Online Appendix for "Alliance Dynamics in the Shadow of Shifting Power"

Contents

1 Appendix A: Bargaining, MPE, and Network Details

1.1 Bargaining Protocol

In the absence of power shifts, transfers are made according to some specific bargaining protocol where ρ represents the protocol between alliance groups and ϕ represents the protocol within alliances. ϕ must specify how alliances divide resources in both war and peace.[1]

First note that it is possible under certain bargaining protocols that there need not exist a stable alliance state. Generally, these kinds of protocols are unreasonable for the alliance application. We remove the possibility by assuming that if the alliance formation procedure leads to no stable alliance states, then in any given alliance state, an allied player i can commit to transferring additional utility $u \leq v_i$ to its alliance partner. This is a natural modification to any arbitrarily specified alliance bargaining protocol, ϕ. Therefore, all ϕ throughout the paper are assumed to allow for the possibility that, when in state $\mathbf{a}$, one partner can unilaterally deviate toward granting the other more utility in order to induce them to not deviate from the alliance. However, potential alliance partners in other potential alliance states, $\mathbf{a}'$ cannot credibly commit to deviating from ϕ in order to break up an otherwise stable $\mathbf{a}$. That is, players know how bargaining will play out in other alliance states when determining whether or not to deviate from the current state $\mathbf{a}$.

For our second restriction, it is helpful to define $\sigma^{\mathbf{a}}$ as the total surplus consumption available in peace versus a war to the finish in alliance state $\mathbf{a}$. So in all alliance states $\mathbf{a}$, $\sigma^{\mathbf{a}} = X - (w_1^{\mathbf{a}} + w_2^{\mathbf{a}} + w_3^{\mathbf{a}})$. Let $\sigma_i^{\mathbf{a}}(\rho)$ be the absolute amount of peaceful surplus captured by isolated country or alliance group i under protocol ρ.

We restrict ρ and ϕ with the following assumption:

Assumption (A). *Bargaining protocols must satisfy the following restrictions:*

1. *(ρ is responsive to military strength) In the absence of a power shift, ρ is restricted to imply that for isolated country or alliance group i, $\frac{\sigma_i^{\mathbf{a}}(\rho)}{\sigma^{\mathbf{a}}}$ is weakly increasing in its war value, $w_i^{\mathbf{a}}$.*

2. *(ϕ incorporates the no alliance outside option when feasible) In the absence of a power shift, if $v_i^{ij} + v_j^{ij} > v_i^0 + v_j^0$, then $v_i^{ij} > v_i^0$ and $v_j^{ij} > v_j^0$.*

Both parts of this assumption are generally, but not always reasonable. A1 restricts attention to cases where increasing the military power of a country or alliance group, weakly increases the proportion of any available bargaining surplus that the country or alliance group captures. If ρ violates A1, then bargaining power may be declining in military power. A1 may be violated in cases where conventions that ignore military power (such as voting rules) dominate bargaining.

A2 states that if an alliance can afford to give both of its members more than they would get in the no alliance state, then it does so. If ϕ violates A2, then alliance members may have an immediate, individual deviation to the no alliance state even when an alliance offers an overall surplus to its members. A2 may be violated in cases where the alliance is highly restricted in its internal bargaining, either by a limited ability to commit to internal bargains or by convention.[2] That A2 is freely violated in models that study alliances with pre-assigned roles is one reason these models are not generally satisfying. It's frequently unclear whether results in the assigned role context extend to optimal deviations in the alliance partner.

When power is shifting in a given period, in order to err on the side of not over predicting war, bargains are unrestricted for the period. Or, equivalently, these bargaining protocols can be thought of as specifying rules contingent on whether or not power shifts occur. When power shifts do occur, the rule is responsive

[1] Note, one protocol for war might be that alliances must divide resources according to the power relation that exists after a war eliminates the out country. However, we generalize this and also consider other protocols where alliances can commit to other divisions.

[2] Note that another possible restriction similar in spirit to A2 would require that in the absence of strength shifts, if $v_i^{ij} + v_j^{ij} > v_i^{\mathbf{a}} + v_j^{\mathbf{a}}$, then $v_i^{ij} > v_i^{\mathbf{a}}$ and $v_j^{ij} > v_j^{\mathbf{a}}$ for all $\mathbf{a} \neq ij$. However, this restriction may be impossible to satisfy since it is possible that $v_i^{ij} + v_j^{ij} > v_i^{ik} + v_j^{ik}$ and $v_i^{ij} + v_j^{ij} > v_i^{jk} + v_j^{jk}$, but that $v_i^{ik} + v_i^{jk} > v_i^{ij} + v_j^{ij}$. Moreover, when possible, this restriction would identify a strict subset of the cases allowed under A2.

to the nature of the power shift. This assumption represents the idea that bargains should be as flexible as possible in order to avoid war due to power shifts, but once power stops shifting, countries will bargain according to some fundamental rule and previous promises to not obey this rule are not credible.

