It's All Relative: Spatial Positioning of Parties and Ideological Shifts

Additional Materials

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Overview

In this document I discuss in greater detail decisions that I made in the analyses dealing with selection of the weights matrices.

Sample

In Table S.1 I provide the countries and time periods under examination, as well as the number of elections and separate parties in the sample. In Table S.2 I provide the summary statistics for the variables in the Adams and Somer-Topcu (2009) replication.

[Tables S.1-S.2 about here]

Specification of Weights Matrices

As a number of scholars have noted, evidence of spatial autocorrelation is highly dependent on the appropriate specification of the weights matrix, including choice of neighbors (in my case, all, family, and ideologically-contiguous) and the functional form (relative distance between parties) (e.g., Kostov 2010; Plümper and Neumayer 2010; Neumayer and Plümper 2013). While my theoretical propositions clearly state *which* parties will be related, it is largely silent as to *how* they will be related.

One approach to choose between the possibly "infinite number of possibilities for specifying a functional form" (Plümper and Neumayer 2010) is to treat it as a model selection problem and use the three-step process described by Zhukov and Stewart (2011: 274). This involves first, selecting the model based on the strength and significance of the spatial dependence, second, using goodness of fit diagnostics (such as AIC, BIC, and in the case of OLS, adjusted R^2 and root mean squared error), and third, estimating the model repeatedly on a large sub-sample of the data and then testing its predictive capability on the excluded data (with the lowest average mean squared error providing the best predictive capability).

I estimate the model described in the manuscript (Model 1) repeatedly, each time changing the functional form of the weights matrix (d_{jk} in Figure 2 of the manuscript) so that the distance is weighted in a different manner. More specifically, I calculate the distance between party j's position and party k's position with the following formula: $(\text{max} - \text{abs}|p_j - p_k|)^x$, where $x \in \{0, .25, \ldots, 3\}$. Subtracting each element from the maximum value ensures that all the elements are positive, where small positive values indicate parties that have little to no spatial interdependence, and large positive values represent large spatial interdependence. Also note that this range of x is broad enough to incorporate multiple common functional forms including a uniform matrix ($x = 0$), linear ($x = 1$), quadratic ($x = 2$) and cubic ($x = 3$).

The first criterion is less helpful in choosing between specifications because the spatial lags of the row-unstandardized weights matrices get quite large as the value of x increases. This means that the magnitude of the spatial autocorrelation will decrease as a function of x. Nevertheless, we can get a sense of the appropriate model fit based on which functional forms have statistically significant and positive ρ parameters. These results are presented in Table S.3. It should be noted that in all the cases the ρ is positive, and is statistically significant for all values of x for the $\mathbf{W_{Family}}$. The $\mathbf{W_{All}}$ and the $\mathbf{W_{Neighbors}}$ specifications are significant at the 90% confidence level at values of x greater than 0.75 and less than 2.25, respectively. Clearly, most of these functional forms are acceptable and in particular, those with $x \in \{0.75, 2.25\}$ are preferred.

[Table S.3 about here]

The second criterion is based on goodness of fit. I provide the four measures of goodness of fit in reverse order of x in Table S.4. While the overall differences in fit are not that substantial between specifications, there are a few values of x that appear to consistently outperform the others. This includes values of $x \in \{2, 3\}$. It should be noted that the uniform matrix specification (with is the row-unstandardized version of the specification in AS-T) is the worst-performing functional form of the 13 specifications.

[Table S.4 about here]

The final criterion is based on randomly selecting 80% of the elections, fitting Model 1 based on the functional form with the given value of x, using those parameters to predict the outcome for the out-of-sample observations, repeating the process 100 times, and then generating the average root mean squared error (ARMSE) (Zhukov and Stewart 2011: 275). I provide the ARMSE in Table S.5. One option ($x = 2.5$) performs quite well and the others tend to do slightly worse. Unlike the previous two criteria, the uniform functional form ($x = 0$) performs quite well compared to the other functional forms, and even beats the quadratic ($x = 2$) and cubic ($x = 3$) specifications.

