Appendix: Results from Alternate Specifications of the Agent-Based Model

The main document contains references to a number of alternate specifications of the agent-based model, which produce largely identical results. Given the consistency across runs, we do not directly report results from these additional runs in the paper, but for completeness we are making those results, along with a short discussion, available here. To enumerate, we change: 1.) the number of actors in the model, 2.) the threshold value for an actor to be considered a democracy, 3.) the number of dimensions on which actors have preferences, 4.) the degree to which capabilities vary across actors, and 5.) the efficiency with which capabilities are aggregated within an alliance. None of these robustness checks alters the central result that the probability of an alliance between similar-regime actors declines as their regime becomes more common in the system more generally.[1] Indeed, one conclusion from this appendix is that the reported effect in the main text is if anything conservative, as most robustness changes strengthen the observed results. That said, it is often informative to see the way in which parameter changes influence the strength of the main effect—results presented here provide that information.

The paper presents results from a representative run of the model with 40 actors, who hold preferences in five dimensions (four non-regime dimensions), with a threshold democracy value of .85 (on a [0,1] scale), with capabilities varying moderately across actors ($\alpha = .5$), and with capabilities aggregated fairly efficiently within alliances ($k = .9$). Below we present results from a wide range of robustness checks. In all cases, a given run collected enough data to ensure that there would be at least 1000 dyad-level observations at each level of systemic democracy. The results are understood most easily through figures analogous to Figure 3 in the main text. We thus present equivalent figures here. In addition, to facilitate comparison across specifications, Tables 1 and 2 present results from OLS regressions of average within-regime alliance probability on systemic democracy levels, thereby providing an easy way to see how slope coefficients change

[1] We also verified that results are consistent when altering the initial random number seed and when repeatedly resetting the random number seed over the course of the run, in each case using a seed determined according to the current date and time in milliseconds. As these results are substantively identical, we do not reproduce the relevant results in this document. For replicability, the primary results are produced with an initial, randomly selected random number seed of 8466061818130569.

as parameters of the model change. Table 1 contains results for linear regressions, which are very easily interpretable but which fit the data slightly less well, given obvious non-linearities. In each pair of models, the first provides results for an analysis of the average rate of alliance formation in democratic dyads, while the second examines alliance formation rates in autocratic dyads. To address the non-linearities, Table 2 introduces a quadratic term, producing a better fit, but slightly complicating interpretation. The remainder of this document summarizes the results from specific robustness checks.

Figures A2 and A3, and the corresponding results in Tables 1 and 2, present results for runs in a system of 20 and 10 actors, respectively. In each case, reducing the number of actors makes the effect of changing the level of systemic democracy if anything stronger than what was observed in the baseline case: the baseline probability of a within-regime alliance rises slightly, while the slope of the effect is larger.

The next robustness checks alter the threshold regime value for an actor to be considered democratic, which in the main analysis and most robustness checks is .85 (corresponding to 7 on a -10 to 10 scale), to either .7 or .5. The basic effects are unchanged, although expanding the range that constitutes democracies limits the size of the uptick in the probability of an alliance in autocratic dyads when the systemic is overwhelmingly democratic. This result is intuitive once one understands the source of the typical uptick. In overwhelmingly democratic systems with a high threshold value for democracy, there will typically be a large gap on the regime dimension between the non-democracies and all other actors in the system, providing a particularly strong reason for the few non-democracies that exist to paper over their differences on other dimensions of preferences.[2]

[2]Assume a threshold value of .85 and a system in which 38 actors are democratic and 2 are non-democratic. The non-democracies will have an average regime score of .425, which differs by .425 from the lowest possible regime score for a democracy. Thus, unless one or both non-democracies has a relatively high draw on the regime dimension, they are likely to be much more similar on that dimension to each other than they are to any other actor in the system, providing an unusually strong incentive to set aside differences on other dimensions of preferences. By contrast, in a world with a threshold regime value of .85 for democracy and only 2 democracies, against 38 non-democracies, it is very likely that at least some of the non-democracies will have regime scores only slightly below the cutoff, while the average regime score for the democracies will be .925, only .075 away from the upper limit for the non-democracies. In this situation, it is likely that the democracies will be able to identify reasonably attractive alliance partners among the non-democracies, thus somewhat reducing (at least in relative terms) the incentive to overlook large differences on other dimensions to form an alliance with each other. In short, when the threshold value for democracy is high, non-democracies are systematically more likely to be very different from all democracies in a democracy-dominated system than are democracies to be systematically very different from all non-democracies in a non-democracy dominated system.