1.2 MPE Restriction

Restricting attention to Markov strategies is useful in the current context for reasons similar to those given in Maskin and Tirole (1988). In particular, this paper is interested in short-run behavior. When focusing on short-run behavior, it is reasonable to expect that past actions that have little influence on the current state are of minimal importance.

Lemma 1 can be used to illustrate why this paper focuses on MPE instead of SPE and why this is a largely reasonable restriction. When a unique stable alliance exists in the stage game, the war values are the minmax values achievable in the repeated game. For Table 1, this is the vector $\mathbf{w}^{\{23\}} = (0.423,\ 0.310,\ 0.168)$ which is the same as $\mathbf{v}^{\{23\}}$ except that the members of the alliance do not capture the bargaining surplus. When patience, δ, is high the folk theorem applies and any equilibrium such that all players i achieved a value greater than or equal to $w_i^{\{23\}}$ is possible. This may include equilibria where players agree to enter alliances other than $\{23\}$ in some percentage of periods. Alternatively, $\{23\}$ may form every period, but any bargain value may become possible so long as all players i receive $w_i^{\{23\}}$ or higher.

Neither of these complications with SPE pose a substantive problem. All equilibria where alliances switch with some probability has a payoff equivalent equilibria where alliances do not change. If there is some small cost to alliance switching (which is reasonable), these equilibria will be dominated by some equilibrium without switching. If these costs are assumed, then Lemma 1 holds for all SPE as well as MPE. The issue that the final payoff in a SPE may deviate from $\mathbf{v}^{\{23\}}$ is where the MPE assumption is particularly convenient. The model already allows for largely arbitrary bargaining protocols ρ and ϕ. The only new payoffs that SPE would allow beyond those that are possible with ρ and ϕ are those that are ruled out in the stage game by Assumption A. The MPE restriction has bite in that it allows us to restrict payoffs to those that are allowed under Assumption A and correspond to the specified bargaining protocols ρ and ϕ.

1.3 Network

To clarify ideas and provide a formal description of war interactions between more than two countries, potential military interactions are modeled as a network consisting of a collection of nodes and a collection of undirected links between them. Each node represents a country and two countries can go to war with each other only if they share a link. Linked countries may share a land border, or possess sea or air forces capable of reaching one another. Undirected links represent a situation where either linked country can initiate war. A directed link would represent a situation where only one country in a linked country pair is able to initiate a conflict. This might be the case where one country dominates a realm of battle. An example might be a dominant sea power such as 19th century Britain.

The set of links is represented by $l \subseteq N^2$, with a typical element $ij \in l$ representing an undirected link between country i and country j. We assume that the network is *connected,* meaning that there is a path of links between any two countries. Let $\mathbf{L} \subseteq N^2$ denote the set of all possible connected networks with undirected links. In a *complete network* every country shares an undirected link with every other country. In the case of three countries, the only other connected network is the *railroad network* which is the same as the complete network, but with a single missing link.

In this paper, in order to focus our attention on the interaction between strength and alliance shifts, we only consider the case of undirected links on a complete network. A related research project studies the impact of network type and dynamics on preventive conflict and alliance formation.

1.3.1 War on Networks

In this section we re-describe how war operates in our model, but with the full formalization of the network. In the current paper, we only study the case of complete networks and given our assumptions, wars in equilibrium will involve all countries fighting at once. However, it is important to specify how wars operate when they only involve two out of three countries in order to clarify the nature of off the equilibrium path behavior.

When a country starts a war with another country to which it is linked, this link has become *engaged*. Consumption is assumed to be 0 for any country with an engaged link. War is assumed to be instantly decisive between combatants (a loser immediately transitions to $s = 0$). In a two country war, i wins with probability $p_i = s_i / (s_i + s_j)$. A three country war, without a coordinated alliance, is won by i with probability $p_i = s_i / (s_i + s_j + s_z)$. When fighting along two links against a coordinated alliance, i faces a penalty for fighting on two fronts of $\chi \in \{1, ..., \min\{s_1, s_2, s_3\}\}$, so that i's probability of victor becomes $p_i(\chi) = (s_i - \chi) / (s_i - \chi + s_j + s_z)$.[3] It is reasonable that there would also be a smaller penalty, $\psi < \chi$ for fighting two uncoordinated opponents who are not linked and therefore cannot attack each other. We will simplify by assuming that $\psi = 0$.

