Spatial Econometrics: An Introduction

Prepared for the University of Melbourne's QuantLab

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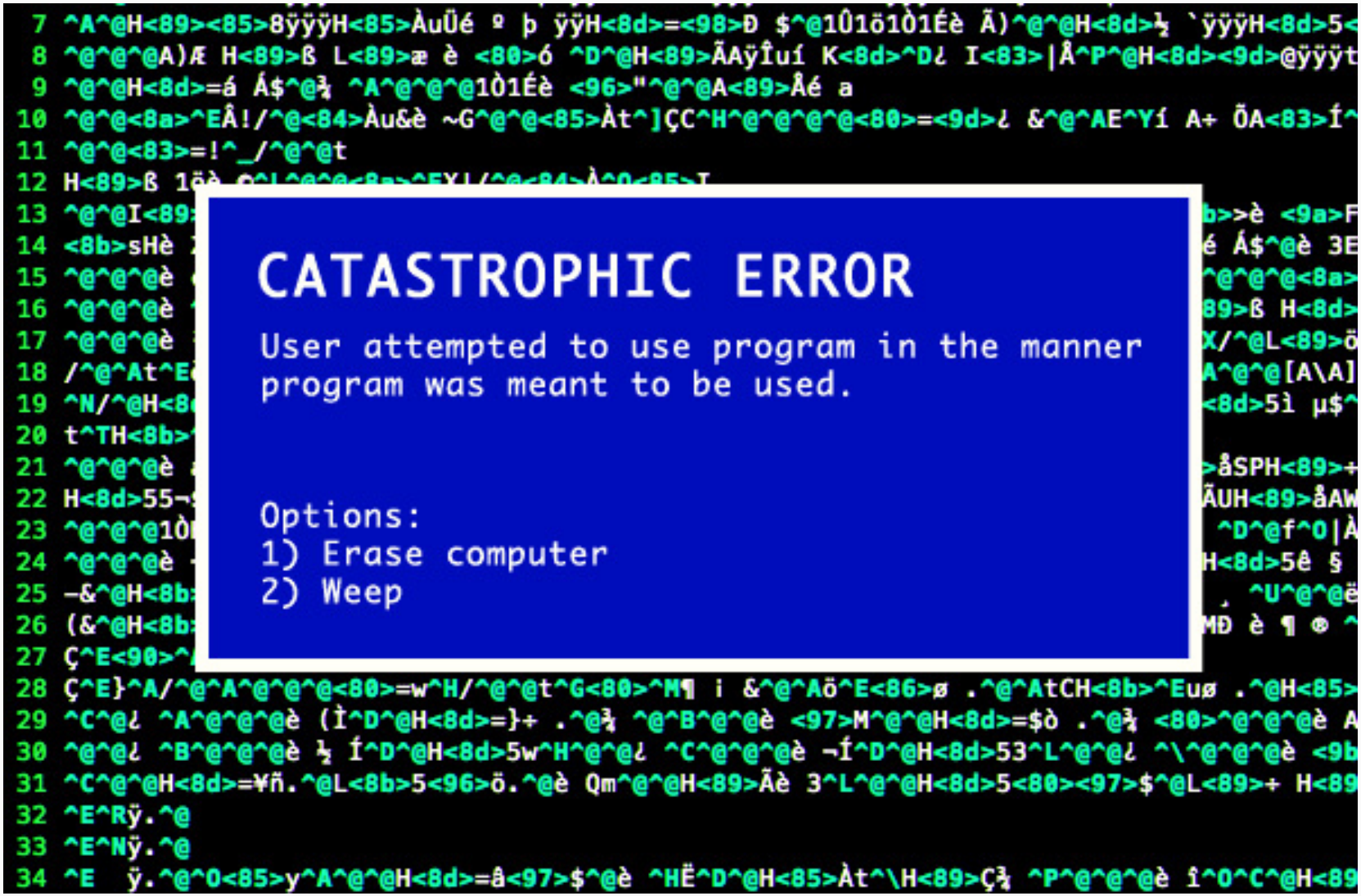
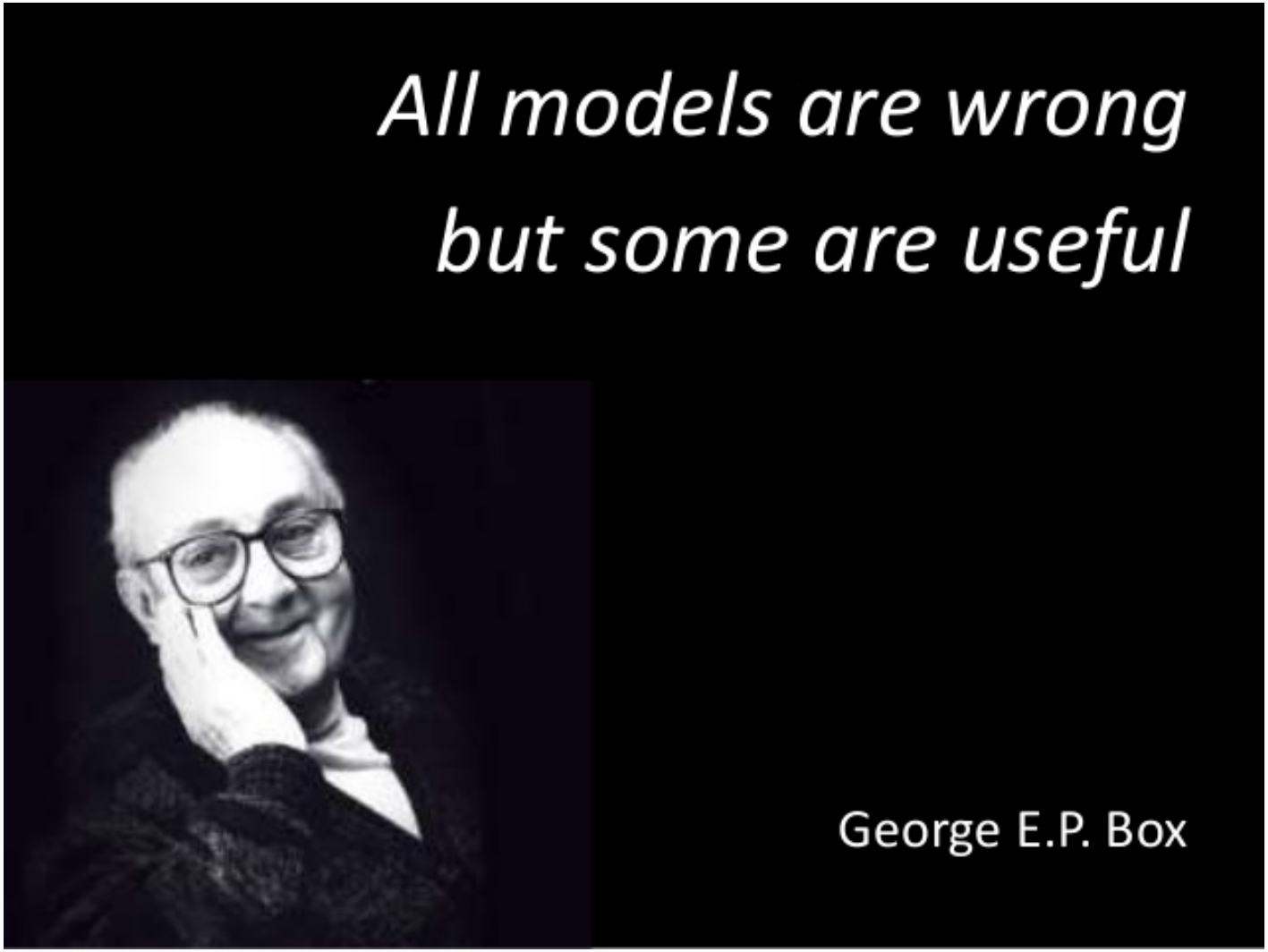
Overview