Consistent with this point, the uptick declines when the threshold value for democracy is .7. When the threshold value is .5, the effect of a changing system on democratic alliance probabilities is effectively the mirror image of the effect for autocratic alliance probabilities.

The next four robustness checks all relate to the way in which the model handles capabilities. The first two, graphed in Figures A6 and A7, alter the distribution of capabilities across actors. Recall that capabilities are determined by taking a draw from a uniform distribution over the $[0, 1]$ range and raising the resulting value to $-\alpha$, where $0 \leq \alpha \leq 1$ is an exogenously defined parameter. This approach produces capabilities that are distributed according to a power-law relationship, with most actors having capabilities slightly larger than 1 but some being several times stronger than average. The primary analyses use a value for α of .5, which produces a moderate range of capability distributions, with the strongest actor in a median run roughly seven times stronger than the weakest. The robustness checks set the distribution of actor capabilities to the extremes of $\alpha = 1$, corresponding to maximal capability variation (with the strongest actor typically over 60 times stronger than the weakest), and α=0, corresponding to constant capabilities across actors. Increasing capability variation appears to flatten effects slightly, while reducing variation strengthens the effect, but the differences involved are minimal.

The following two checks (Figures A8 and A9) relate to the efficiency with which alliances cumulate capabilities. In the basic model, the strength of alliance F_i in its interactions with other actors is equal to $k \sum_{j \in Fi} c_j$, where $k \in [0, 1]$ represents the efficiency with which alliances cumulate the capabilities of members and c_j represents the capabilities of individual actors. The primary analysis uses $k = .9$, which corresponds to high but imperfect cumulation. Two robustness checks allow for perfect cumulation ($k = 1$) and very inefficient cumulation ($k = .7$). Unsurprisingly, more efficient capability cumulation produces a greater willingness to ally, while low efficiency has the opposite effect. Especially in the latter case, this change to the baseline willingness to ally alters the slope of the relationship between within-regime alliance behavior and systemic democracy levels, although the central comparative static relationship is preserved. In addition, Figure A10 presents results from an alternate approach that imposes diminishing marginal returns to alliance size by setting the combined capabilities of alliance F_i to $(\sum_{j \in F_i} cap_j)^{k(f-1)}$, where f is the number of

different members of the alliance (including i).[3] By raising k to the $(f-1)$ power, this formulation increases the inefficiency penalty associated with alliances for each new member that is added, making particularly large alliances unattractive. As with all other specifications, the central finding that democracies become less likely to ally as the system becomes more democratic (with autocracies becoming more likely to ally) is preserved.

Figures A11 and A12 present results when actor preferences are limited to two or three dimensions, respectively, instead of the standard five. Intuitively, we should expect that increasing the number of different dimensions for preferences would tend to wash out the effects of democracy, attenuating the relationship of interest. Results in these figures and in Tables 1 and 2 confirm this intuition. As the number of dimensions to preferences decreases, within-regime alliances become more common at every level of systemic democracy, while the marginal effect of changes to systemic democracy increases. These checks thus provide another indication that the parameter specifications used to produce the results in the main text were relatively conservative.

Finally, Figure A13 presents results from a run that alters the alliance proposal procedures. In the standard model, each actor receives one opportunity to propose alliances and can only successfully propose a single alliance. This version of the model, by contrast, resets the list of actors who will have an opportunity to serve as proposer every time a proposal is accepted. As a result, each iteration of the model ends only when every actor in sequence has taken a turn as proposer and has failed to form a new alliance; in this circumstance, the alliance system is stable, in the sense that there exist no utility-improving alliances that the actors have not identified. As is evident from the figure and from the results in Tables 1 and 2, this modification produces at most a limited difference in secondary implications, with the primary comparative static result unchanged.