It is not realistic that there are no penalties for fighting a two-front war even with uncoordinated countries, but it is reasonable that the penalty is smaller than fighting against coordinated opponents. The most important aspect of this assumption, which may or may not be true in a given situation, is that by assuming there is no penalty for fighting uncoordinated opponents, it is optimal to spread war in the no alliance case. An additional aspect of this assumption is that, while it does not qualitatively affect the results, incorporating $\psi > 0$ in the examples of incomplete networks would make middle-wing alliances relatively more attractive.[4]

If one country is defeated, so that two countries remain, the country that beat the defeated country acquires the defeated countries resources, so that if for instance, i wins against j, $s_i = \min\{s_i + s_j,\ K\}$. Defeated countries receive a continuation payoff of 0.

Any country winning along any engaged link with a newly disarmed country i, inherits all of i's links and receives an equal share of i's resources x_i with all other victors.[5] Since a country j only inherits a defeated country i's links after this period's war resolves, if j is not initially connected to z, j must wait until next period to use i's link to fight z if so desired.

Let w_i represent i's war value for continuing to fight until all opponents are defeated. When fighting two uncoordinated opponents at once,

$$w_i = \delta \frac{s_i}{s_i + s_j + s_z}$$

since consumption is lost in the one period of fighting. Similarly, when fighting two coordinated opponents at once,

$$w_i = \delta \frac{s_i - \chi}{s_i - \chi + s_j + s_z}.$$

When fighting opponents in sequence over two periods,[6]

$$w_i = \delta^2 \left(\frac{s_i}{s_i + s_j}\right)\left(\frac{s_i + s_j}{s_i + s_j + s_z}\right) = \delta^2 \frac{s_i}{s_i + s_j + s_z}.$$

2 Appendix B: Proofs

Before proving Lemma 1 from the main text, it is useful to establish the following additional lemma.
Lemma 2.

[3] This particular contest success form assumed here is not necessary for the results. They are provided for concreteness and to ease exposition of the alliance-utility tables below.

[4] The middle country faces a higher cost of war in the no-alliance state, which lowers its outside option and makes it a more attractive alliance partner.

[5] The sharing rule does not qualitatively affect the result.

[6] An alternative formulation would be that j and z pool their resources in state j and fight in a single period on j's territory. This would imply $w_i = \delta\,(s_i - \chi' / s_i - \chi' + s_j + s_z)$ where χ' is the penalty for fighting two coordinated opponents on a single front. This formulation would give similar results to the one explored here. The formulation used here is chosen for its parsimony and its intuitive relationship to strategic depth.

1. If $s_i' > s_i$ and $s_j' = s_j$ for all $j \neq i$, then $w_i^{\mathbf{a}}(\mathbf{s}') > w_i^{\mathbf{a}}(\mathbf{s})$.

2. $v_i^0 > v_i^{jz}$.

3. Under peace, $v_i^{ij} + v_j^{ij} > v_i^0 + v_j^0$.

2.1 Proof of Lemma 2

Proof. Statement 1 requires showing that in all cases, war values are increasing in a player's strength state.

When i faces uncoordinated opponents, then $w_i = \delta s_i / (s_i + s_j + s_z)$. The derivative with respect to s_i is

$$\frac{dw_i}{ds_i} = \delta \frac{s_j + s_z}{[s_i + s_j + s_z]^2} > 0.$$

Similarly, this derivative is

$$\frac{dw_i}{ds_i} = \delta^2 \frac{s_j + s_z}{[s_i + s_j + s_z]^2} > 0$$

when i is facing coordinated opponents with a single link to i. When facing coordinated opponents, both with links to i, the derivative becomes

$$\frac{dw_i}{ds_i} = \delta \frac{s_j + s_z - \chi}{[s_i - \chi + s_j + s_z]^2}$$

which is positive since $\chi \leq \min\{s_1, s_2, s_3\}$.

Statement 2 requires demonstrating that countries always do better when facing uncoordinated opponents, then coordinated opponents.