1. An overview of spatial econometric tools and their utility
2. What is space?
3. Suggested checklist for using spatial econometric tools
4. Further resources

Quantitative analysis≠Coding



To make you feel great about your research...

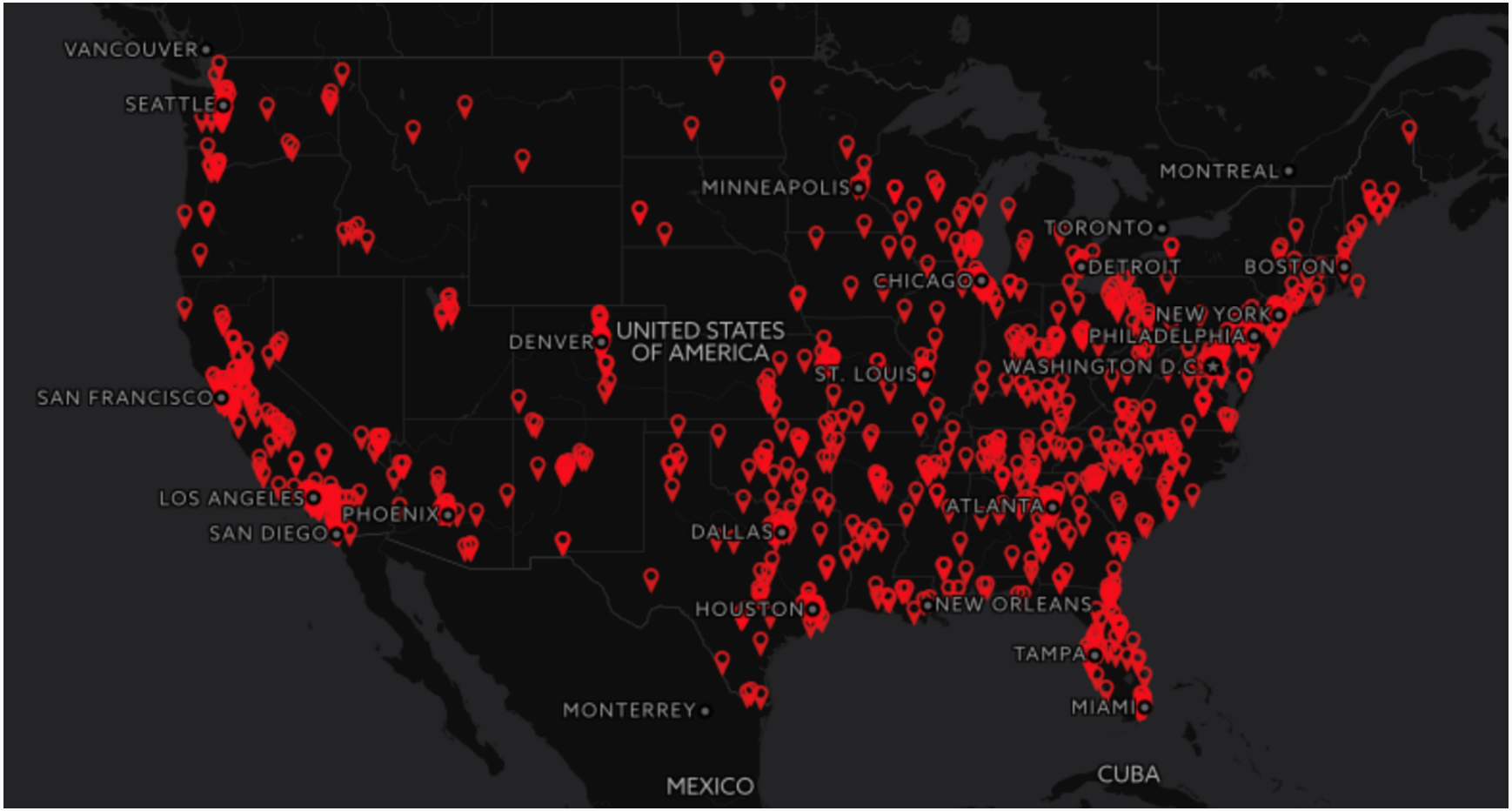


OLS assumptions

1. The regression model is linear in the coefficients and the error term.
2. The error term has a population mean of zero.
3. **All independent variables are uncorrelated with the error term.**
4. Observations of the error term are uncorrelated with each other.
5. The error term has a constant variance.
6. No independent variable is a perfect linear function of other explanatory variables.
7. The error term is normally distributed.

Spatial processes: John Snow's cholera map

Spatial processes: police violence in the US



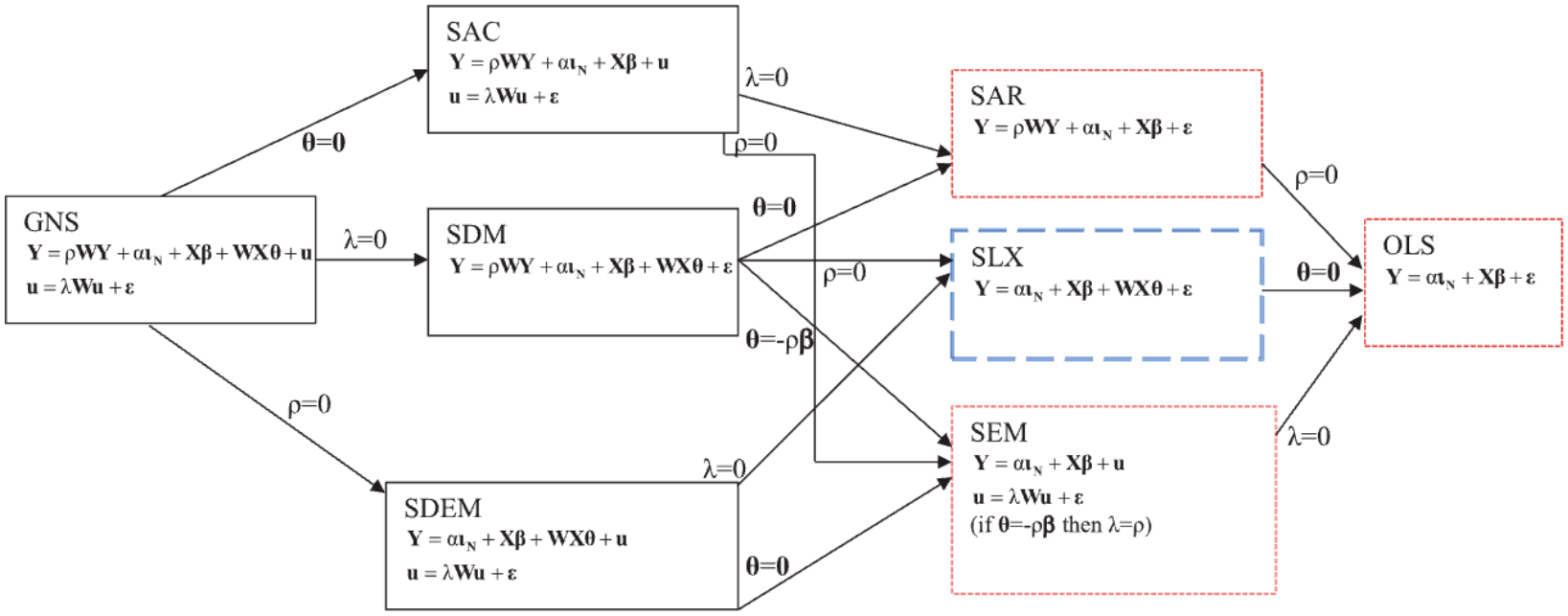
How do we usually model?