[3]For this robustness check, k is set to .95. The change to the formula means that the value of k in this specification does not directly correspond to a particular value for k in the standard specification. As a value of .9 for this robustness check produced a rather sparse alliance structure (albeit with the standard comparative static effect for changes to the systemic prevalence of democracy), a slightly higher value was used.

Table 1: Model Results for Different Parameter Settings (Linear Specification)

DV: Alliance Prob.	Baseline		20 Actors		10 Actors		Dem. Threshold= .7	
Variable	Dems.	Auts.	Dems.	Auts.	Dems.	Auts.	Dems.	Auts.
Prop. Democracy	-0.12**	0.16**	-0.16**	0.20**	-0.25**	0.24**	-0.13**	0.16**
	(0.0066)	(0.013)	(0.013)	0.019	0.031	(0.034)	(0.0081)	(0.014)
Intercept	0.18**	0.034**	0.25**	0.065**	0.39**	0.12**	0.18**	0.038**
	(0.0040)	(0.0073)	(0.0083)	(0.0098)	(0.020)	(0.016)	(0.0048)	(0.0075)
N	39	39	19	19	9	9	39	39
	Dem. Threshold= .5		No Power Variation		High Power Variation		High Alliance Efficiency	
Variable	Dems.	Auts.	Dems.	Auts.	Dems.	Auts.	Dems.	Auts.
Prop. Democracy	-0.15**	0.15**	-0.13**	0.18**	-0.10**	0.13**	-0.12**	0.19**
	(0.012)	(0.012)	(0.0079)	(0.017)	(0.0082)	(0.012)	(0.011)	(0.016)
Intercept	0.20**	0.046**	0.19**	0.031**	0.16**	0.035**	0.20**	0.051**
	(0.0073)	(0.0067)	(0.0047)	(0.0095)	(.0049)	(0.0064)	(0.0065)	(0.0087)
N	39	39	39	39	39	39	39	39
	Low Alliance Efficiency		2 Pref. Dimensions		3 Pref. Dimensions		Alt. Proposals	
Variable	Dems.	Auts.	Dems.	Auts.	Dems.	Auts.	Dems.	Auts.
Prop. Democracy	-0.052**	0.053**	-0.23**	0.35**	-0.17**	0.27**	-0.11**	0.17**
	(0.0051)	(0.0056)	(0.019)	(0.028)	(0.010)	(0.021)	(0.011)	(0.014)
Intercept	0.088**	0.023**	0.45**	0.073**	0.29**	0.049**	0.19**	0.044**
	(0.0030)	(0.0031)	(0.011)	(0.015)	(0.0062)	(0.012)	(0.0066)	(0.0076)
N	39	39	39	39	39	39	39	39

Significance levels : $*$: 5% $**$: 1%. All tests are two-tailed.

Table 2: Model Results for Different Parameter Settings (Quadratic Specification)

