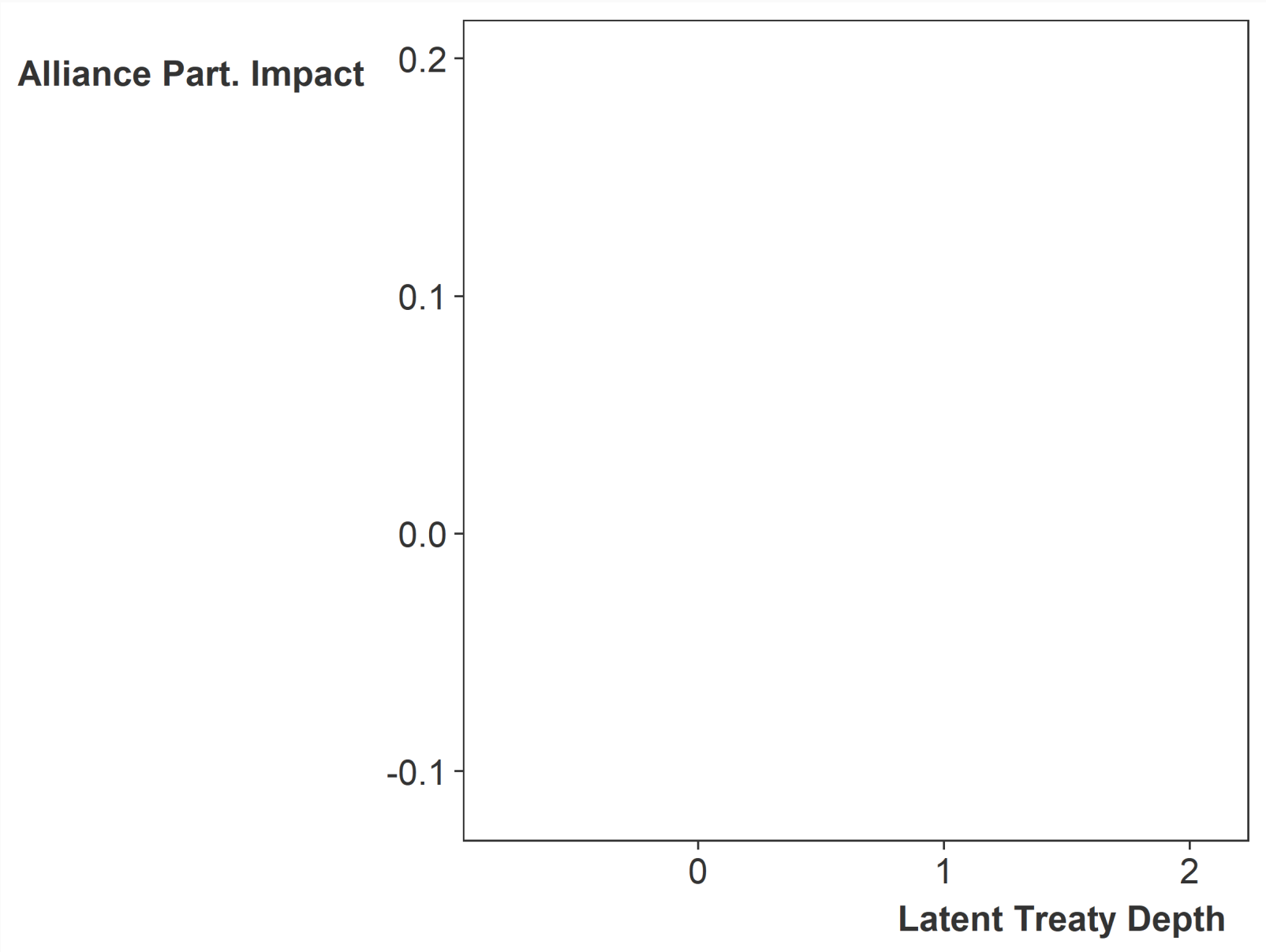


Substantive Importance

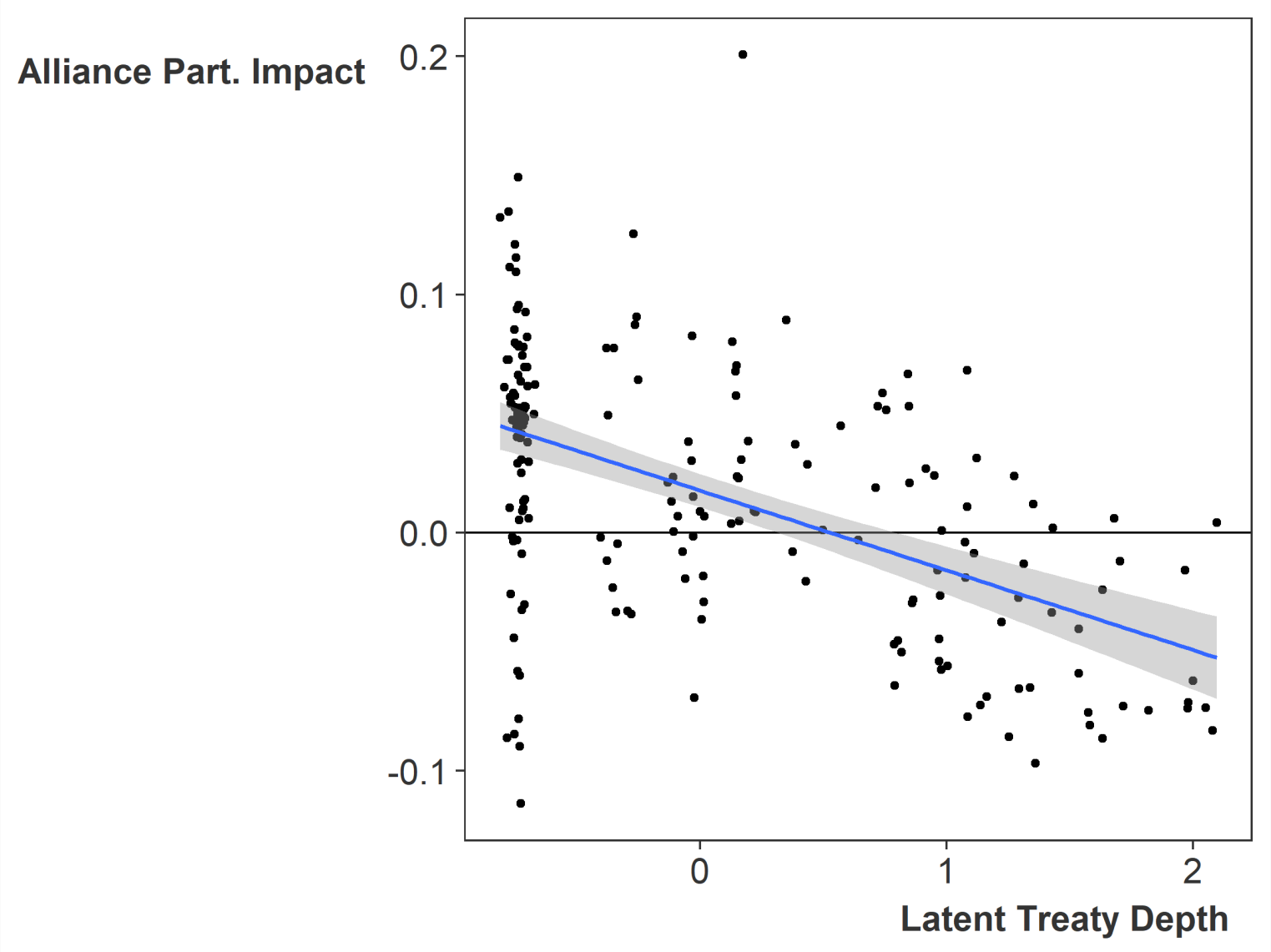
Substantive Importance



How Treaty Depth Modifies Alliance Impact



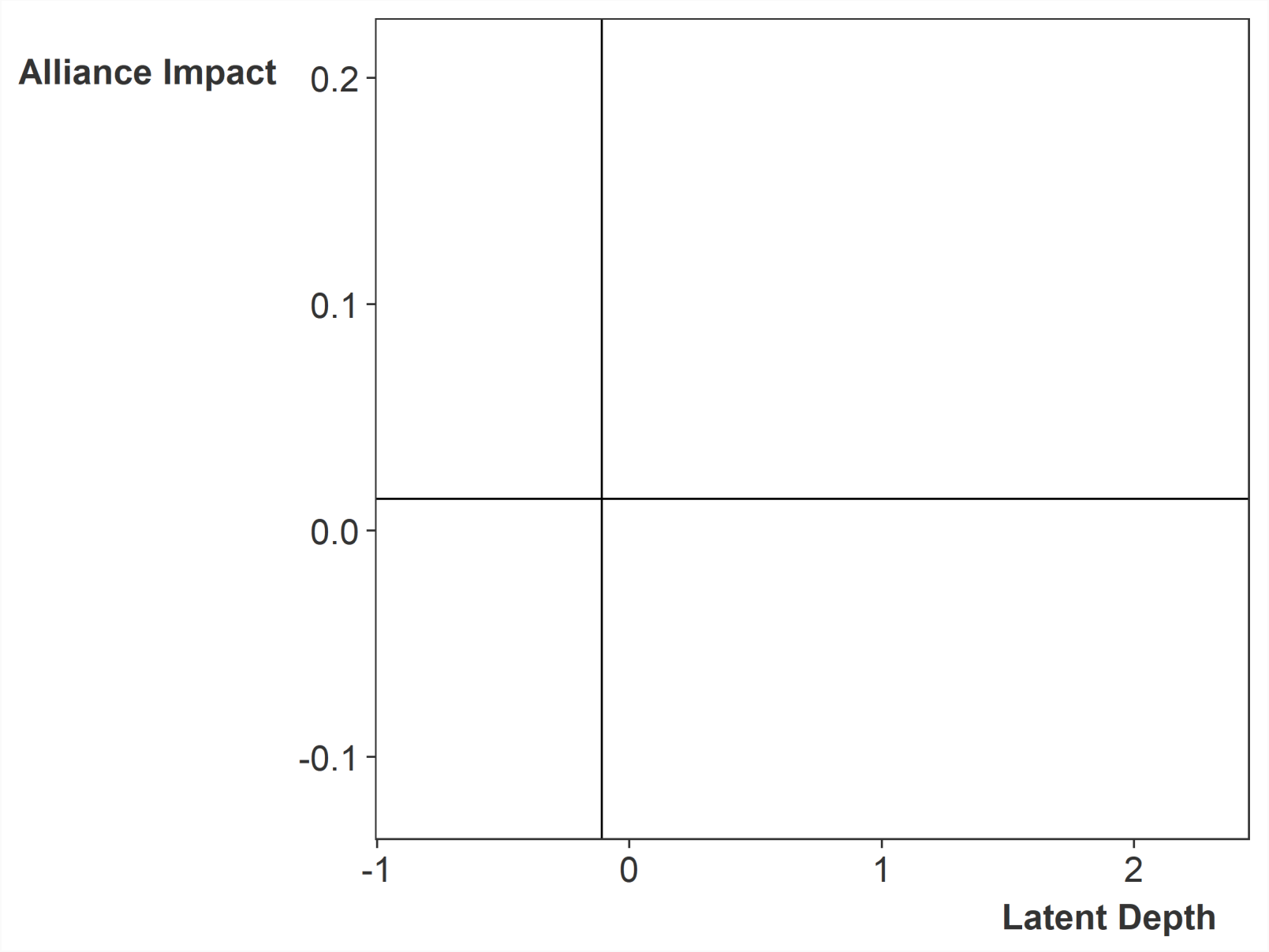
Treaty Depth and Alliance Impact



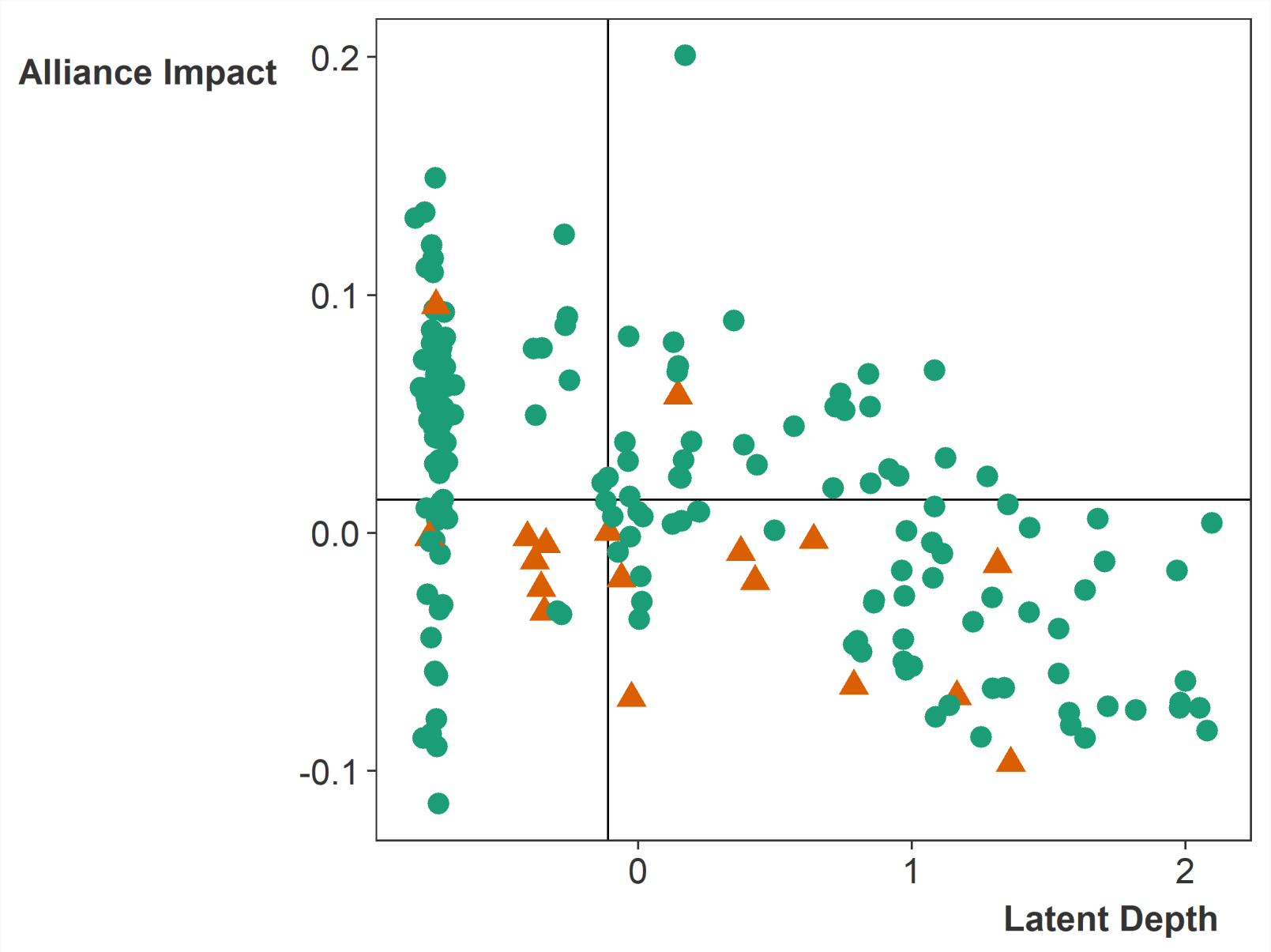
