

Civil War: Spatiality, Contagion, and Diffusion

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Abstract

The spatial diffusion of violent conflict has been a major concern in recent literature on war. Specifically, students of international conflict have come to devote increasing attention to civil war and how various other forms of internal conflict disperse through a region. In this paper, we assess the effect of spatiality and distance on the proliferation of civil conflict and the prospects for diffusion of civil war either through clustering or contagion from state to state. We employ methods of spatial analysis, including join count statistics, to evaluate spatial dependence in the occurrence of civil war in the post-Cold War period, from 1991-2004. In addition to discerning the existence of dispersion in the incidence of civil war, our analysis moves toward allowing us to distinguish between clustering and contagion (and the effects of different measures of distance). Our findings provide evidence that domestic conflict does indeed spread through spatial dispersion.

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INTRODUCTION: THE DISEASE AND ITS CONSEQUENCES

Over 35 years ago Norman Z. Alcock wrote *The War Disease* (1972). He developed a model that was based on the idea that because at least one war (interstate war, which was his concern) was taking place somewhere in the system, the various mechanisms based on the security dilemma and its attendant uncertainty and fear, would serve to generate more war among what we would now call “relevant dyads.” In this way, the “war disease” would continue to spread within the social system of nation-states.

One major theme that Alcock presented was the idea that war generated more war. He was, thus, concerned with the consequences of war. As one of the present authors noted that same year (Starr 1972), the study of international conflict was then (as it is now) heavily weighted toward the study of the causes of conflict, while much less attention was devoted to the consequences of conflict. However, the two areas of study are intimately connected in that one of the major consequences of conflict may be more conflict. This has been well demonstrated in the study of war (for two overviews see Most, et al. 1989, and Starr and Siverson 1998), looking at several forms of diffusion. More recently, students of civil war (e.g. Murdoch and Sandler 2004; Sambanis 2002; Gleditsch et al. 2008) have also been concerned with the consequences of civil war; (although, see also Starr 1994). Again, one of the most importance consequences of civil

war may be the generation of further civil war in other states.¹ This paper wishes to add to the literature on the diffusion of civil war.

THE DIFFUSION OF CIVIL WAR: WHAT WE WILL AND WILL NOT DO

There has been a growing attention to civil war by political scientists (primarily by international relations scholars concerned with international conflict and comparative politics scholars concerned with development, democratization, and stability), as well as economists. The literature on civil war has been growing rapidly over the past 10-15 years. As the primary manifestation of violent conflict in the global system since the end of World War II (and especially the last 30 years), civil war is of great concern to students of conflict.² Two special issues of the *Journal of Peace Research* illustrate this concern, as well as the extent of the current literature, by addressing the “Duration and Termination of Civil War,” and “Civil War in Developing Countries,” (Murshed 2002, and Hegre 2004, respectively). Another source of literature review is Sambanis (2002), who provides an overview of quantitative studies of civil war. Economists have also argued the importance of studying civil war—from its strongly negative impact on economic growth (Murdoch and Sandler 2004), to the role of civil war in levels of violent conflict, and the “interplay” of civil war and economics regarding population dynamics, collective action, and rent-seeking analysis (Hegre and Sandler 2002, 429).

¹ This is separate from the question of whether or not civil war promotes further civil war in the same state, a process that Most and Starr (1980) called “positive reinforcement.” For such a study see Walter (2004). In this paper we are concerned with various forms of the process Most and Starr called “positive spatial diffusion.”

² See, for example, Sarkees et al. (2003) for elaboration of this argument, and Elbadawi and Sambanis (2000) for analyses of the amount of civil war in the system.

Given this large literature, it is important to note what this paper will not be doing. We will not be developing a “full” model of the causes of civil war—as has been attempted in a number of studies, such as those by the economist Paul Collier (e.g. 2000 or Collier and Hoeffler 2004). We will not be attempting to deal with the relative impact of broad categories of causes—such as the distinction between factors of economic and politics, which Collier refers to as “greed” and “grievance” (Collier and Hoeffler 2004; see also Murshed 2002, Braithwaite 2006, or Elbadawi and Sambanis 2000).