DV: Alliance Prob.	Baseline		20 Actors		10 Actors		Dem. Threshold= .7	
Variable	Dems.	Auts.	Dems.	Auts.	Dems.	Auts.	Dems.	Auts.
Prop. Democracy	-0.24**	-0.098**	-0.37**	-0.070*	-0.61**	-0.038	-0.31**	-0.11**
	(0.019)	(0.027)	(0.037)	0.025	0.096	(0.068)	(0.018)	(0.028)
Prop. Democracy^2	0.12**	0.27**	0.19**	0.30**	0.30**	0.35**	0.17**	0.28**
	(0.017)	(0.028)	(0.033)	(0.027)	(0.079)	(0.082)	(0.017)	(0.029)
Intercept	0.20	0.074**	0.30**	0.10**	0.48**	0.15**	0.22**	0.079**
	(0.0043)	(0.0056)	(0.0089)	(0.0043)	(0.026)	(0.012)	(0.0042)	(0.0058)
N	39	39	19	19	9	9	39	39
	Dem. Threshold= .5		No Power Variation		High Power Variation		High Alliance Efficiency	
Variable	Dems.	Auts.	Dems.	Auts.	Dems.	Auts.	Dems.	Auts.
Prop. Democracy	-0.40**	-0.074*	-0.28**	-0.17**	-0.17**	-0.085**	-0.29**	-0.12**
	(0.031)	(0.029)	(0.022)	(0.033)	(0.034)	(0.026)	(0.038)	(0.032)
Prop. Democracy^2	0.24**	0.23**	0.15**	0.37**	0.061	0.23**	0.16**	0.32**
	(0.029)	(0.029)	(0.020)	(0.034)	(0.031)	(0.026)	(0.035)	(0.033)
Intercept	0.24**	0.080**	0.22**	0.085**	0.17**	0.069**	0.23**	0.098**
	(0.0072)	(0.0059)	(0.0050)	(0.0068)	(0.0078)	(0.0053)	(0.0086)	(0.0066)
N	39	39	39	39	39	39	39	39
	Low Alliance Efficiency		2 Pref. Dimensions		3 Pref. Dimensions		Alt. Proposals	
Variable	Dems.	Auts.	Dems.	Auts.	Dems.	Auts.	Dems.	Auts.
Prop. Democracy	-0.11**	-0.014	-0.30**	-0.20**	-0.36**	-0.14**	-0.30**	-0.064
	(0.020)	(0.019)	(0.082)	(0.057)	(0.032)	(0.044)	(0.035)	(0.037)
Prop. Democracy^2	0.055**	0.070**	0.073	0.58**	0.18**	0.43**	0.18**	0.25**
	(0.018)	(0.019)	(0.076)	(0.058)	(0.029)	(0.045)	(0.032)	(0.037)
Intercept	0.098**	0.033**	0.47**	0.16**	0.32**	0.11**	0.22**	0.081**
	(0.0045)	(0.0039)	(0.019)	(0.012)	(0.0072)	(0.0091)	(0.0080)	(0.0075)
N	39	39	39	39	39	39	39	39

Significance levels : $*$: 5% $**$: 1%. All tests are two-tailed.

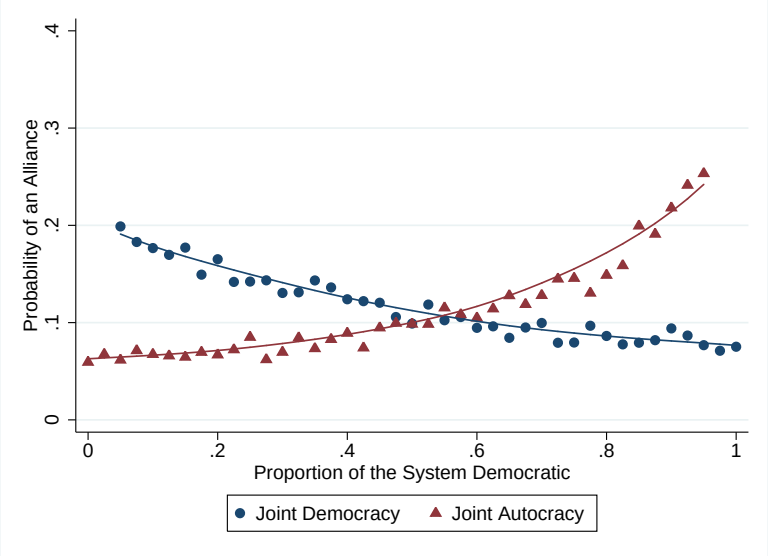

Figure A1: Baseline model (figure 3 in the main text)