US Alliances

Reassurance

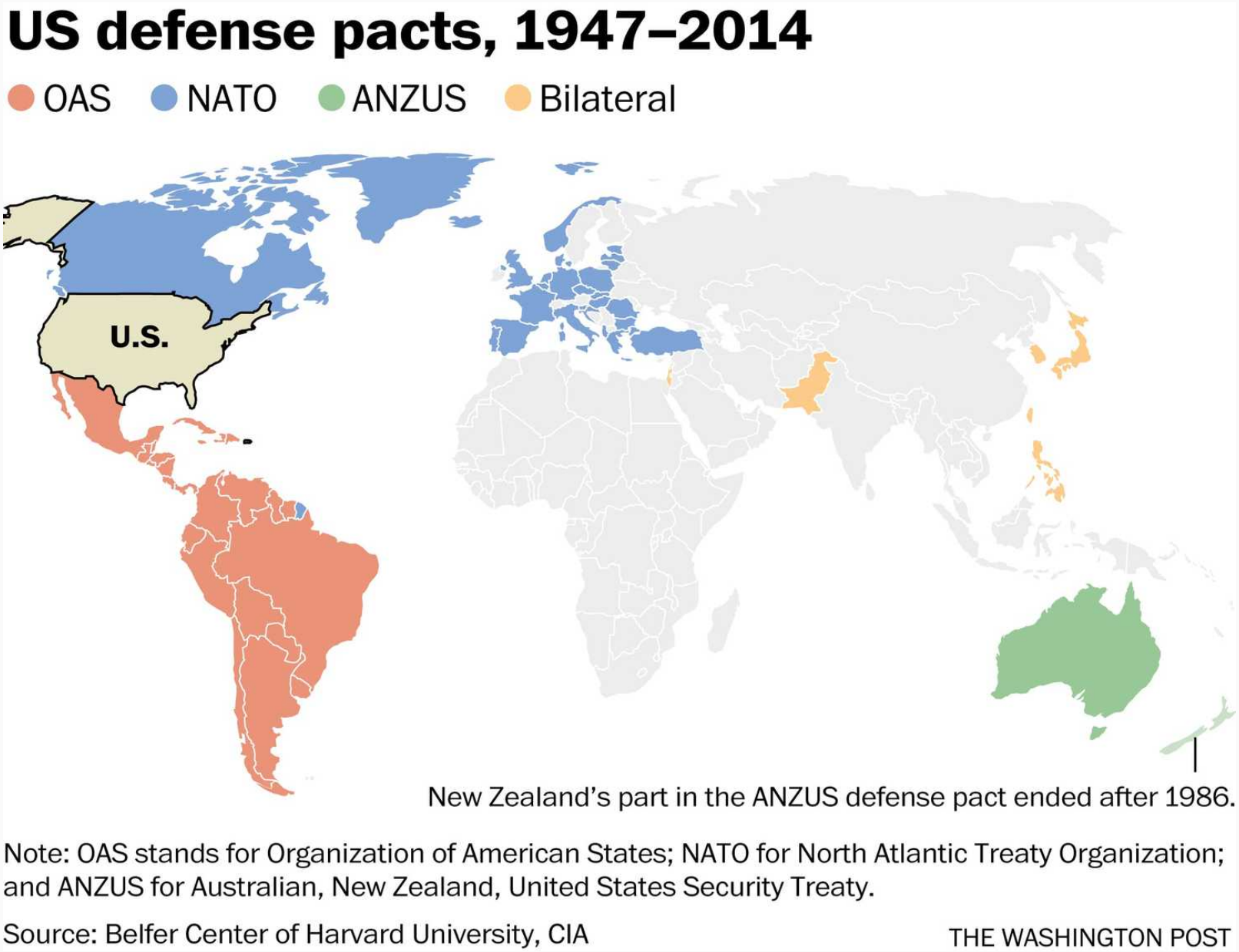
US Alliances in Context



US Alliances in Context



Implication: What to do with US alliances?



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

Dissertation

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!