Data Editor (Browse) — RDD_CPS_replication.dta

cowcode[1] 700

	cowcode	year	gwf_country	gwf_casename	gwf_durati…	gwf_fail	log_devel…	growth	inter_stat…	democrati…	fo
1049	42	1975	Dominican Rep	Dominican Rep 66-78	9	0	6.549511	5.1932534	0	0	
1050	42	1976	Dominican Rep	Dominican Rep 66-78	10	0	6.617762	6.7281226	0	0	
1051	42	1977	Dominican Rep	Dominican Rep 66-78	11	0	6.742409	4.9817839	0	0	
1052	42	1978	Dominican Rep	Dominican Rep 66-78	12	1	6.758394	2.1406847	0	1	
1053	130	1946	Ecuador	Ecuador 44-47	2	0	.	.	0	0	
1054	130	1947	Ecuador	Ecuador 44-47	3	1	.	.	0	1	
1055	130	1964	Ecuador	Ecuador 63-66	1	0	5.423715	7.8118896	0	0	
1056	130	1965	Ecuador	Ecuador 63-66	2	0	6.119562	4.7179732	0	0	
1057	130	1966	Ecuador	Ecuador 63-66	3	1	6.10791	-.33952564	0	1	
1058	130	1971	Ecuador	Ecuador 70-72	1	0	6.088495	6.2926062	0	0	
1059	130	1972	Ecuador	Ecuador 70-72	2	1	6.205744	5.0176407	0	0	
1060	130	1973	Ecuador	Ecuador 72-79	1	0	6.377742	13.950682	0	0	
1061	130	1974	Ecuador	Ecuador 72-79	2	0	6.878054	11.20851	0	0	
1062	130	1975	Ecuador	Ecuador 72-79	3	0	7.008974	10.972154	0	0	
1063	130	1976	Ecuador	Ecuador 72-79	4	0	7.143926	7.3971876	0	0	
1064	130	1977	Ecuador	Ecuador 72-79	5	0	7.31005	1.6048421	0	0	
1065	130	1978	Ecuador	Ecuador 72-79	6	0	7.361732	5.7068249	0	0	
1066	130	1979	Ecuador	Ecuador 72-79	7	1	7.508636	3.7340484	0	1	
1067	651	1946	Egypt	Egypt 22-52	24	0	.	.	0	0	
1068	651	1947	Egypt	Egypt 22-52	25	0	.	.	0	0	
1069	651	1948	Egypt	Egypt 22-52	26	0	.	.	1	0	
1070	651	1949	Egypt	Egypt 22-52	27	0	.	.	1	0	
1071	651	1950	Egypt	Egypt 22-52	28	0	.	.	0	0	
1072	651	1951	Egypt	Egypt 22-52	29	0	.	.	0	0	

Spatial econometric models



Note: GNS = general nesting spatial model, SAC = spatial autoregressive combined model, SDM = spatial Durbin model, SDEM = spatial Durbin error model, SAR = spatial autoregressive model, SLX = spatial lag of **X** model, SEM = spatial error model, OLS = ordinary least squares model.

Vega, Solmaria Halleck, and J. Paul Elhorst. 2015. "The SLX Model." *Journal of Regional Science* 55(3): 339-63.

Spatial autoregressive model (SAR)

$$Y = \rho WY + \alpha + X\beta + \epsilon$$

- ρ: coefficient of how outcomes in nearby units influence unit *i*'s outcome
- W: a weights matrix that defines connectivity between units
- y: outcome

Spatial autoregressive model (SAR)

Don't Stand So Close to Me: Spatial Contagion Effects and Party Competition

Laron K. Williams University of Missouri
Guy D. Whitten Texas A&M University

In this article, we bring together elements from the literatures on economic voting and spatial voting to gain theoretical leverage on the combined role of clarity of responsibility, party policy positions, and economic performance in elections. Building on evidence of voter knowledge, we develop a theory of spatial contagion effects to explain how factors drawn from both of these literatures combine to shape changes in support for political parties. We test this theory with a spatial autoregressive model of party competition in 23 nations from 1951 to 2005. As expected, we find evidence of strong spatial contagion effects in elections with low clarity of responsibility.