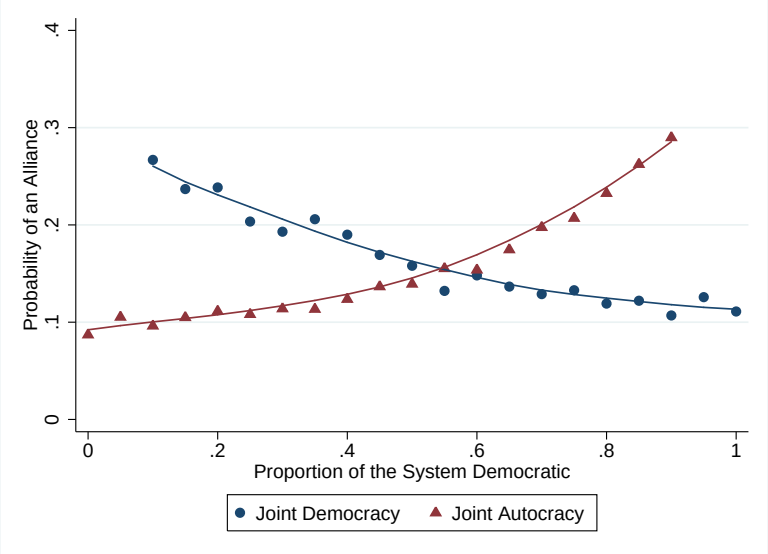

Figure A2: Robustness graph: 20 actors

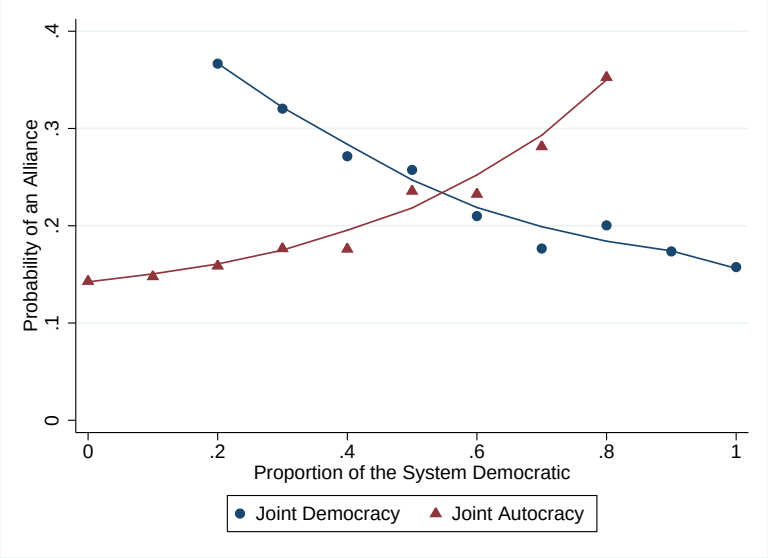

Figure A3: Robustness graph: 10 actors

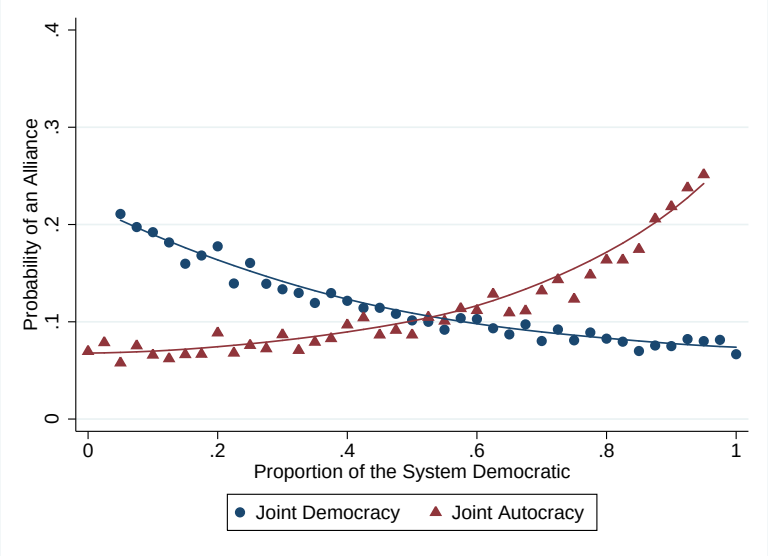

Figure A4: Robustness graph: threshold democracy level= .7

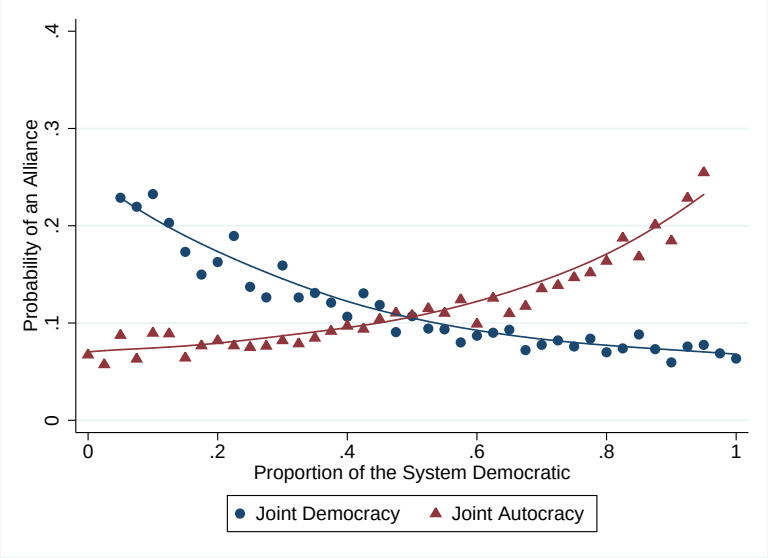