jkalley14@tamu.edu

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

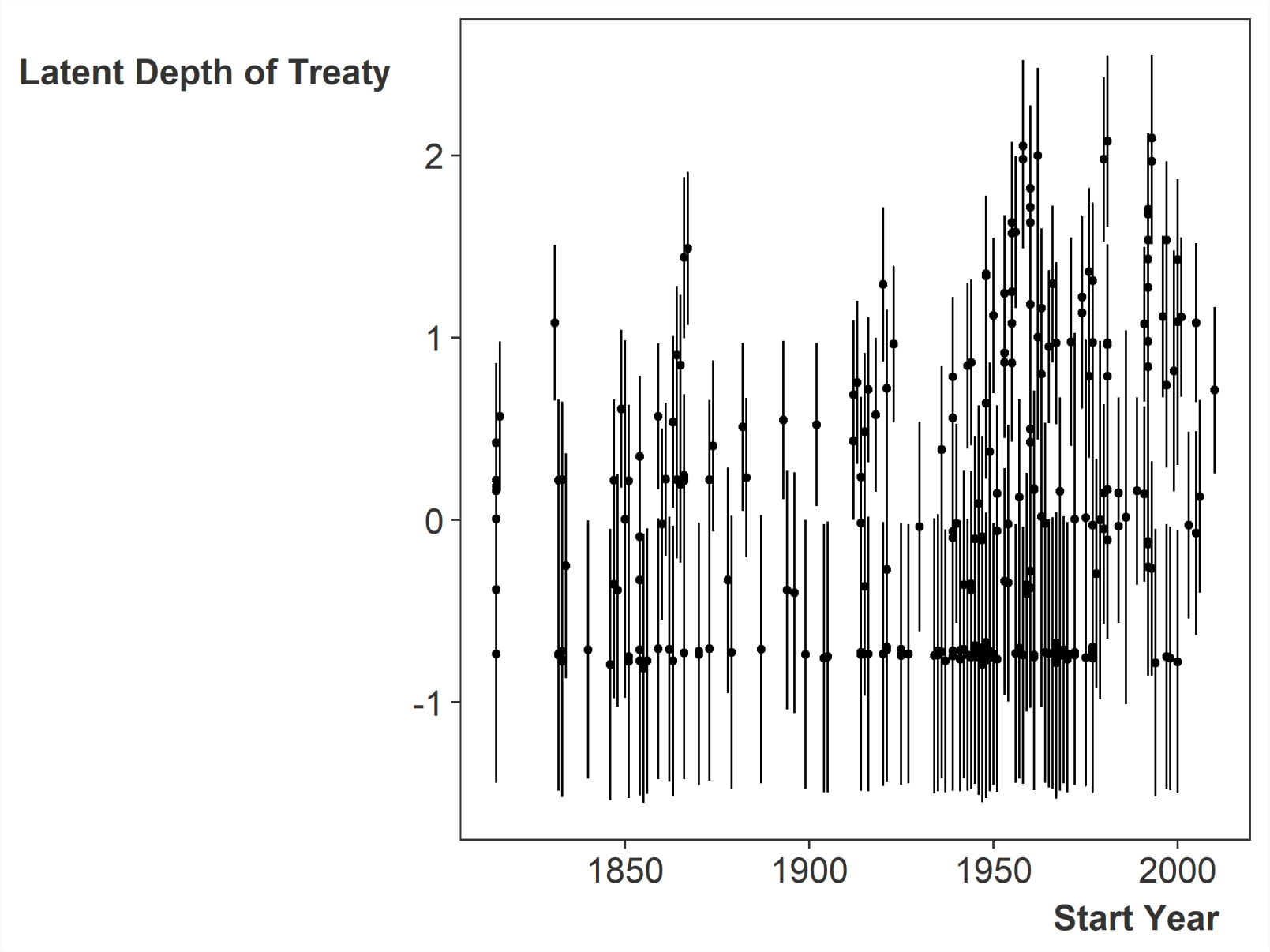
Details of Measurement Model

- 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.

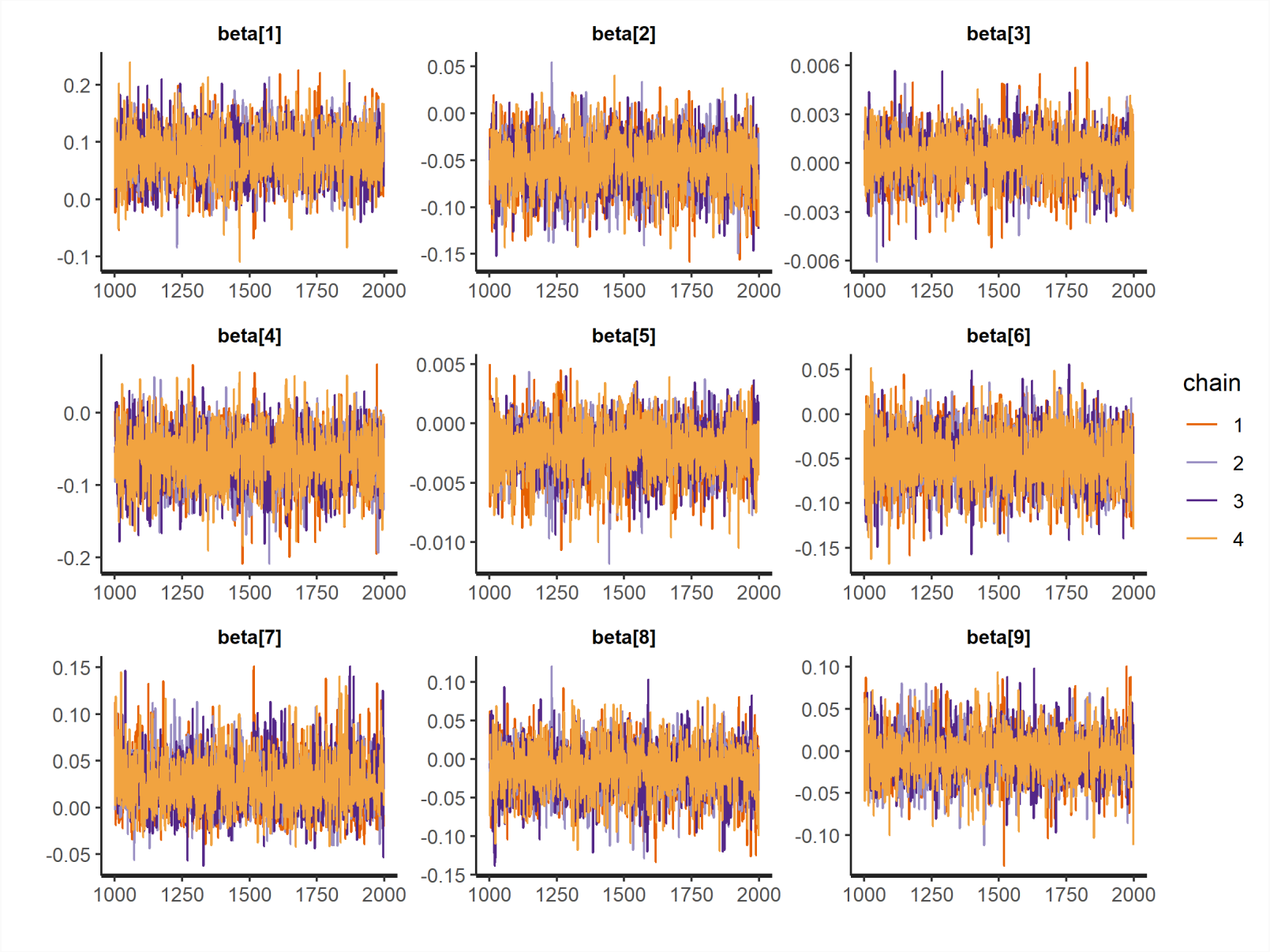
Aside: Benson and Clinton 2016

- 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



Trace plots: Non-Major



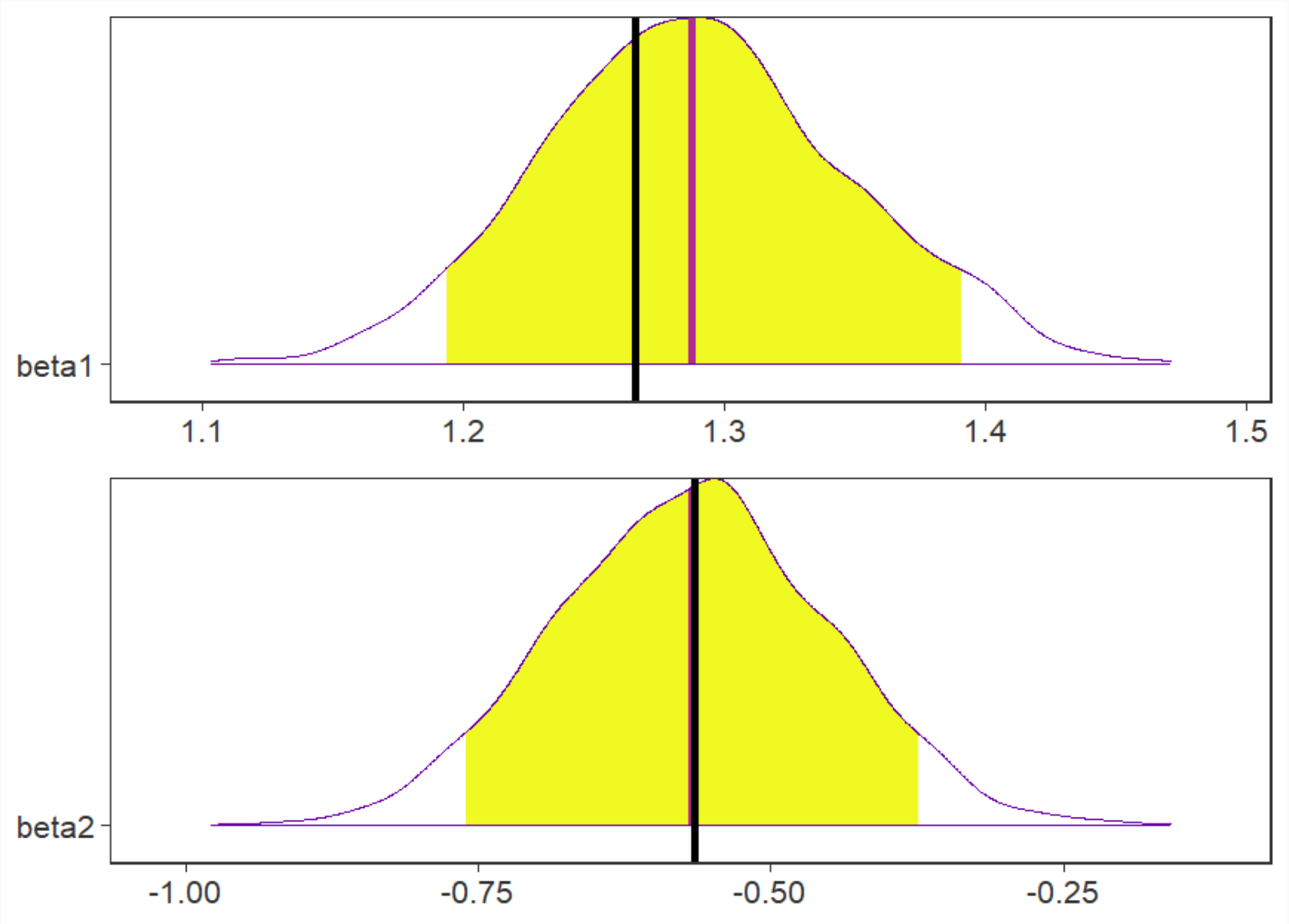
Model Check: Recovering Known Parameters