Since by Assumption A1, ρ is restricted to imply that $\frac{\sigma_i^{\mathbf{a}}(\rho)}{\sigma^{\mathbf{a}}}$ is weakly increasing in $w_i^{\mathbf{a}}$, it follows that $v_i^{\mathbf{a}}$ is weakly increasing in $w_i^{\mathbf{a}}$ if $\sigma^{\mathbf{a}}$ is constant or increasing within an alliance state as $w_i^{\mathbf{a}}$ changes. Hence, increasing $w_i^{\mathbf{a}}$ in all such state weakly increases $v_i^{\mathbf{a}}$.

This is clearly true in all states since $\sigma^{\mathbf{a}}$ is independent of the distribution of probability of victory in all cases except one. In the railroad network with a middle-wing alliance, $\sigma^{\mathbf{a}}$ is changing in the middle countries probability of victory. In this case, $\sigma^{\mathbf{a}} = p_m(1-\delta) + (1-p_m)(1-\delta^2)$ where p_m is the probability that the middle country defeats the out country in the first round. Since, $\delta < 1$, then $1-\delta < 1-\delta^2$. Hence, increasing p_m reduces the bargaining surplus. Hence, increasing $w_o^{\mathbf{a}}$ where o is the out country (through changes in one or more of the country's strength states), either does not affect p_m or reduces it. Hence, increasing $w_o^{\mathbf{a}}$ through strength state changes weakly increases $\sigma^{\mathbf{a}}$. Alternatively, increasing $w_o^{\mathbf{a}}$ through decreasing δ strictly increases $\sigma^{\mathbf{a}}$. Since $\frac{\sigma_i^{\mathbf{a}}(\rho)}{\sigma^{\mathbf{a}}}$ is weakly increasing in w_o by assumption, increasing $w_o^{\mathbf{a}}$ weakly increases $\sigma_i^{\mathbf{a}}(\rho)$ in this case, therefore $v_0^{\mathbf{a}}$ is weakly increasing in $w_o^{\mathbf{a}}$. Therefore, we can state that it is alway true that v_i^{jz} is weakly increasing in w_i^{jz}. Additionally, a middle-wing alliance is excluded by definition in the no-alliance state, so v_i^0 is weakly increasing in w_i^0.

This then implies that we need only show that $w_i^0 > w_i^{jz}$ in order to proof statement 2.

It is always the case that $w_i^0 > w_i^{jz}$ or

$$\frac{s_i}{s_i + s_j + s_z} > \frac{s_i - \chi}{s_i - \chi + s_j + s_z}$$

because $s_i(s_i + s_j + s_z) - \chi s_i > s_i(s_i + s_j + s_z) - \chi(s_i + s_j + s_z)$ and canceling leads to $s_j + s_z > 0$ which is true by the assumption that j and z are initially active.

Under peace, statement 3 follows almost immediately from statement 2. Since peace is efficient, $v_i^{ij} + v_j^{ij} = X - v_z^{ij}$ and $v_i^0 + v_j^0 = X - v_z^0$. From 2, it must be the case that $v_z^0 > v_z^{ij}$. From $c \geq 0$, it must be that $v_z^{\mathbf{a}} \geq 0$ Hence, $v_i^{ij} + v_j^{ij} > v_i^0 + v_j^0$. □

2.2 Proof of Lemma 1

Proof. From Lemma 2.1 and Lemma 2.2, Assumption 1 from Krainin (2014) holds. Therefore, Proposition 1 from Krainin (2014: proof found on pages 435 - 437) holds and a stable state exists in the stage game $\Gamma(t)$.

Assume there exists a unique stable state, $\mathbf{a}$ of the stage game $\Gamma(t)$. $\mathbf{a}$ only forms if it gives the highest possible payoffs for at least 2 players and the third does weakly worse under war. Therefore, $\mathbf{a}$ gives a higher stage game payoff for all players relative to their individually available deviations. Hence, deviations are possibly beneficial only if future play is affected by a deviation. However, under Markov strategies, players do not condition on payoff irrelevant past actions. □

2.3 Proof of Proposition 1

Proof. Part 2 of Proposition 1 follows from the example in the text labeled "Alliance shift exacerbates a strength shift."

Part 1 of Proposition 1 can be operationalized as claiming that for an initially non-allied i, it must be the case that

$$(1-\delta)\, c_i + \delta \left[v_i^{\mathbf{a}'}\left(\mathbf{s}'\right)\right] \quad > \quad (1-\delta)\, c_i + \delta \left[v_i^{\mathbf{a}}\left(\mathbf{s}'\right)\right].$$

Where $\mathbf{a}'$ and $\mathbf{s}'$ are the alliance and strength state after a shift in power. This immediately reduces to

$$v_i^{\mathbf{a}'}\left(\mathbf{s}'\right) \quad > \quad v_i^{\mathbf{a}}\left(\mathbf{s}'\right).$$

WLOG, let $\mathbf{a}' = ij$ since i must be included in the alliance after an alliance switch.