Figure A5: Robustness graph: threshold democracy level= .5

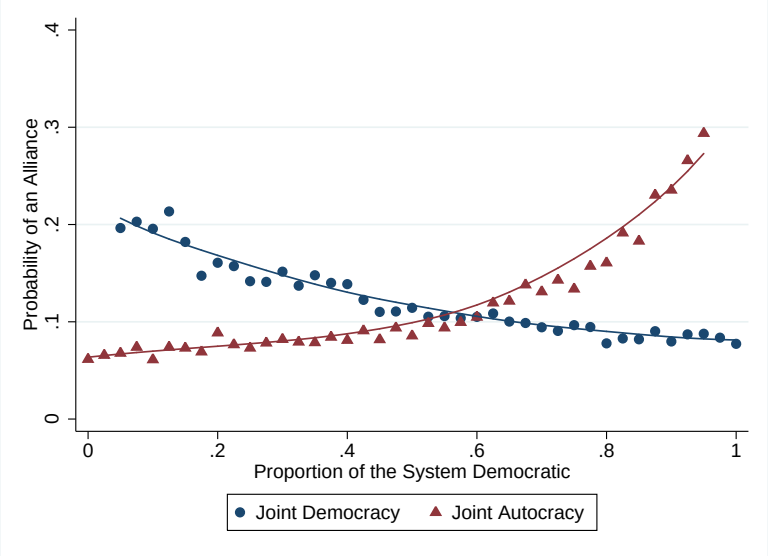

Figure A6: Robustness graph: capability levels do not vary across actors

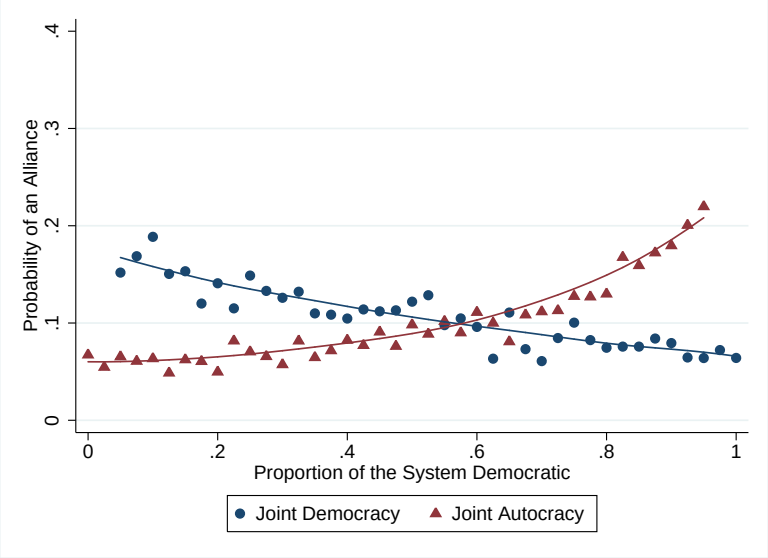

Figure A7: Robustness graph: capability levels vary highly across actors

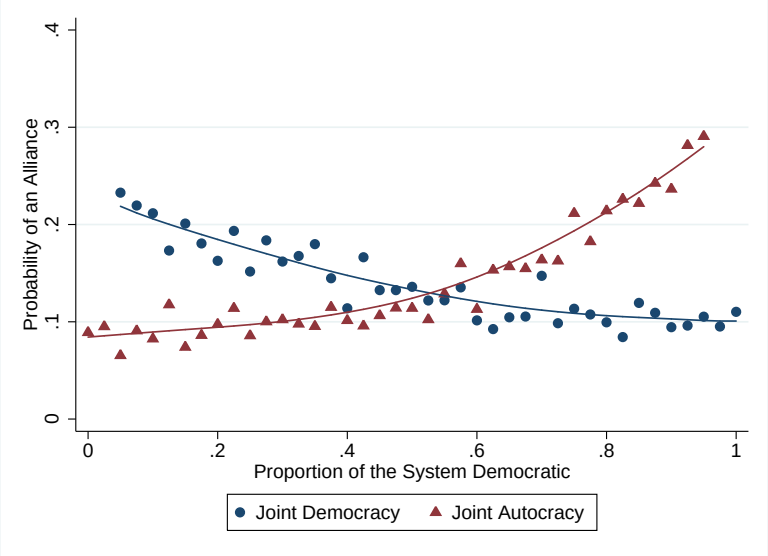