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

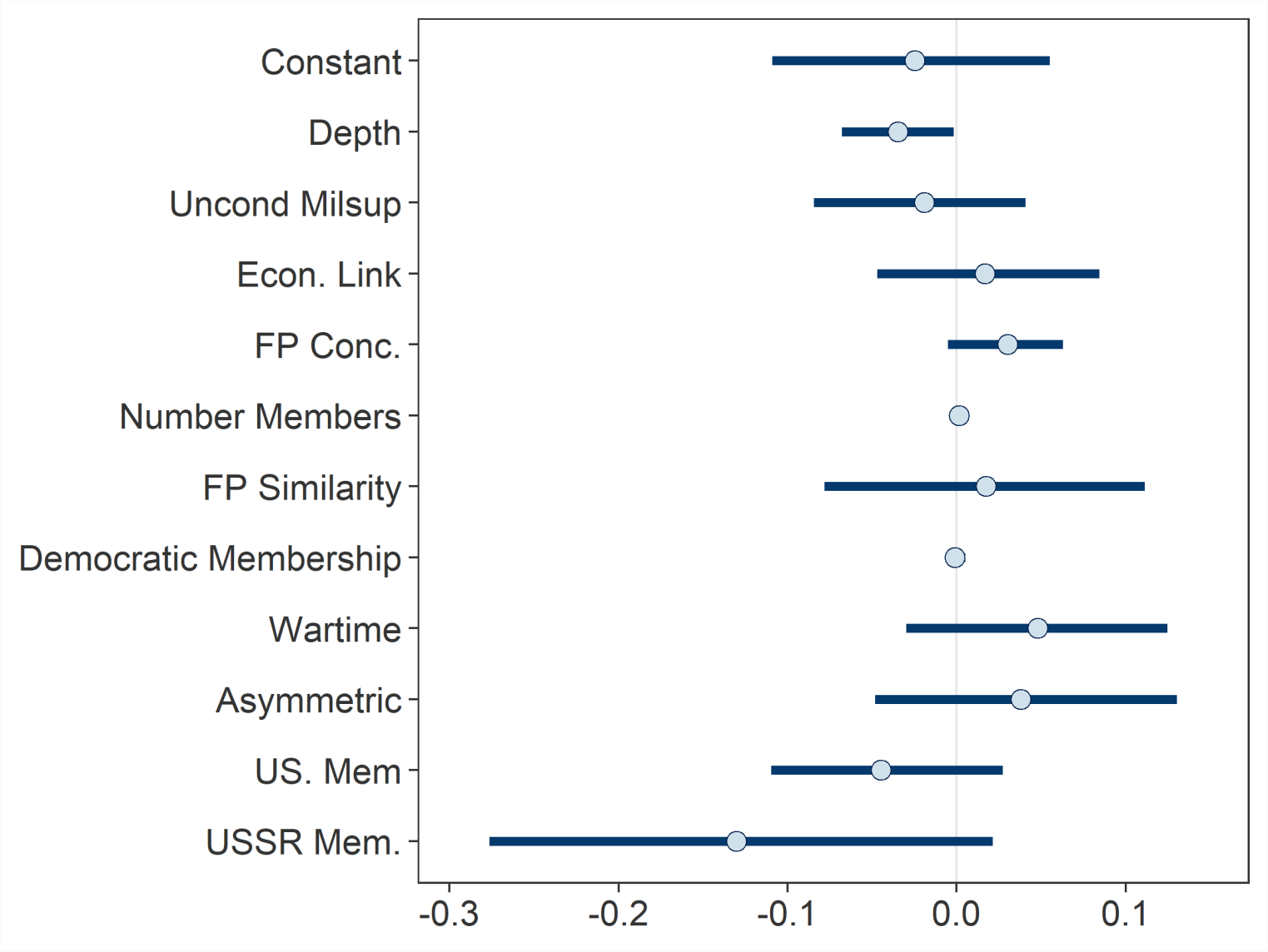


Alliance-Level Regression Table: Non-Major Powers

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.

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

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

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

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

$+$ Argentine Characteristics

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

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

Example

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

Example year: Argentina 1955

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

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

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

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

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

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

Example

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

Example year: Argentina 1955

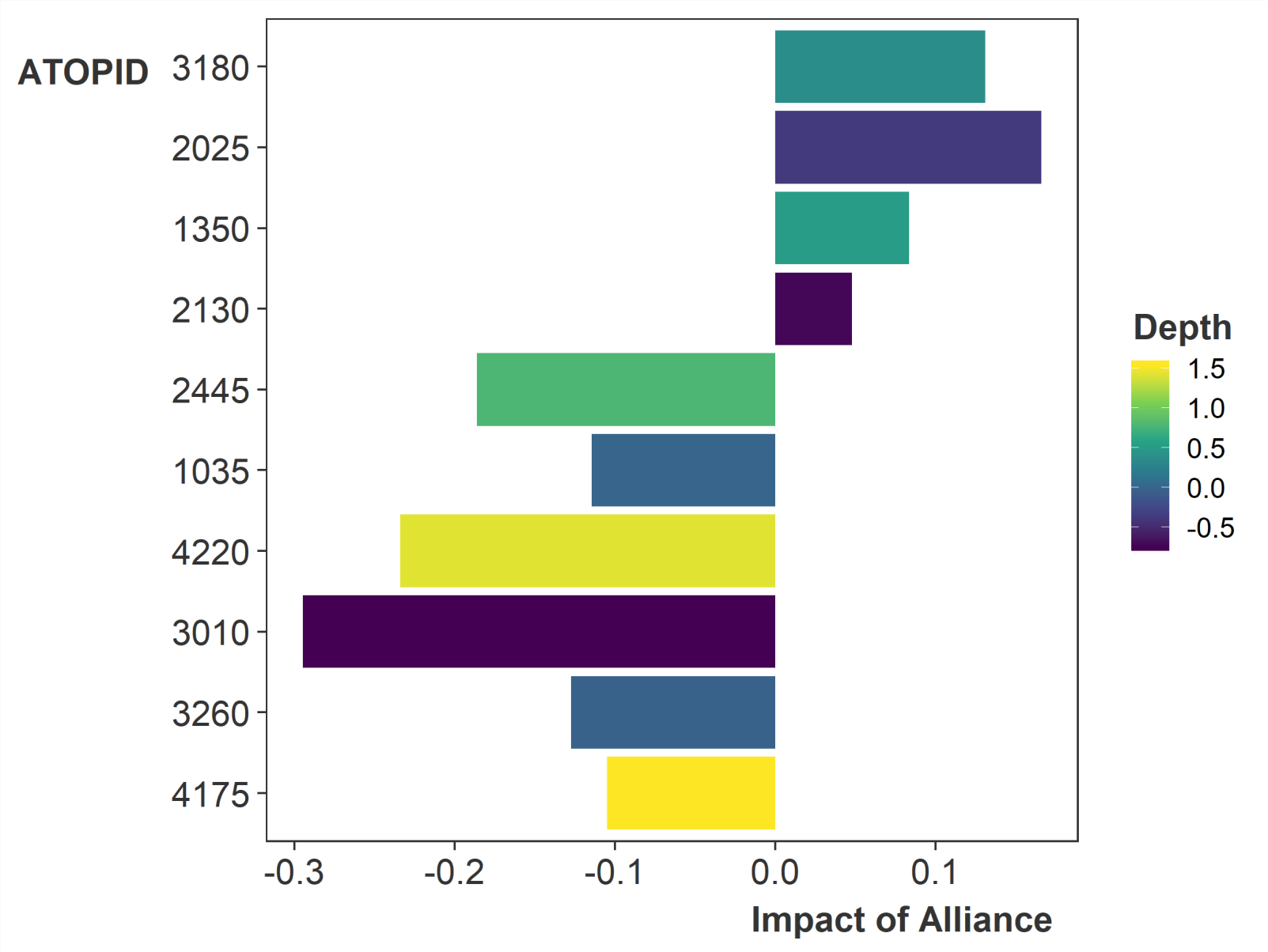
1955 % Change Milex. = Overall mean
+ Argentine Intercept + 1955 Intercept
+ Argentine Characteristics
+ $\lambda_{OAS} *$ OAS Expenditure + $\lambda_{Rio} *$ Rio Pact Expenditure