Since by assumption, i is not allied in period 1, then the initial alliance state, $\mathbf{a}$, is either 0 or jz. Therefore, without alliance switching, i receives a value $v_i^{\mathbf{a}}(\mathbf{s}') \leq v_i^{0}(\mathbf{s}')$ since $v_i^{jz}(\mathbf{s}') \leq v_i^{0}(\mathbf{s}')$ by Lemma 2.2. By Lemma 1, a peaceful alliance forms once power stops shifting, hence Lemma 2.3 applies. By Lemma 2.3, the conditional statement in Assumption A.2 holds. Therefore, $v_i^{ij}(\mathbf{s}') > v_i^{0}(\mathbf{s}') \geq v_i^{jz}(\mathbf{s}')$ which then implies $v_i^{\mathbf{a}'}(\mathbf{s}') > v_i^{\mathbf{a}}(\mathbf{s}')$. □

2.4 Proof of Corollary 1

Proof. Lemma 1 establishes that when an anticipated strength shift is size 0, then no alliance shifts occur. Proposition 2 demonstrates the existence of a nonempty set of parameters where an anticipated strength shift causes an alliance shift. Together this implies that for some parameters, an alliance shift will occur for a nonzero anticipated strength shift. Let $\hat{z}$ be the smallest such value. By definition no alliance shifts occur for the range $[0, \hat{z})$. By construction all $z \in [0, \hat{z})$ do not result in an alliance shift while $z = \hat{z}$ results in 1 alliance shift. Let $\hat{z} = Z$. □

3 Appendix C: Theoretical Robustness

3.1 Persistent Shifts

Up to this point, all shifts have been assumed to last a single period. There are at least two ways to think about adding more general shifts to this model. The first would be one-time strength shifts that last $T \geq 1$ periods. The second would be to consider a model where strength is continually shifting with some probability (Fearon 2004; Paine 2016; Bas and Schub 2017).

Except for the most simplified versions, the latter type of shift is beyond the scope of the current paper. These types of shifts are interesting when characterizing long run equilibrium in international systems. The current model primarily analyzes the short run effects of shocks to a system with endogenously formed, but committed alliances.

The current model can be naturally extended to incorporate the first type of strength shift. Persistent shifts of this type may combine features of anticipated and unanticipated shifts from the baseline model.

When a shift is known to last more than a single period, even if it begins as an unanticipated shift in the initial period, in future periods the shift will be anticipated and potentially influence alliance formation. Consider the following initial scenario:

Table A1: Before Shift: Complete Network, $\mathbf{s} = (100, 97, 98)$, $\chi = 50$, $\delta = 0.9$

	no alliance	{12}	{13}	**{23}**
v_1	0.405	**0.467**	**0.467**	0.184
v_2	0.296	0.358	0.173	**0.407**
v_3	0.299	0.176	0.360	**0.410**

Now consider a shift of the the form $(i, z, T) = (2, 2, 2)$ where the third value of the vector represents the number of periods for which a shift persists. After one period of shifting, the system will be exactly as described in the section on anticipated shifts ($\mathbf{s} = (100, 99, 98)$ with a further anticipated shift to $\mathbf{s} = (100, 101, 98)$ the period after). If the game reaches that stage, the alliance {13} will form, war will be avoided, and players will receive values $\mathbf{v}^f = (0.416, 0.184, 0.400)$.

Going back to the first stage, if the initial shift was unanticipated, then a bargain of the following form would avoid war:

$$c_1 \geq \frac{1}{(1-0.1)} [0.184 - 0.9\,(0.416)] = -1.904$$
$$c_2 \geq \frac{1}{(1-0.1)} [0.357 - 0.9\,(0.184)] = 1.914$$
$$c_3 \geq \frac{1}{(1-0.1)} [0.360 - 0.9\,(0.400)] = -5.55$$

However, 2 cannot be satisfied and war occurs. That is, when 2 observes that the persistent, unanticipated shift in the initial stage, 2 recognizes that a further period of shifting will occur next period. At that time, if war has not occurred, the shift will be anticipated, causing {13} to form in order to avoid war in that period. However, anticipating this peaceful future alliance incentivizes 2 to initiate war immediately! Hence, as in the case of the two country model of persistent shifts, persistent shifts will impact alliance formation and war decisions in a manner similar to rapid (one period) shifts. Moreover, persistent economic shifts that are significant enough to cause conflict are more empirically realistic than very large and rapid economic shifts.[7]

3.2 Defensive Alliances

Alliances are assumed to be offensive in the baseline model. A defensive alliance would replace the assumption that alliance members make a binding commitment to go to war whenever their alliance partner does. Instead, the agreement to go to war would be binding only when an alliance partner is attacked by the out country.