Figure A8: Robustness graph: alliances aggregate capabilities perfectly

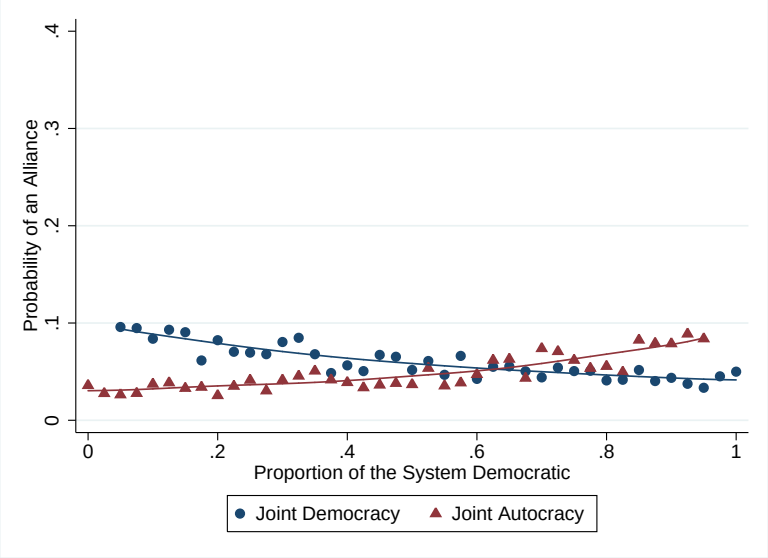

Figure A9: Robustness graph: alliances aggregate capabilities less efficiently

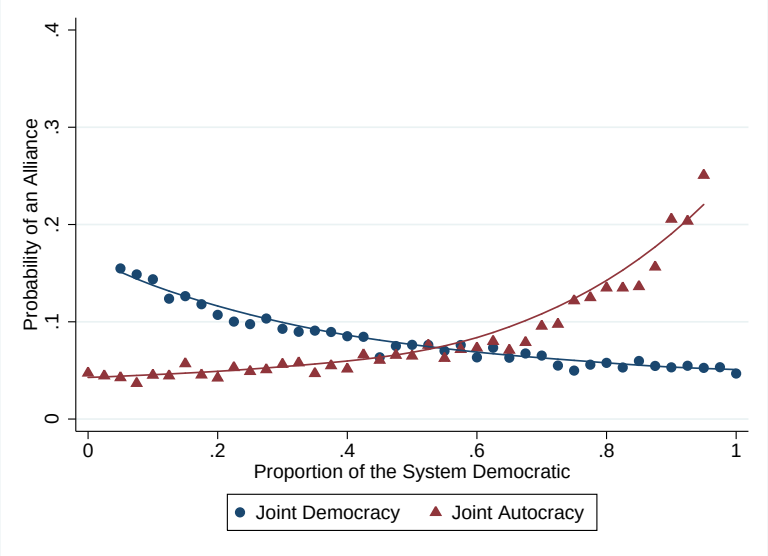

Figure A10: Robustness graph: diminishing marginal returns in alliance cumulation