Given that diffusion models are concerned primarily with external effects—cues, demonstrations, proximate “treatments,” contagion, and the like—we will not be investigating general domestic models of civil war or any specific domestic cause of civil war, such as ethnicity (see, for example, the contrasting views of Fearon and Laitin 2003 to those of Lake and Rothchild 1998 or Buhaug and Gleditsch 2008), or the “rebels dilemma” of “why men rebel” (e.g. Lichbach 1995 and Gurr 1970, respectively). Again, given our concern that the occurrence of a civil war somewhere will alter the probability of a subsequent occurrence of a civil war somewhere else—or positive spatial diffusion (see Most and Starr 1980, 1991)—we will not study positive reinforcement effects, whereby the occurrence of a civil war increases the probability of another civil war in the same state (e.g. Walter 2004, Collier and Hoeffler 2004).

THE ‘WHY’ AND ‘HOW’ OF DIFFUSION: CONCEPTS, MEASURES, METHODS

It should be clear that the question of diffusion is a central one. The puzzle of “why” civil war occurs requires that we look at the external, contextual, or environmental component as part of the complex interaction with the internal components that would

make a state “ready” for civil war. As O’Loughlin and Wittmer note (2005, 3; 10), “the location of a state (and its civil wars) is not simply an attribute, but another potential cause of conflict... diffusion and escalation are important and understudied features of civil war because entire regions can escalate into a series of civil wars feeding off each other.”

Given the importance of diffusion, we are led to questions such as: how does civil war spread? And why does civil war spread? In using diffusion as a conceptual tool, we must understand both the core concept and its dimensions, as well as a primary component of most diffusion analyses—spatiality/distance-proximity. Following Most and Starr (1990) and more recently Elkins and Simmons (2005), diffusion effects should be seen as processes and not outcomes; that diffusion is neither an independent nor dependent variable, but a “class of mechanisms” (Elkins and Simmons 2005, 37; see also Simmons and Elkins 2004). We must also understand that diffusion may work through a variety of processes, which include the spread of conflict or the growth of an ongoing conflict. At least initially we will not distinguish between clustering of phenomena and the spatial diffusion of conflict phenomena. Ultimately, however, this will be of use in helping to address the “how” and “why” questions noted above. Elkins and Simmons present several possibilities as to the “why?” They note, “one conventional answer is that countries react similarly, but independently, to similar domestic conditions (2005, 34). We see this as a potentially important way to address clustering, while another possibility—of “uncoordinated interdependence” based on adaptation and learning—seems to fit better with positive spatial diffusion.

The literature on domestic violence and civil war has fairly well established that some form of diffusion takes place. A sample of such findings include those of Most and Starr (1980), Starr and Most (1983, 1985), Ward and Gleditsch (2002) Ward (2005), O’Loughlin and Wittmer (2005), Salehyan and Gleditsch (2006). Several of these studies, along with Buhaug and Rod (2006), Braithwaite (2005, 2006), and McGowan (2005), find clear clusters of domestic conflict and/or civil war³, especially in regional studies of Africa. We believe, however, that in order to best come to grips with the why and how of diffusion, that we must step back somewhat.

First, we are concerned with the diffusion of domestic/civil conflict from one state to another.⁴ While Buhaug and colleagues (Buhaug and Gates 2000, Buhaug 2003, Buhaug and Rod 2006), as well as Braithwaite (2005, 2006) rightly argue that many questions about civil war require us to drop our investigations down one level of analysis to a “country level approach” and study the internal geopolitics of civil war, especially the location of fighting within states—we will be concerned with the diffusion of civil war (whether clustering or positive spatial diffusion/contagion) from state to state.

The very term “contagion” brings us back to Alcock’s construct of “disease”—and the question of how and why some catch the disease, and how it might spread. Iqbal and Starr (forthcoming) elaborate on the analogy:

“The term ‘contagion’ reflects an epidemiological perspective that sees certain events or stimuli spreading through various forms of contact. Positive spatial

³ One example of the study of clusters is Braithwaite’s (2005, 253-54) analysis of “hot spots”—which are “spatial-temporal aggregation of MIDs... connected by temporal and geographic proximity.”