The first thing to note about defensive alliances is that their differences with offensive alliances depend upon the network structure.[8] In the railroad network, a defensive alliance between the middle country and a wing country is indistinguishable from an offensive alliance. On the other hand, when power is static, a defensive alliance between wing countries can only bargain with war threats equivalent to those that are already possible in the no alliance state.[9] In a complete network, defensive alliances incorporate the defensive aspects of a middle/wing alliance in the incomplete network, but lack the offensive advantages of an offensive alliance between wing powers.

However, defensive alliances are not always inferior to offensive ones. If power shifts are known to be possible with some probability, a defensive alliance may prevent war since it is no longer possible for a current

[7]See Powell (1999: 133) for an argument as to why sufficiently large and rapid shifts in power are unlikely to be caused by economic changes.

[8]See Appendix A for a description of networks in this model.

[9]A defensive alliance between wing countries would, however, reduce the war threat of the middle country.

alliance member that will later become the out country to go to war with the forced support of its current partner. Similarly, a defensive alliance (as well as an offensive alliance) between all three countries will always prevent war. Essentially, defensive alliances often give up some bargaining power, but allow the system to avoid war in certain cases. From an interim perspective, when war would have occurred under offensive alliances, one country will be worse off in a defensive alliance than it would have been in an offensive alliance. From an ex-ante perspective, defensive alliances are relatively more valuable if countries are risk averse and the cost of war is high.

In practice, it may be difficult to distinguish which country initiates war. Moreover, commitments may not always be perfectly observable, possibly for strategic reasons. In light of these realities, it may be difficult to determine whether a defensive alliance is in effect, offensive, or just a commitment not to attack the alliance partner in the event of war with the out partner. Given this, the out country may interpret a defensive alliance as a probabilistically offensive alliance. When this is the case, a defensive alliance may share some characteristics with a pure offensive alliance and some characteristics with a pure defensive alliance.

4 Appendix D: Empirical Robustness Tests

Table A1: Summary Statistics

	N	Mean	St. Dev.	Min	Max
Region with Major Powers					
Outcome Variables					
Total Alliances Changed	655	0.70	1.63	0	13
Alliances Formed	655	0.37	0.99	0	12
Alliances Terminated	655	0.33	0.99	0	9
Explanatory Variables					
Expected Power Shift (Mean)	655	0.33	0.21	0.08	1.25
Expected Power Shift (Max.)	655	1.89	1.00	0.40	7.20
Expected Power Shift (Mean–3yrs)	653	0.89	0.57	0.20	3.28
Control Variables					
Alliance Start Count	655	4.46	6.01	0	27
Number States	655	21.26	9.85	6	50
Number Major Powers	655	1.63	2.05	0	6
Regional Uncertainty	655	0.49	0.15	0.28	0.95
War	655	1.01	2.01	0	13
War Termination	655	0.49	1.35	0	12
Region without Major Powers					
Outcome Variables					
Total Alliances Changed	526	0.68	1.69	0	13
Alliances Formed	526	0.35	1.00	0	12
Alliances Terminated	526	0.33	1.05	0	9
Explanatory Variables					
Expected Power Shift (Mean)	526	0.17	0.15	0.02	1.01
Expected Power Shift (Max.)	526	1.15	0.95	0.08	7.20
Expected Power Shift (Mean–3yrs)	524	0.47	0.40	0.07	2.49
Control Variables					
Alliance Start Count	526	4.35	6.17	0	27
Number States	526	21.98	10.08	3	46
Number Major Powers	526	2.03	2.10	0	6
Regional Uncertainty	526	0.44	0.11	0.28	0.73
War	526	1.18	2.18	0	13
War Termination	526	0.57	1.47	0	12

Table A2: Robust Standard Errors

	(1)	(2)	(3)
Expected Power Shift	0.15	0.76***	1.43***
	(0.23)	(0.28)	(0.40)
Year			0.004*
			(0.002)
Alliance Start Count			0.03
			(0.02)
Number Major Powers			−0.12
			(0.14)
Number States			−0.02
			(0.02)
Regional Uncertainty			−2.46***
			(0.88)
Constant	0.65***	1.34***	−4.81
	(0.10)	(0.19)	(3.85)
N	655	655	655
Region FEs	N	Y	Y

$^{*}p < 0.1$ $^{**}p < 0.05$ $^{***}p < 0.01$

Notes: OLS regression with region-year including major powers as the unit of analysis. Robust standard errors in parentheses. Outcome is number of intra-regional alliance changes. Region fixed effects not shown.