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

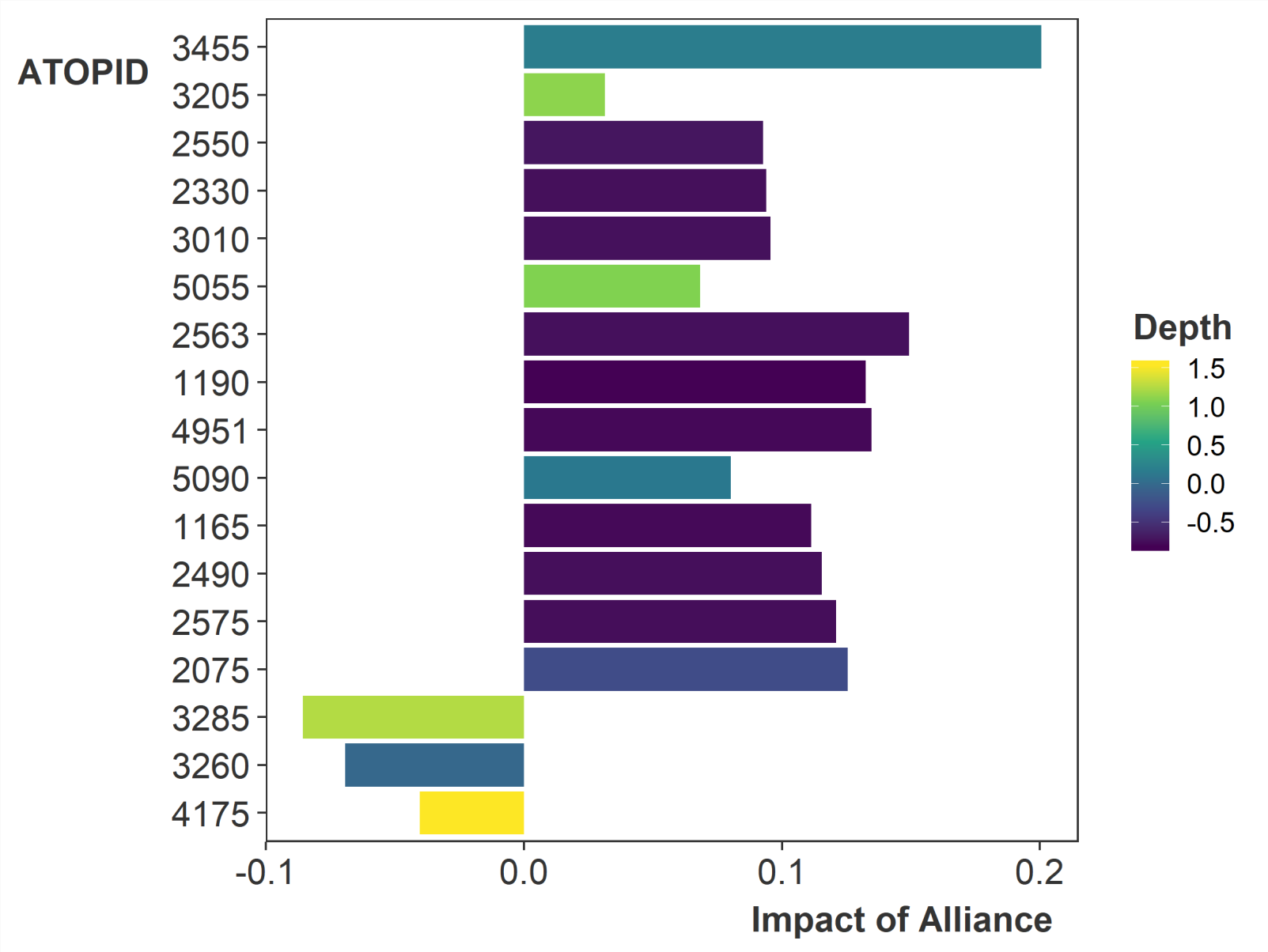
Z

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

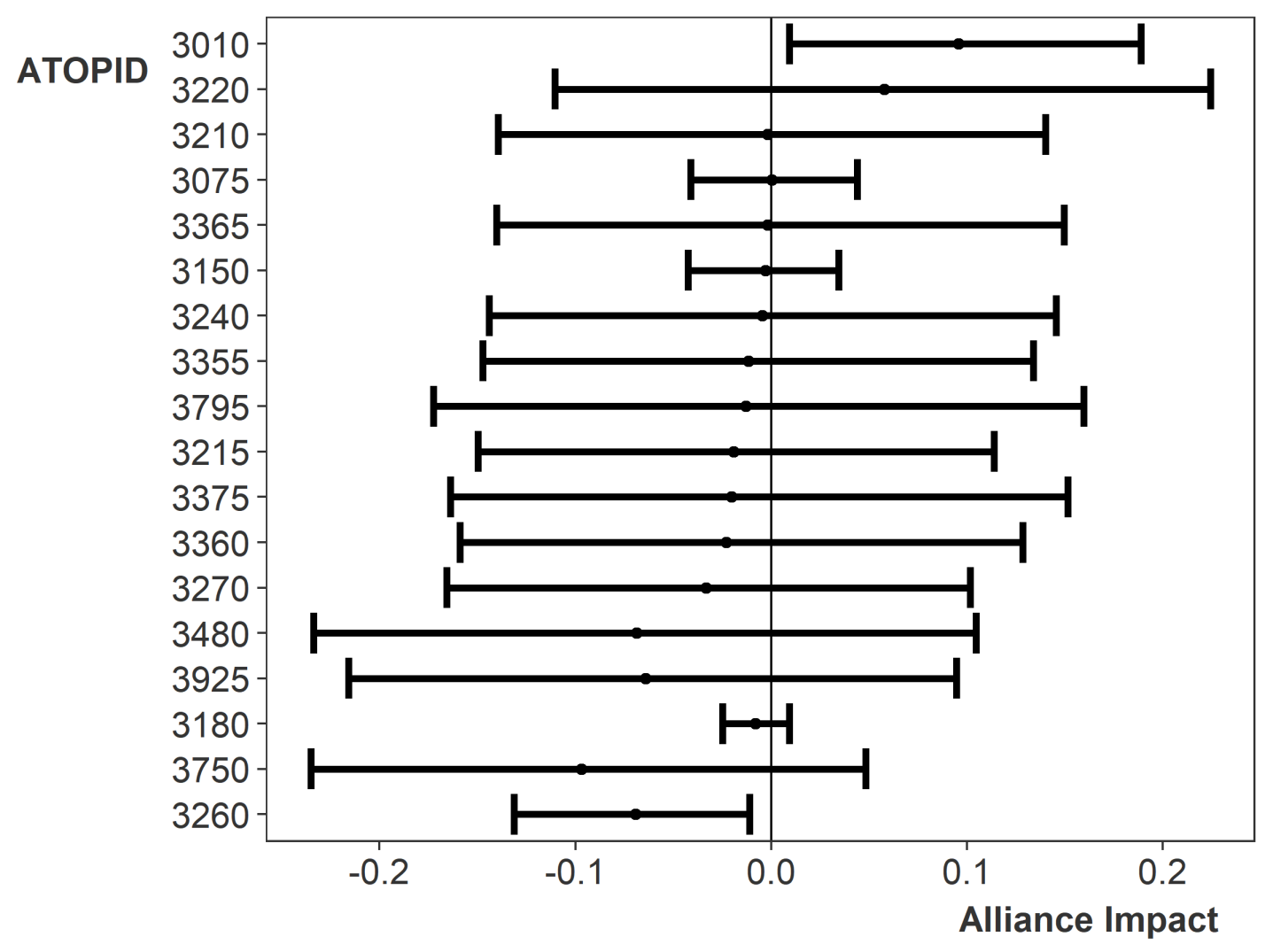
Notable Major Power Alliances



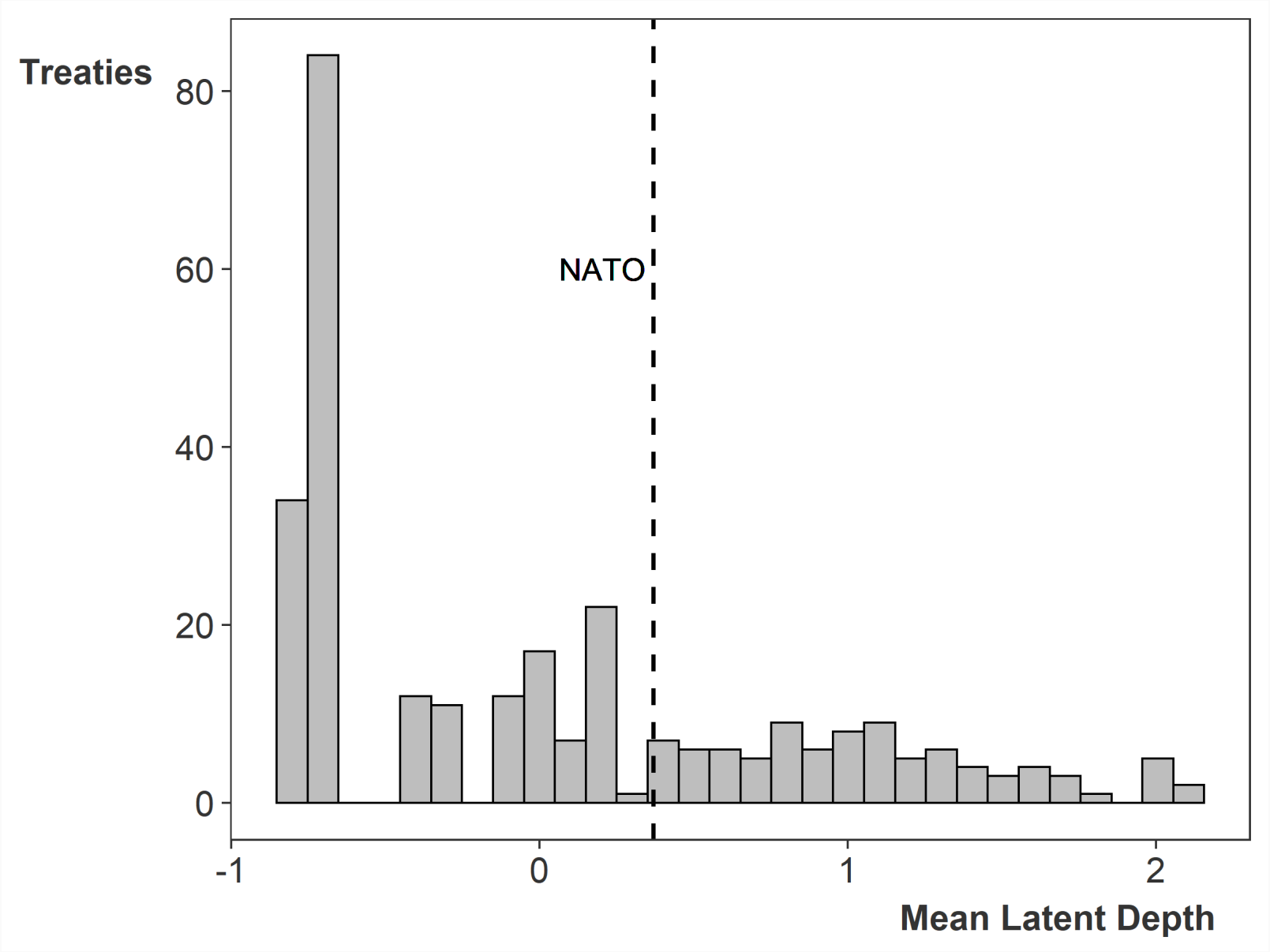
Notable Non-Major Power Alliances



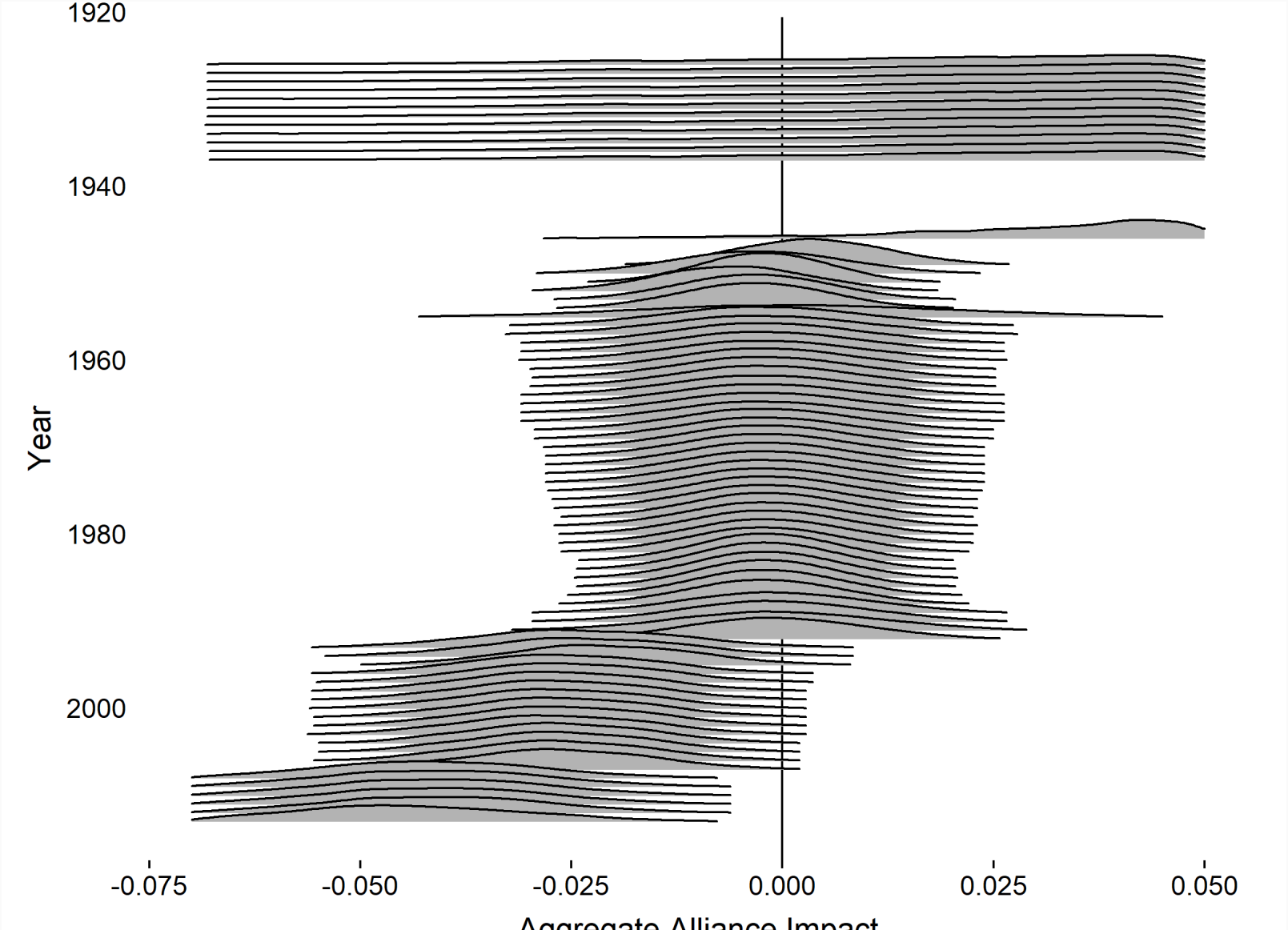
Impact of US Alliance on Non-major Power Military Spending