The basic setup of SAR models is as follows:

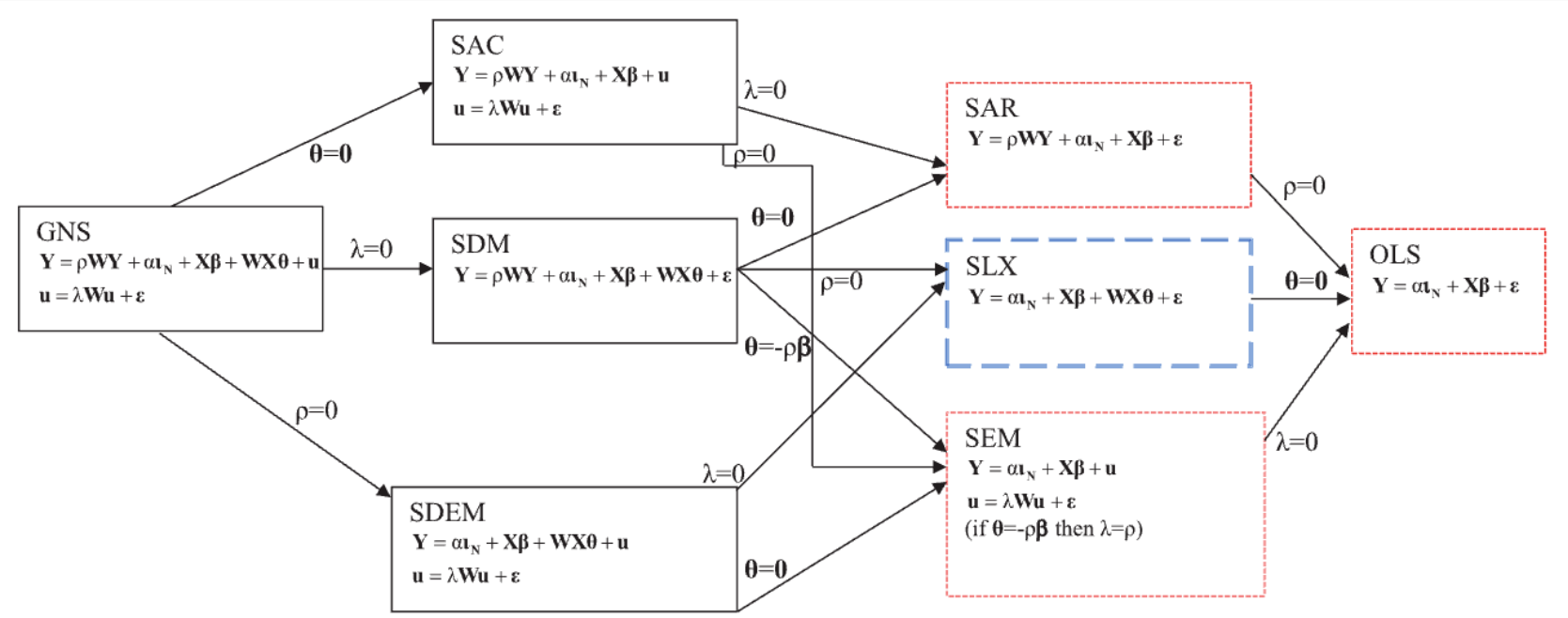
$$\mathbf{y} = \rho \mathbf{W}\mathbf{y} + \mathbf{X}\beta + \epsilon,$$

and the reduced form of this equation is.

$$\mathbf{y} = (\mathbf{I}_N - \rho \mathbf{W}_N)^{-1}(\mathbf{X}\beta + \epsilon),$$

where $\mathbf{y}$ is a vector of dependent variable values (in our models: change in the vote percentage for each party from the previous election); ρ is the spatial autoregressive coefficient; $\mathbf{W}$ is a weights matrix that contains the spatial relationship between each pair of cases;[8] $\mathbf{X}$ is a matrix of independent variables that we theorize impact $\mathbf{y}$ (in our models: measures of the economy, timing of the election, party characteristics, and coalition characteristics);

Spatial econometric models



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Vega, Solmaria Halleck, and J. Paul Elhorst. 2015. "The SLX Model." *Journal of Regional Science* 55(3): 339-63.