Table A3: Negative Binomial Analysis

	(1)	(2)	(3)
Expected Power Shift	0.23	0.75*	2.36***
	(0.41)	(0.42)	(0.52)
Year			0.003
			(0.003)
Alliance Start Count			0.04*
			(0.02)
Number Major Powers			0.12
			(0.14)
Number States			−0.004
			(0.02)
Regional Uncertainty			−4.45***
			(1.44)
Constant	−0.43***	0.21	−5.60
	(0.16)	(0.17)	(5.18)
θ	0.29*** (0.03)	0.45***	
(0.06)	0.57*** (0.08)		
N	655	655	655
Region FEs	N	Y	Y

$^{*}p < 0.1$ $^{**}p < 0.05$ $^{***}p < 0.01$

Notes: Negative binomial regression with region-year including major powers as the unit of analysis. Standard errors in parentheses. Outcome is number of intra-regional alliance changes. Region fixed effects not shown.

Table A4: Max. Anticipated Strength Shifts and Alliance Dynamics

	(1)	(2)	(3)
Expected Power Shift	0.29***	0.34***	0.26***
	(0.06)	(0.06)	(0.06)
Year			0.003
			(0.002)
Alliance Start Count			0.03
			(0.02)
Number Major Powers			−0.14
			(0.11)
Number States			−0.02
			(0.02)
Regional Uncertainty			−1.58
			(1.02)
Constant	0.16	0.95***	−2.45
	(0.13)	(0.15)	(4.01)
N	655	655	655
Region FEs	N	Y	Y

$^{*}p < 0.1$ $^{**}p < 0.05$ $^{***}p < 0.01$

Notes: OLS regression with region-year including major powers as the unit of analysis. Standard errors in parentheses. Outcome is number of intra-regional alliance changes. Region fixed effects not shown. Explanatory variable based on the maximum (rather than mean) absolute value strength shift within a region-year.

Table A5: Persistent Strength Shifts and Alliance Dynamics

	(1)	(2)	(3)
Expected Power Shift	0.04	0.26**	0.47***
	(0.11)	(0.12)	(0.15)
Year			0.003
			(0.002)
Alliance Start Count			0.03
			(0.02)
Number Major Powers			−0.14
			(0.11)
Number States			−0.02
			(0.02)
Regional Uncertainty			−2.58**
			(1.02)
Constant	0.67***	1.38***	−3.35
	(0.12)	(0.14)	(4.03)
N	653	653	653
Region FEs	N	Y	Y

$^{*}p < 0.1$ $^{**}p < 0.05$ $^{***}p < 0.01$

Notes: OLS regression with region-year including major powers as the unit of analysis. Standard errors in parentheses. Outcome is number of intra-regional alliance changes. Region fixed effects not shown. Explanatory variable based on three-year (rather than one-year) projected strength shifts for all states in region-year.

Table A6: Additional Sample Years

	(1)	(2)	(3)
Expected Power Shift	0.17	0.74**	1.35***
	(0.30)	(0.32)	(0.40)
Year			0.004*
			(0.002)
Alliance Start Count			0.03*
			(0.02)
Number Major Powers			−0.14
			(0.11)
Number States			−0.02
			(0.02)
Regional Uncertainty			−2.19**
			(0.95)
Constant	0.63***	1.35***	−4.55
	(0.12)	(0.14)	(3.82)
N	675	675	675
Region FEs	N	Y	Y

$^{*}p < 0.1$ $^{**}p < 0.05$ $^{***}p < 0.01$

Notes: OLS regression with region-year including major powers as the unit of analysis. Standard errors in parentheses. Outcome is number of intra-regional alliance changes. Region fixed effects not shown. Sample includes observations from *before* the first regional alliance in each region (provided it had at least three independent states) meaning the outcome variable definitionally equals zero for these additional observations.