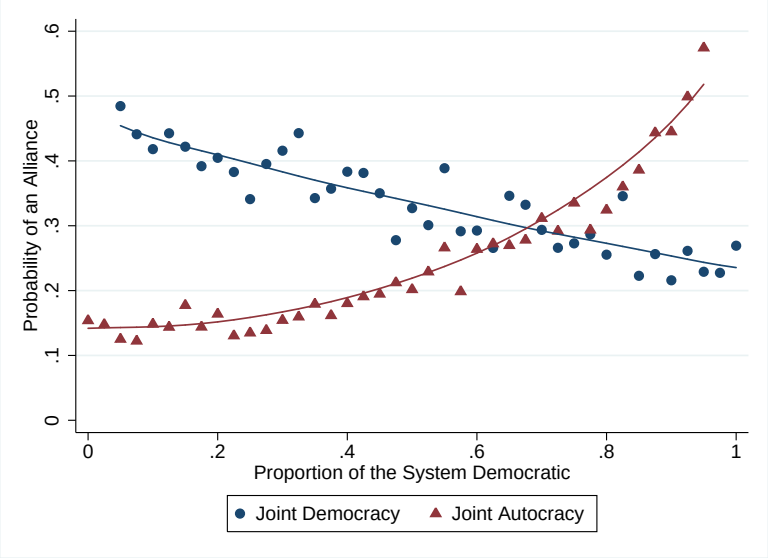

Figure A11: Robustness graph: only two dimensions to actor preferences

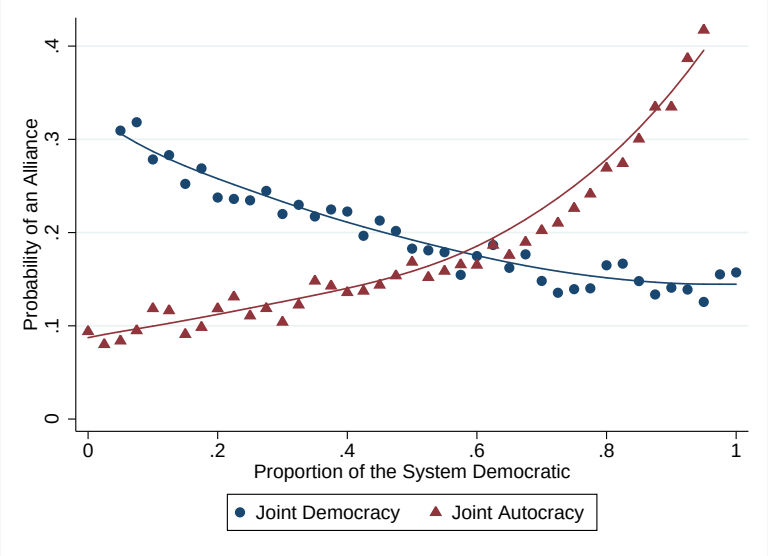

Figure A12: Robustness graph: only three dimensions to actor preferences

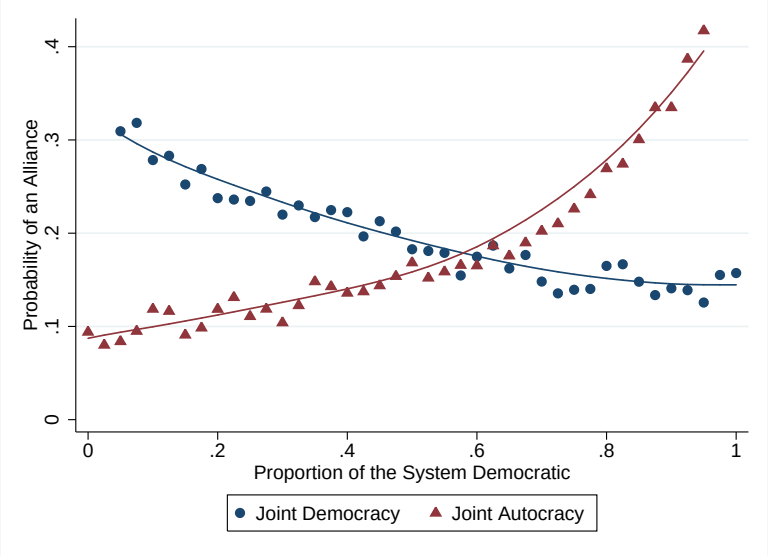

Figure A13: Robustness graph: guaranteed stable alliance structure