Spatial-X model

$$Y = \alpha + X\beta + \theta WX + \epsilon$$

- θ: coefficient of how independent variables of nearby units influence unit *i*'s outcome
- W: a weights matrix that defines connectivity between units
- X: independent variable

Spatial-X model

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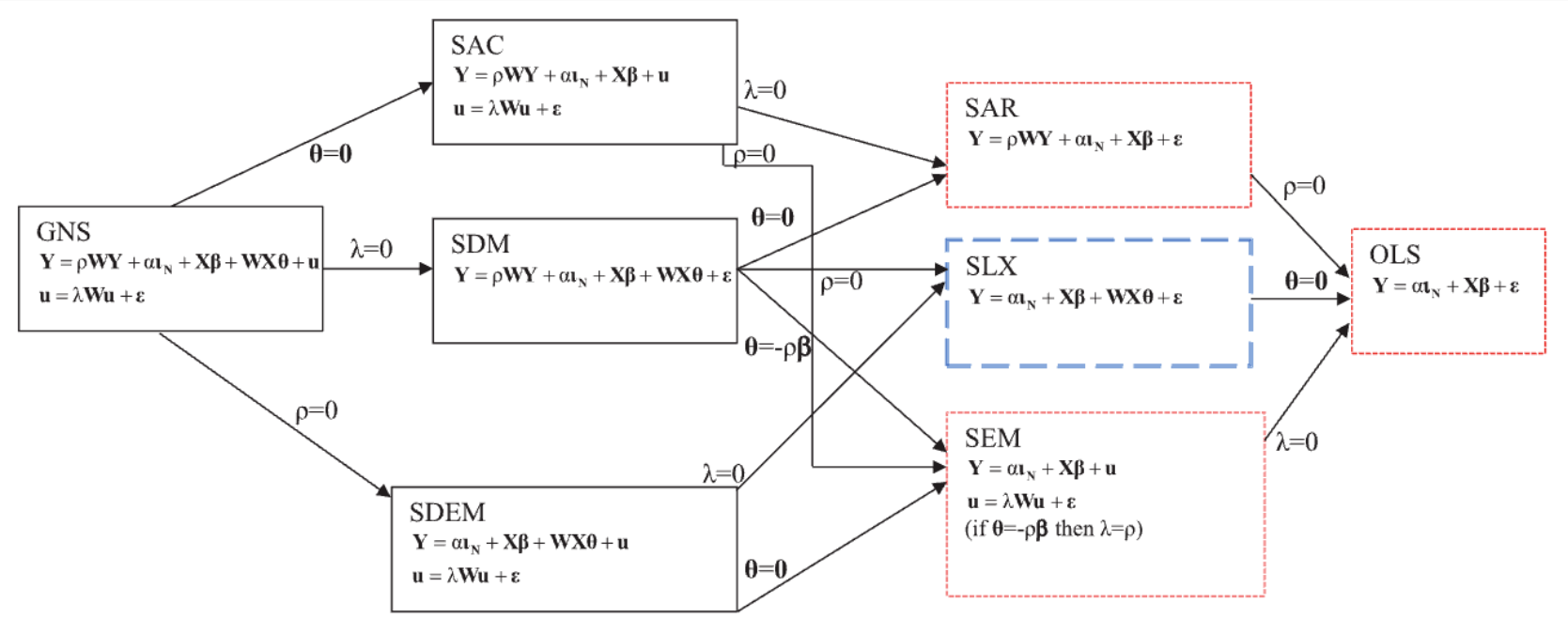
All Economics is Local: Spatial Aggregations of Economic Information*

DAVID FORTUNATO, CLINT S. SWIFT AND LARON K. WILLIAMS

National economic indicators play a foundational role in political economic research, particularly in regards to electoral politics. Yet, scholars have failed to recognize that national economic indicators are simply aggregations of local economic information, and the manner in which they are aggregated may not be consistent with the process voters use to acquire, access, and incorporate economic information. We argue that the economic similarities among localities, and the way in which the media report on these similarities, provide more theoretically satisfying means of specifying how local information aggregates into an overall portrait of the national economy. We introduce a novel estimation procedure called the spatial-X ordered logit that offers the chance to model how voters' evaluations respond to changes in contextualized economic information. Our results support our theory that voters incorporate economic information from other localities with similarly structured economies and in ways that are shaped by media messages. Furthermore, these two specifications offer greater explanatory power than national indicators and other geographical means of aggregating economic information. We conclude by offering a number of implications for research questions ranging from electoral accountability to spatial diffusion processes.