Table A7: Dropping observations with *Expected Power Shift* in lowest quartile

	(1)	(2)	(3)
Expected Power Shift	−0.17	0.70*	1.37***
	(0.38)	(0.40)	(0.43)
Year			0.003
			(0.002)
Alliance Start Count			0.04
			(0.03)
Dyads			0.01
			(0.004)
Number Major Powers			−0.32**
			(0.13)
Regional Uncertainty			−1.68
			(1.09)
Constant	0.84***	1.53***	−2.76
	(0.17)	(0.18)	(4.06)
N	491	491	491
Region FEs	N	Y	Y

$^{*}p < 0.1$ $^{**}p < 0.05$ $^{***}p < 0.01$

Notes: OLS regression with region-year including major powers as the unit of analysis. Standard errors in parentheses. Outcome is number of intra-regional alliance changes. Region fixed effects not shown. Sample drops observations with an *Expected Power Shift* close to zero (the lowest quartile of values) to insure that results are not simply due to observations clustered at zero on the main explanatory and outcome variables.

Table A8: Including a proxy measure for preferences

	(1)	(2)	(3)
Expected Power Shift	2.68**	2.69*	2.29*
	(1.15)	(1.39)	(1.20)
UN Preference Dispersion		−0.02	
		(0.50)	
Change in UN Preference Dispersion			3.32*
			(1.76)
Constant	1.57***	1.60**	1.37***
	(0.34)	(0.69)	(0.37)
N	259	254	245
Region FEs	Y	Y	Y

$^{*}p < 0.1$ $^{**}p < 0.05$ $^{***}p < 0.01$

Notes: OLS regression with region-year including major powers as the unit of analysis. Standard errors in parentheses. Outcome is number of intra-regional alliance changes. Region fixed effects not shown. *UN Preference Dispersion* is the standard deviation of UNGA ideal point scores for all states in the region. *Change in UN Preference Dispersion* represents the year-over-year shift in that value for a region. Ideal point scores based on measures from Bailey, Strezhnev, and Voeten (2017).

Table A9: Including NATO in the analysis

	(1)	(2)	(3)
Expected Power Shift	0.15	0.75**	1.43***
	(0.31)	(0.33)	(0.42)
Year			0.004*
			(0.002)
Alliance Start Count			0.03*
			(0.02)
Number Major Powers			−0.12
			(0.11)
Number States			−0.02
			(0.02)
Regional Uncertainty			−2.46**
			(1.02)
Constant	0.66***	1.35***	−4.90
	(0.12)	(0.14)	(3.94)
N	655	655	655
Region FEs	N	Y	Y

$^{*}p < 0.1$ $^{**}p < 0.05$ $^{***}p < 0.01$

Notes: OLS regression with region-year including major powers as the unit of analysis. Standard errors in parentheses. Outcome is number of intra-regional alliance changes. Region fixed effects not shown. Sample includes NATO within the relevant regions, which is otherwise excluded because of minor powers across the regions (Canada, many states in Europe, Turkey).

Table A10: Splitting Early MENA Observations

	(1)	(2)	(3)
Expected Power Shift	0.15	1.00^{**}	0.75^{***}
	(0.31)	(0.43)	(0.20)
Constant	0.65^{***}	0.54^{***}	-0.23^{*}
	(0.12)	(0.14)	(0.12)
N	655	535	120
Region FEs	N	N	N

$^{*}p < 0.1$ $^{**}p < 0.05$ $^{***}p < 0.01$

Notes: OLS regression with region-year including major powers as the unit of analysis. Standard errors in parentheses. Outcome is number of alliance changes. M1 includes the full sample. M2-3 demonstrate that cross-regional comparisons drive the null result in the bivariate model without fixed effects. M2 excludes MENA observations from before the first non-major power alliance in the region. M3 analyzes only those excluded early MENA observations. The expected relationship holds within each subsample.

Problematic inter-regional comparisons. As noted in the manuscript, the null result in Table 3 Model 1 (recreated in Table A10 Model 1 here) primarily stems from the inclusion of 120 Middle East and North Africa observations from a period in which there were no fully local alliances. The alliances that do exist are primarily between European major powers and the Ottoman Empire. These 120 observations are notable because external major powers outnumber the local states. A higher ratio of external major powers to local states causes (1) the expected strength shift to increase because these tend to be larger for major powers and (2) the number of alliance changes to decrease because there are fewer local states with which to form an alliance. The average expected power shift in these observations is 60% above the full sample average while the average number of alliance changes is 75% below the full sample average. For these reasons, inter-regional comparisons are potentially problematic which argues for including fixed effects. Our main result holds when we exclude these MENA observations from the sample (Model 2 here). Importantly, we also find the expected relationship within the 120 MENA observations (Model 3 here), which further highlights the value of including regional fixed effects.