[Table S.5 about here]

The three-step process identifies three functional forms that perform nearly equally well ($x = 2$, 2.5 or 3), one of which I select in the manuscript ($x = 2$). I choose a quadratic functional form because of its common usage in Downsian proximity models to represent declining utility as the distance between voter and candidate increases (Merrill and Grofman 1999: 21).

As a comparison I show the results for the row-unstandardized version of the uniform matrix employed by Adams and Somer-Topcu ($x = 0$) (Table S.6). It is important to note that in the final model of Table S.6, the only spatial lag that is statistically significant is the one based on ideological neighbors. It makes more sense that this is the case in this specification because all parties' movements have the same influence, regardless of ideological proximity. Given this weighting scheme, it is reasonable that only the movement of ideological neighbors would be influential.

[Table S.6 about here]

I now turn to demonstrating the robustness of the models with these other functional forms (see Tables S.7 and S.8). Though the size of the estimated ρs decreases as one increases the value of x, it is clear that the results are robust to these other specifications. The one exception is the neighborhood spatial lag in the cubic functional form, which is nearly statistically significant. Given that the relative distances are magnified even more due to the larger exponent ($x = 3$), much more weight is already given to those parties that are in close proximity. This possibly explains why the neighborhood spatial lag is no longer significant. Nonetheless, these additional models provide greater confidence that the evidence of positive spatial autocorrelation presented in the manuscript is not a result of a unique functional form.

[Tables S.7-S.8 about here]

Tables

Table S.1: Sample Countries and Years

Country	**Elections**	**Parties**	**Obs.**	**Time**
Australia	20	4	68	1951-1998
Austria	13	4	41	1956-1995
Belgium	15	16	93	1950-1995
Canada	15	4	54	1953-1997
Denmark	20	12	162	1950-1998
Finland	13	10	88	1951-1995
France	12	8	58	1956-1997
Germany	12	5	38	1957-1998
Great Britain	13	3	37	1951-1997
Greece	7	4	17	1981-1996
Iceland	14	6	59	1953-1995
Ireland	14	8	55	1954-1997
Israel	12	20	65	1955-1996
Italy	12	12	79	1953-1996
Japan	11	7	55	1967-1996
Luxembourg	10	4	39	1951-1994
Netherlands	14	10	68	1952-1998
New Zealand	16	3	43	1951-1996
Norway	12	8	75	1953-1997
Portugal	7	8	38	1979-1995
Spain	5	11	37	1982-1996
Sweden	15	7	78	1956-1998
Switzerland	10	9	61	1955-1995
Turkey	5	7	14	1957-1995
United States	11	2	22	1956-1996
Total	192	308	1,444	

Table S.2: Summary Statistics

	Min.	**Max.**	**Mean**	**Std. Dev.**
Party Shift$_t$	-88.69	102.1	0.08	18.66
Party Shift$_{t-1}$	-88.69	102.1	0.14	18.79
Public Opinion Shift$_t$	-47.60	55.25	0.44	14.35
Average Party Shift$_{t-1}$	-41.75	54.0	0.14	10.93
Average Family Shift$_{t-1}$	-88.69	83.36	0.01	11.54

Table S.3: Spatial Autocorrelation Coefficients and T-Statistics for the Three Neighborhood Schemes across Functional Forms