Spatial econometric models



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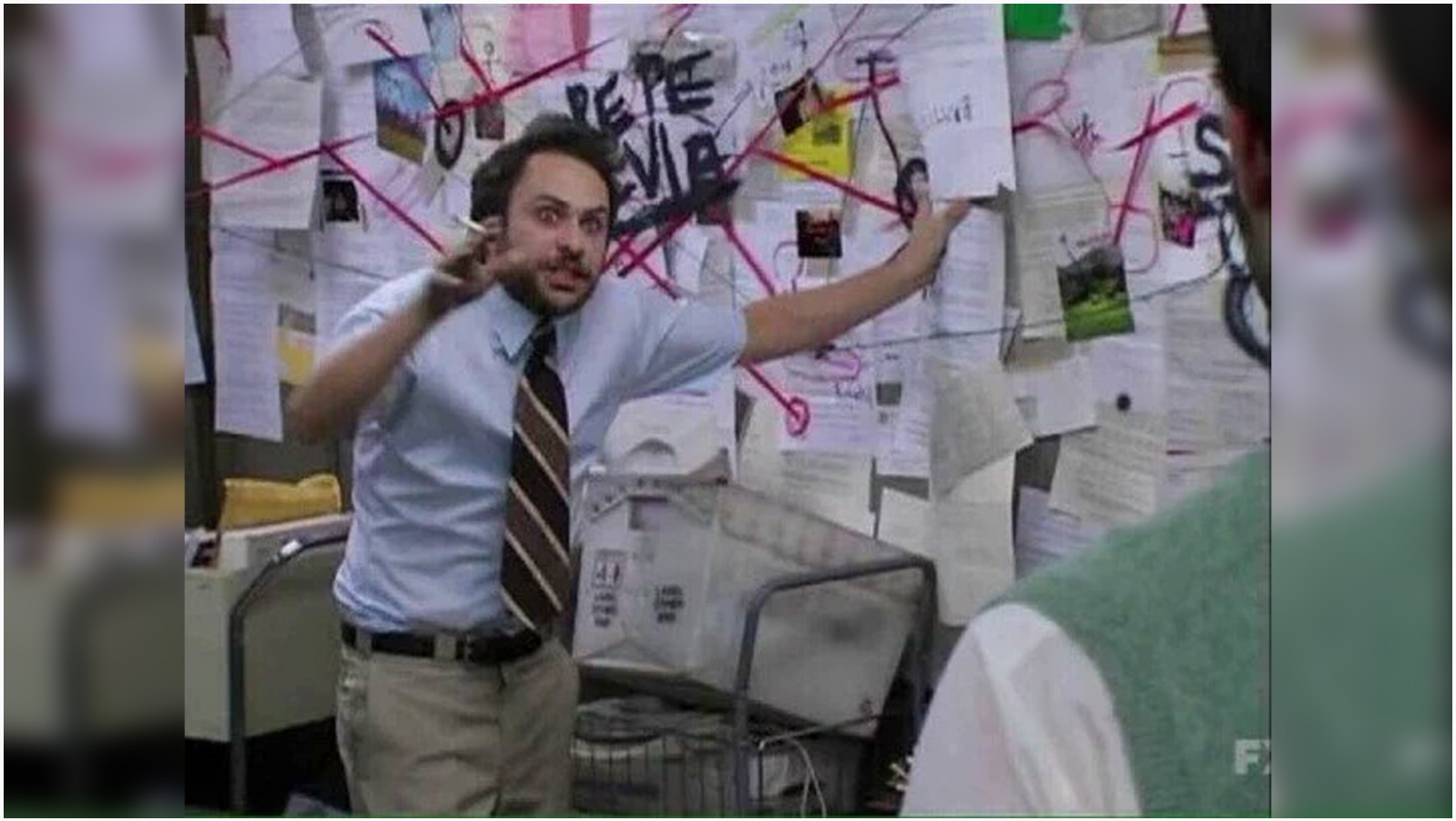
Vega, Solmaria Halleck, and J. Paul Elhorst. 2015. "The SLX Model." *Journal of Regional Science* 55(3): 339-63.

Theory drives everything



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Article

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SAGE

Rethinking Democratic Diffusion: Bringing Regime Type Back In

Edward Goldring[1]
and Sheena Chestnut Greitens[1]

Abstract

Studies of democratic diffusion often emphasize geographic proximity: democratization in a country or region makes democratization nearby more likely. We argue that regime type has been underappreciated; authoritarian breakdown and democratization often diffuse along networks of similar regimes. A regime's *type* affects its vulnerability to popular challenge, and regime similarity increases the likelihood that protest strategies developed against one regime are effective against similar regimes. We

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Outcome	*Autocratic breakdown*	*Democratization*
	Number of autocratic breakdowns in geographical neighbors at t-1	Number of democratizations in geographical neighbors at t-1
	Number of autocratic breakdowns in similar regimes at t-1	Number of democratizations in similar regimes at t-1
	Plus, interactions (i.e., breakdowns or democratizations in geographic neighbors that are similar regimes having a bigger effect than similar regimes that are further away) - thanks, reviewer 2!	

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Table 2. Effects of Autocratic Breakdowns in Regime and Geographic Neighbors on the Likelihood of *Autocratic Breakdown*.