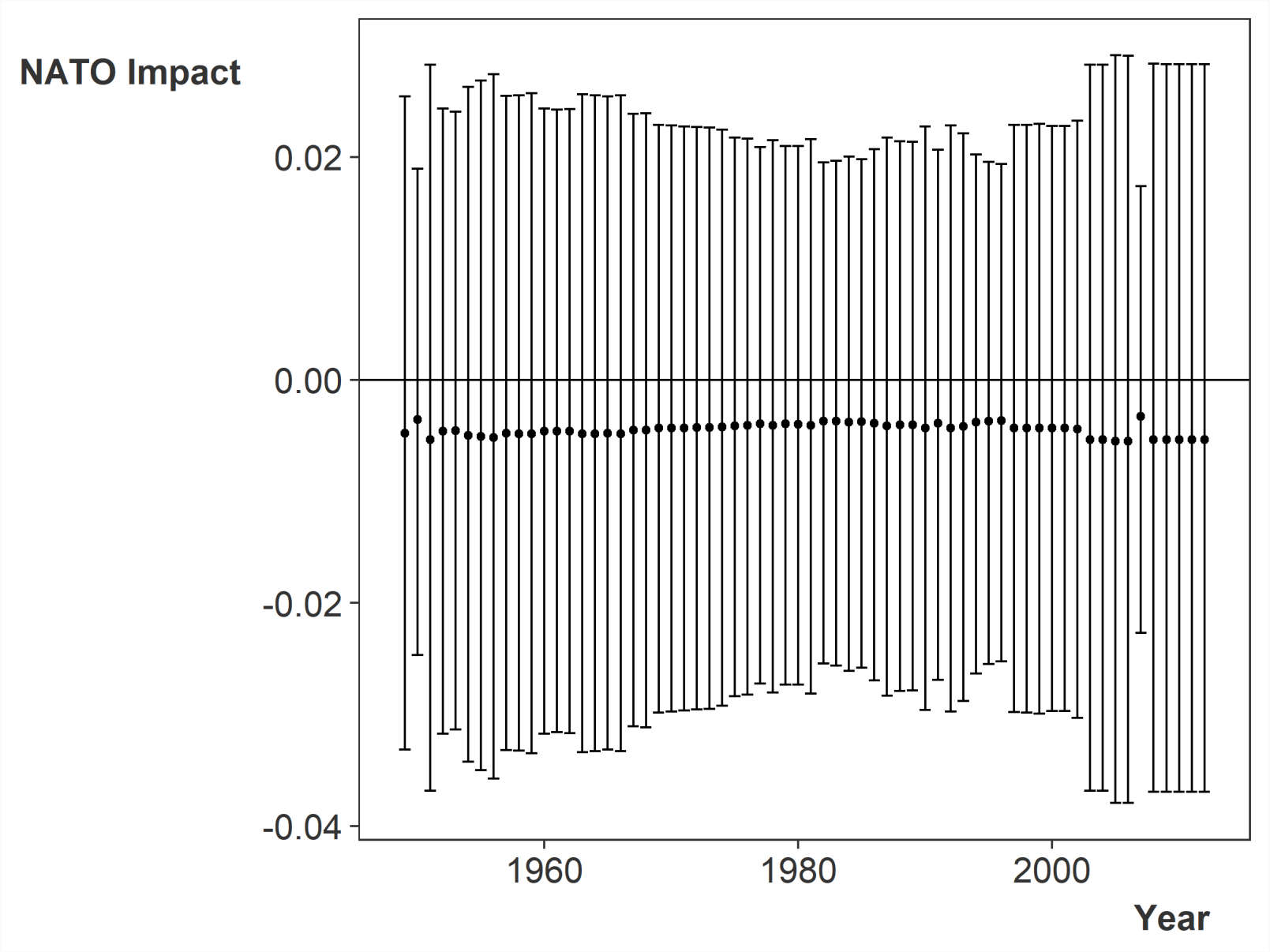
NATO



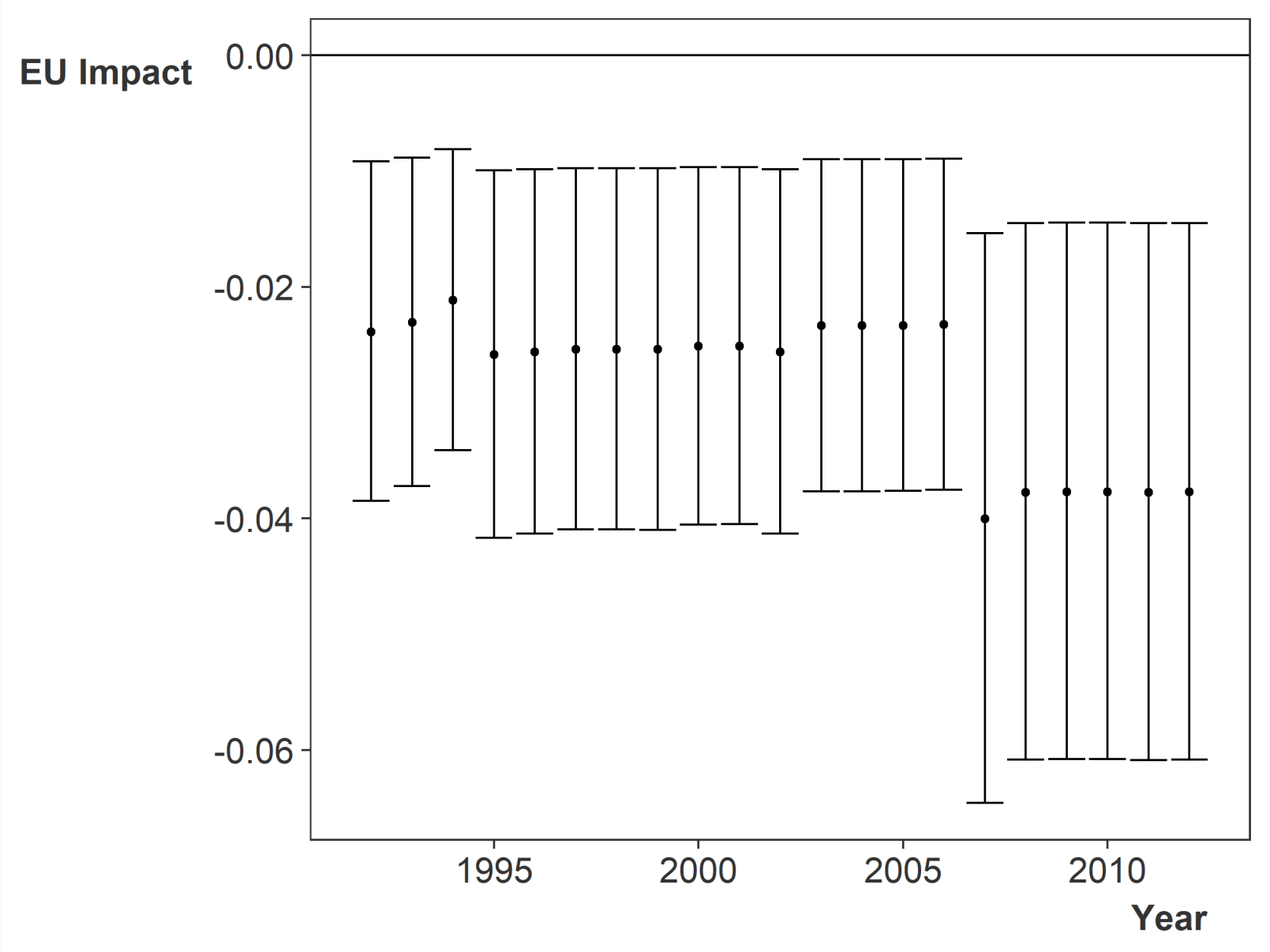
Alliance Participation and Military Spending: Belgium



Impact of NATO on Belgium



Impact of EU on Belgium



Varying Slopes Model

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

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

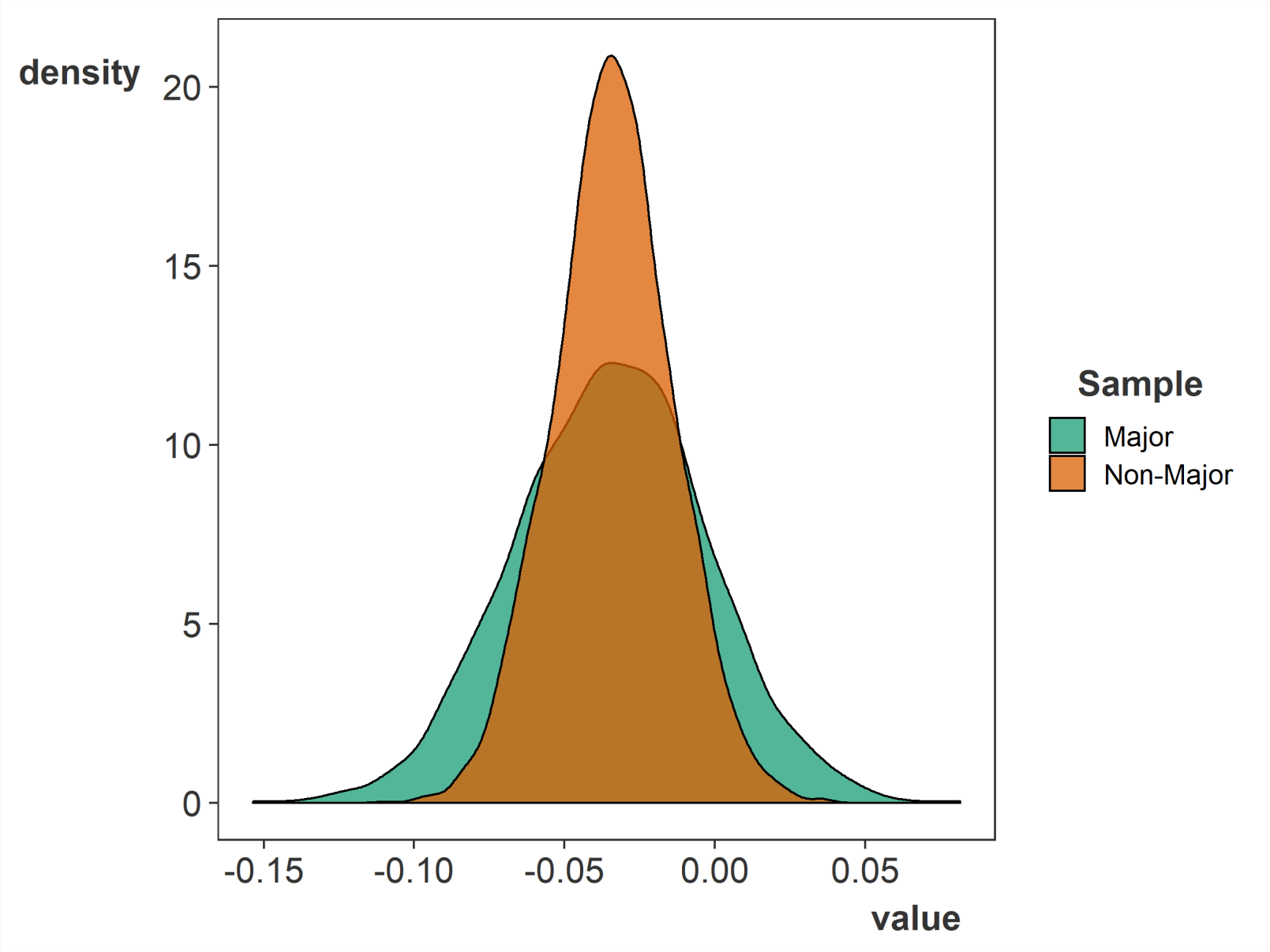
$$\lambda_j \sim N(\theta_j, \sigma_j^{all})$$