x	$\mathbf{W}_{\mathbf{All}}$		$\mathbf{W}_{\mathbf{Family}}$		$\mathbf{W}_{\mathbf{Neighbor}}$	
	ρ	T-Statistic	ρ	T-Statistic	ρ	T-Statistic
3	2.91×10^{-8}	2.41	4.34×10^{-8}	2.21	2.48×10^{-8}	1.41
2.75	9.37×10^{-8}	2.38	1.42×10^{-7}	2.20	8.75×10^{-8}	1.51
2.5	3.01×10^{-7}	2.35	4.66×10^{-7}	2.18	3.09×10^{-7}	1.62
2.25	9.60×10^{-7}	2.31	1.52×10^{-6}	2.16	1.09×10^{-6}	1.74
2	3.04×10^{-6}	2.26	4.94×10^{-6}	2.14	3.84×10^{-6}	1.87
1.75	9.55×10^{-6}	2.20	1.6×10^{-5}	2.11	1.4×10^{-5}	2.02
1.5	3.0×10^{-5}	2.12	5.2×10^{-5}	2.08	4.8×10^{-5}	2.18
1.25	9.1×10^{-5}	2.03	1.7×10^{-4}	2.04	1.7×10^{-4}	2.35
1	2.7×10^{-4}	1.91	5.3×10^{-4}	2.00	5.9×10^{-4}	2.54
0.75	8.0×10^{-4}	1.76	0.002	1.97	0.002	2.76
0.5	0.002	1.57	0.005	1.94	0.007	3.0
0.25	0.006	1.32	0.017	1.94	0.025	3.27
0	0.014	1.01	0.056	1.98	0.088	3.58

Note: Relative proximity is calculated with the following: $(\max - \text{abs}|p_j - p_k|)^x$

Table S.4: Goodness of Fit Statistics across Functional Forms

x	Adj. R^2	RMSE	AIC	BIC
3	0.3086	15.516	12022.5	12054.1
2.75	0.3086	15.516	12022.5	12054.1
2.5	0.3085	15.517	12022.6	12054.2
2.25	0.3084	15.518	12022.8	12054.5
2	0.3082	15.521	12023.3	12054.9
1.75	0.3079	15.524	12023.9	12055.5
1.5	0.3075	15.528	12024.7	12056.3
1.25	0.307	15.534	12025.7	12057.4
1	0.3064	15.540	12027.0	12058.7
0.75	0.3056	15.549	12028.6	12060.2
0.5	0.3047	15.559	12030.4	12062.0
0.25	0.3038	15.570	12032.5	12064.1
0	0.3027	15.582	12034.7	12066.3

Note: Relative proximity is calculated with the following: $(\max - \text{abs}|p_j - p_k|)^x$

Table S.5: Predictive Capability across Functional Forms

x	ARMSE	Rank
3	15.608	8
2.75	15.638	9
2.5	15.461	1
2.25	15.600	6
2	15.559	5
1.75	15.520	3
1.5	15.662	10
1.25	15.519	2
1	15.604	7
0.75	15.686	13
0.5	15.670	12
0.25	15.662	11
0	15.548	4

Note: Relative proximity: $(\max - \text{abs}|p_j - p_k|)^x$

Table S.6: Replication of Adams and Somer-Topcu's (2009) Spatial-X Model with Specifications of the Weights Matrix Based on Relative Proximity: $x = 0$ (Uniform, Row-Unstandardized)

Variable	**A&S-T**	**Model 1**	**Model 2**
Intercept	-0.11	-0.16	-0.17
	(0.37)	(0.41)	(0.41)
Party Shift ($t-1$)	-0.36**	-0.38**	-0.38**
	(0.03)	(0.02)	(0.02)
Public Opinion Shift (t)	0.48**	0.49**	0.48**
	(0.03)	(0.03)	(0.03)
Average Party Shift ($t-1$)	0.16**		-0.06
	(0.04))		(0.09)
Average Family Shift ($t-1$)	0.10**		-0.01
	(0.05)		(0.07)
$\mathbf{W}_{\mathbf{All}}\times$Party Shift($t-1$)		0.01	0.03
		(0.01)	(0.02)
$\mathbf{W}_{\mathbf{Neighbors}}\times$Party Shift($t-1$)		0.09**	0.09**
		(0.02)	(0.02)
$\mathbf{W}_{\mathbf{Family}}\times$Party Shift($t-1$)		0.06**	0.06
		(0.03)	(0.04)
RMSE	15.7	15.6	15.6
Adj. R^2	0.294	0.303	0.302
AIC	12051.5	12034.7	12038.3
BIC	12077.8	12066.3	12080.5
N	1444	1444	
W	Uniform	Distance	Distance

Note:$** = p < .05$, $* = p < .1$ (two-tailed)
Weights matrix represents reversed quadratic relative distance at election $t-2$.