	Model 1	Model 2	Model 3
Similar regime autocratic breakdown (lag)		.19** (.06)	.18** (.06)
Similar regime × Geographic neighbor autocratic breakdown (lag)			.15 (.43)
Geographic neighbor autocratic breakdown (lag)	.17 (.19)	.06 (.18)	−.01 (.25)

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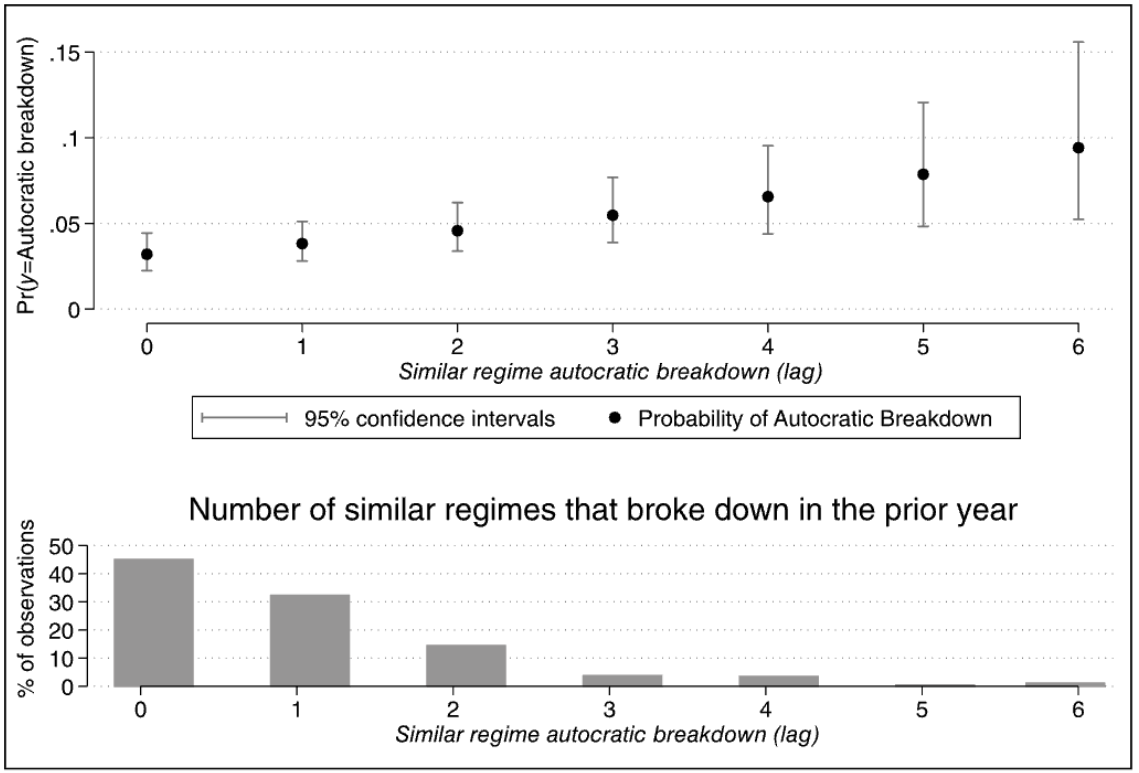

Figure 2. Likelihood of *Autocratic breakdown* as *Similar regime autocratic breakdown (lag)* increases.
Predicted probability of *Autocratic breakdown* is calculated after estimating Model 2. All other variables held at their mean (continuous) and mode (binary).

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Space Is More than Geography: Using Spatial Econometrics in the Study of Political Economy

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KRISTIAN SKREDE GLEDITSCH

University of Essex, University of California, San Diego, and Centre for the Study of Civil War

KYLE BEARDSLEY

University of California

Although spatial econometrics is being used more frequently in political science, most applications are still based on geographic notions of distance. Here we argue that it is often more fruitful to consider political economy notions of distance, such as relative trade or common dyad membership. We also argue that the spatially autoregressive model usually (but not always) should be preferred to the spatially lagged error model. Finally, we consider the role of spatial econometrics in analyzing time-series–cross-section data, and show that a plausible (and testable) assumption allows for the simple introduction of space (however defined) into such analyses. We present examples of spatial analyses involving trade and democracy.

Suggested checklist

1. Come up with a question
2. Visualize the data (for the outcome)
3. Theorize
4. Diagnostic tests (e.g., Moran's I)
5. Consider what model you need to estimate
6. Prepare your data (i.e., obtaining weights matrices, constructing variables)
7. Estimate your models: analyze the statistical and substantive significance of your findings
8. Ensure that your replication code is accessible

Further resources

1. Stata
2. R
3. GeoDa (although, increasingly redundant IMO)
4. Find weights matrices online
5. Ward, Michael D., and Kristian Skrede Gleditsch. 2008. *Spatial Regression Models*. Sage Publications.
6. Darmofal, David. 2015. *Spatial Analysis for the Social Sciences*. Cambridge University Press.
7. Methods Summer Schools: e.g., IPSA, ICPSR, Essex, Oxford