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

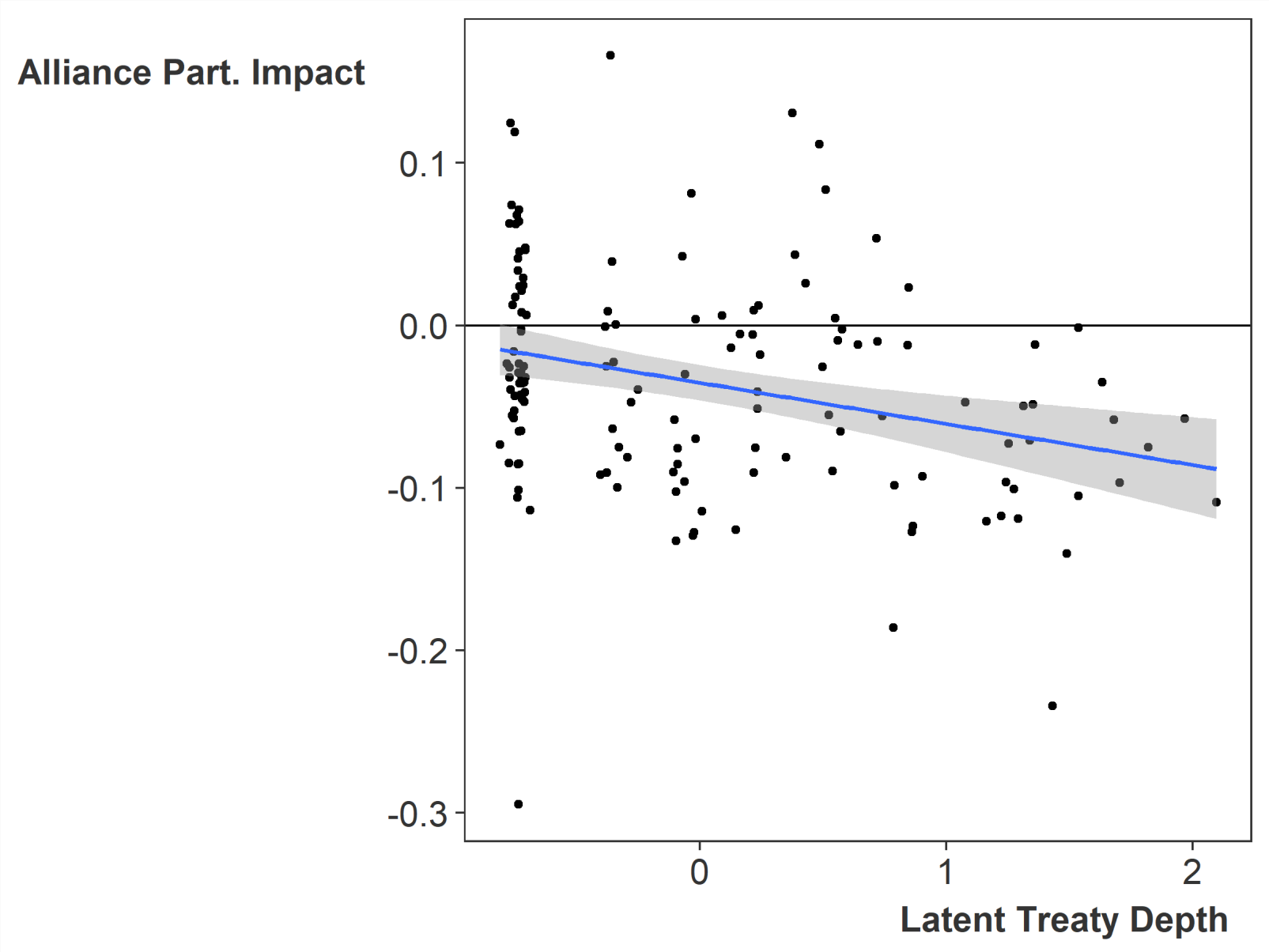
I give β_j a multivariate normal prior with prior scale τ:

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

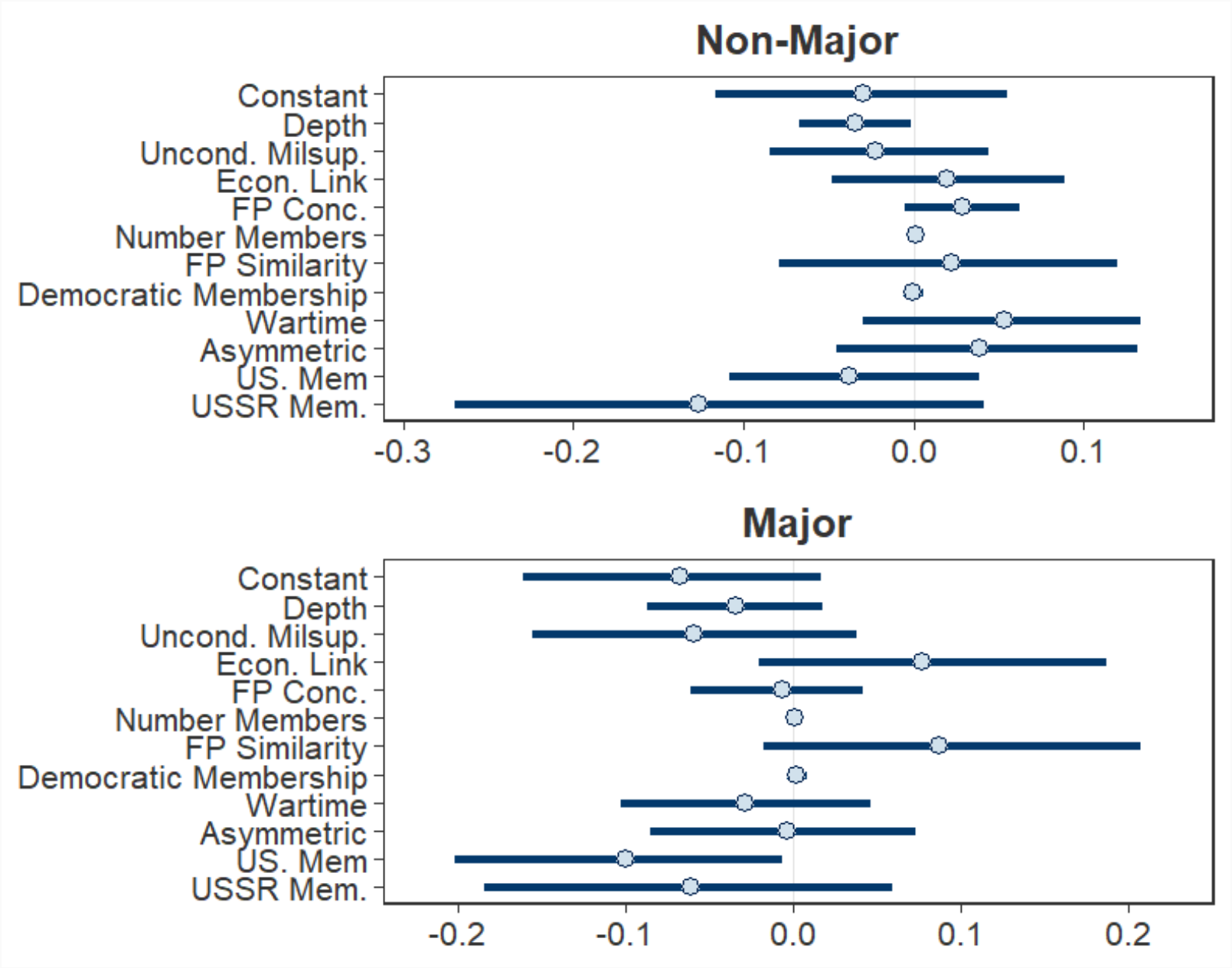
Varying Slopes Results: Depth



Treaty depth and λ: Major Powers



Full Varying Slopes Results



Correlates of War Spending Data

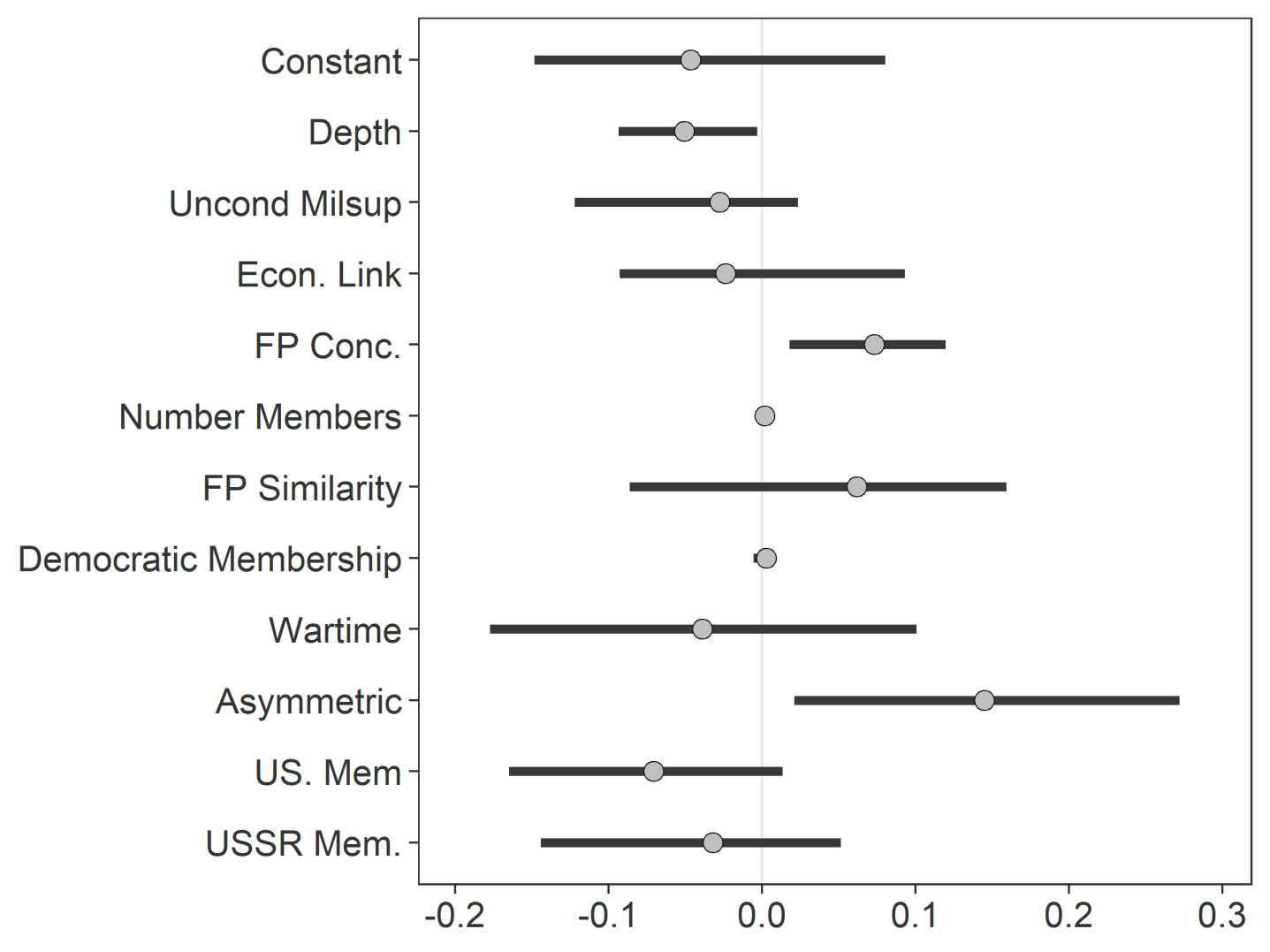
Is messy...

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

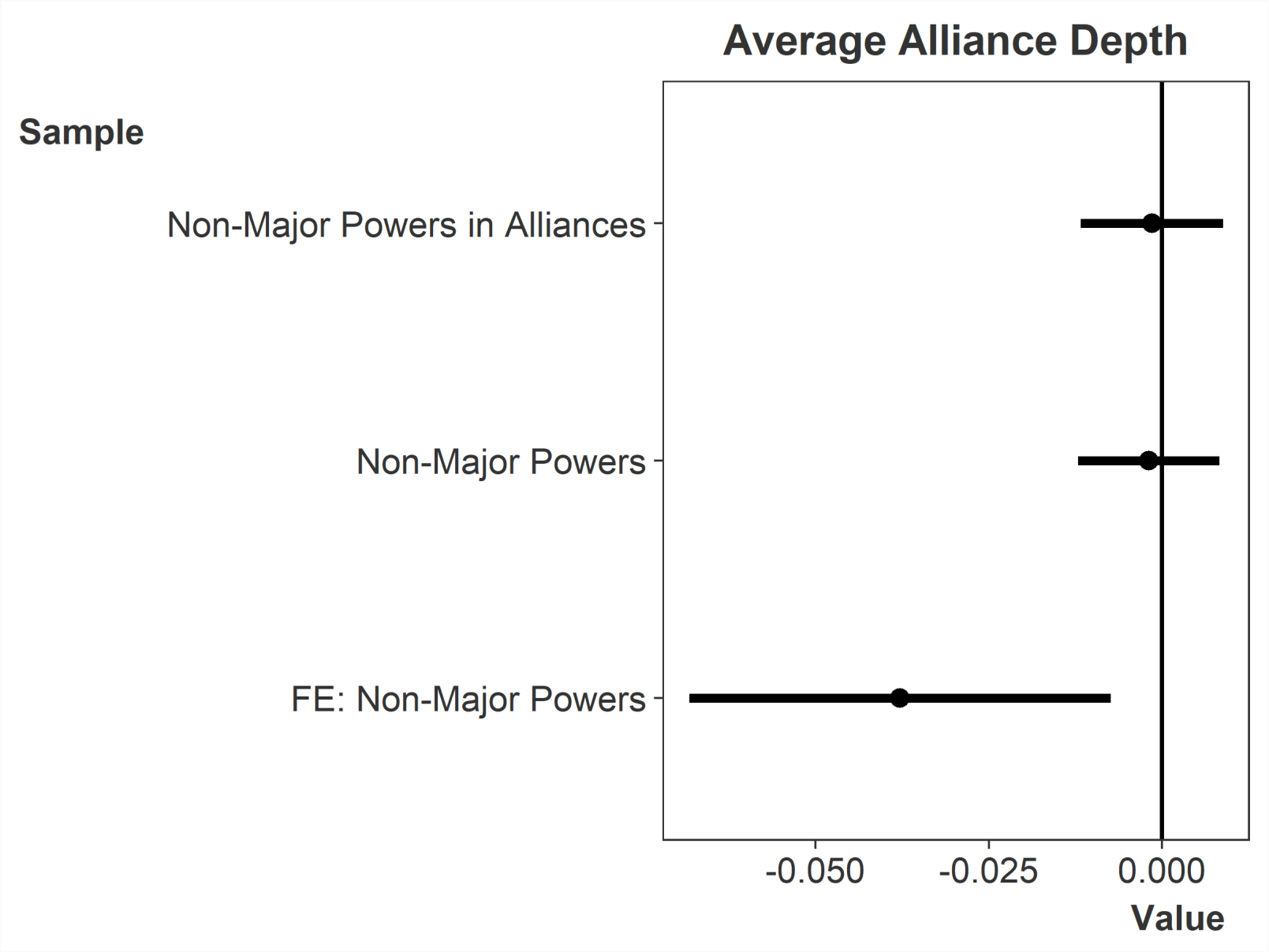
Alternative Measure of Military Spending

- 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.

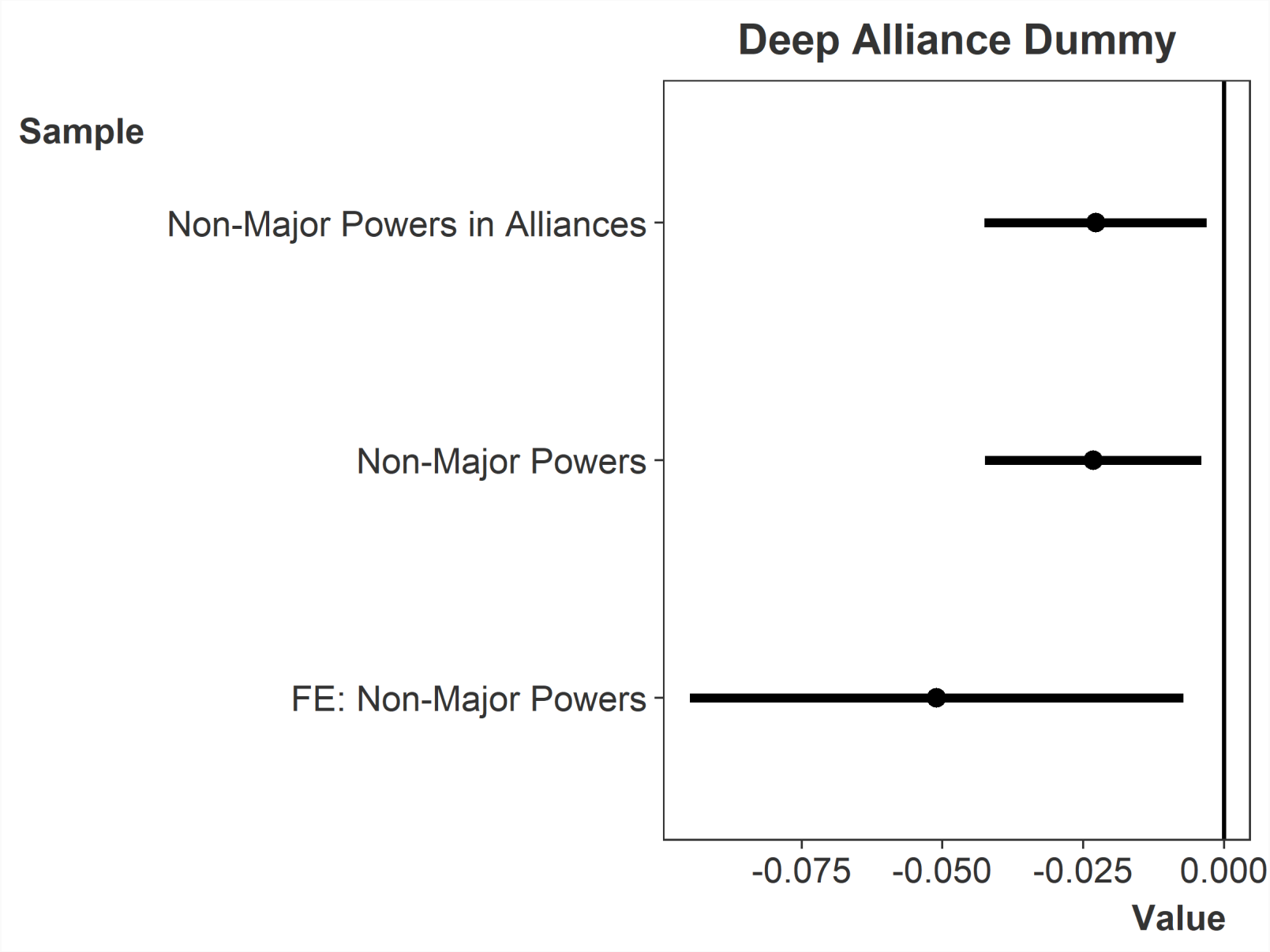
Alternative Measure of Military Spending: Results



Single-Level Regression: Average Depth



Single-Level Regression: Deep Alliance Dummy



Bounds Analysis of Single-Level Regression