Table S.7: Replication of Adams and Somer-Topcu's (2009) Spatial-X Model with Specifications of the Weights Matrix Based on Relative Proximity: $x = 2.5$

Variable	**A&S-T**	**Model 1**	**Model 2**
Intercept	-0.11	-0.27	-0.30
	(0.37)	(0.41)	(0.41)
Party Shift ($t-1$)	-0.36**	-0.39**	-0.40**
	(0.03)	(0.02)	(0.02)
Public Opinion Shift (t)	0.48**	0.49**	0.49**
	(0.03)	(0.03)	(0.03)
Average Party Shift ($t-1$)	0.16**		-0.04
	(0.04))		(0.06)
Average Family Shift ($t-1$)	0.10**		-0.02
	(0.05)		(0.06)
$\mathbf{W}_{\mathbf{All}}$×Party Shift($t-1$)		3.0×10^{-7}**	3.7×10^{-7}**
		(1.2×10^{-7})	(1.5×10^{-7})
$\mathbf{W}_{\mathbf{Neighbors}}$×Party Shift($t-1$)		3.1×10^{-7}*	3.1×10^{-7}*
		(1.8×10^{-7})	(1.8×10^{-7})
$\mathbf{W}_{\mathbf{Family}}$×Party Shift($t-1$)		4.7×10^{-7}**	5.4×10^{-7}**
		(2.0×10^{-7})	(2.8×10^{-7})
RMSE	15.7	15.5	15.5
Adj. R^2	0.294	0.308	0.308
AIC	12051.5	12022.6	12025.7
BIC	12077.8	12054.2	12067.9
N	1444	1444	1444
W	Uniform	Distance	Distance

Note: $** = p < .05$, $* = p < .1$ (two-tailed)
Weights matrix represents reversed quadratic relative distance at election $t-2$.

Table S.8: Replication of Adams and Somer-Topcu's (2009) Spatial-X Model with Specifications of the Weights Matrix Based on Relative Proximity: $x = 3$

Variable	**A&S-T**	**Model 1**	**Model 2**
Intercept	-0.11	-0.28	-0.30
	(0.37)	(0.41)	(0.41)
Party Shift $(t-1)$	-0.36**	-0.39**	-0.40**
	(0.03)	(0.02)	(0.02)
Public Opinion Shift (t)	0.48**	0.49**	0.49**
	(0.03)	(0.03)	(0.03)
Average Party Shift $(t-1)$	0.16**		-0.03
	(0.04))		(0.06)
Average Family Shift $(t-1)$	0.10**		-0.02
	(0.05)		(0.05)
$\mathbf{W}_{\mathbf{All}}\times$Party Shift$(t-1)$		2.9×10^{-8}**	3.3×10^{-8}**
		(1.1×10^{-8})	(1.4×10^{-8})
$\mathbf{W}_{\mathbf{Neighbors}}\times$Party Shift$(t-1)$		2.5×10^{-8}	2.5×10^{-8}
		(1.7×10^{-8})	(1.7×10^{-8})
$\mathbf{W}_{\mathbf{Family}}\times$Party Shift$(t-1)$		4.3×10^{-8}**	4.9×10^{-8}**
		(1.8×10^{-8})	(2.5×10^{-8})
RMSE	15.7	15.5	15.5
Adj. R^2	0.294	0.309	0.308
AIC	12051.5	12022.5	12026.0
BIC	12077.8	12054.1	12068.2
N	1444	1444	1444
W	Uniform	Distance	Distance

Note: $** = p < .05$, $* = p < .1$ (two-tailed)
Weights matrix represents reversed quadratic relative distance at election $t-2$.