⁴ Note that Murdoch and Sandler (2002, 2004) find the spatial diffusion of the negative economic consequences of civil war, such as strong negative impact on the growth of income per capita in neighboring states.

diffusion through close proximity (such as contiguity) could be conceptualized as ‘skin-borne’ disease. Regional effects could perhaps be seen as ‘air-borne’ disease— where proximity is still important, (but less so than in contiguous situations). It is crucial to distinguish these ‘contagion’ processes from the conceptualization of diffusion simply as emulation, whereby people see some occurrence – no matter how near or far – and change the probabilities of their own behavior through a desire to repeat (or avoid) that occurrence.”

We must stress that the conception of diffusion we want to use here is that of clustering, contagion or positive spatial diffusion, and not simply emulation. As such, the idea of proximity or distance, within a spatial framework, becomes central to our investigation of how and why civil war might spread. We will be concerned with how we conceptualize space and distance, and especially how we measure distance. Therefore, this is what we **will do in this paper**: investigate diffusion without (at this point) distinguishing clustering from positive spatial diffusion and focusing on one specific measure of distance (which will be compared to other measures of distance in subsequent work). This is a necessary first step before distinguishing between clustering and spatial diffusion, or between spatial lag models and spatial error models. Our approach will be monadic, in studying states within specific external contexts-- neighbors, neighborhoods, or regions.

MEASURING SPATIAL AUTOCORRELATION IN CIVIL WARS

Alcock’s conception of the war disease carries with it the expectation of spatial autocorrelation, or spatial dependence: the occurrence of a conflict in one location will

make the occurrence of conflict in other locations more likely.⁵ In this paper we undertake an initial examination of spatial dependence in civil wars through an exploratory spatial data analysis (ESDA). In this spatial analysis, we identify whether civil wars exhibit spatial autocorrelation in the absence of covariates. Discussions of exploratory spatial data analysis can be found in Moran (1948), Anselin (1995), and Ord and Getis (1995). Exploratory spatial analysis is distinct from, and is often a precursor to, a modeling based approach in which spatial econometric models are employed to model spatial and non-spatial sources of the phenomenon of interest. Discussions of spatial econometrics can be found in Beck, Gleditsch, and Beardsley (2006), Franzese and Hays (2007), and Darmofal (2007).

Neighboring units can be defined in a variety of ways. Among these are direct contiguity, k -nearest neighbor, distance band, distance-decay, and non-spatial definitions of neighbors. In this paper, as an initial step in examining spatial dependence in civil wars, we define unit i 's neighbors as all units that share a contiguous border with unit i (a queen contiguity neighbor definition in spatial analysis parlance).

In our view, the existence or non-existence of a civil war is a binary phenomenon: a state either experiences a civil war at a particular point in time or it does not. As a consequence, we employ a spatial autocorrelation measure designed for binary variables: the join count statistic (Cliff and Ord 1973, 1981). Join count statistics have been employed in a variety of disciplines (see, e.g., Chung et al. 2006, Hui and McGeoch

⁵ Formally, spatial autocorrelation is a non-zero covariance on a random variable of interest: $Cov(y_i, y_j) = E(y_i y_j) - E(y_i)E(y_j) \neq 0$ for $i \neq j$, where i and j are spatially referenced locations (Anselin and Bera 1998, 241-242).

2007, Meng et al. 2005), but have been little used within political science to date.⁶

The logic of join count statistics proceeds from the metaphor of a chessboard, the classic example of a binary variable whose values are spatially arrayed. Following the colors of the chessboard, units with a value of 1 on the variable of interest are, by convention, denoted as black (or *B*) units while units with a value of 0 on the variable are denoted as white (or *W*) units. The interest then, is in determining whether *B* units neighboring other *B* units (*BB* joins), *B* units neighboring *W* units (*BW* joins), and *W* units neighboring other *W* units (*WW* joins) cluster spatially.

The number of *BB* joins in a data set is:

$$BB = \frac{1}{2} \sum_{i=1}^n \sum_{j=1}^n \delta_{ij} x_i x_j, \quad (1)$$

the number of *BW* joins is:

$$BW = \frac{1}{2} \sum_{i=1}^n \sum_{j=1}^n \delta_{ij} (x_i - x_j)^2, \quad (2)$$

and the number of *WW* joins is:

$$WW = A - (BB + BW), \quad (3)$$

where δ_{ij} are the elements of a binary spatial weights matrix with $\delta_{ij} = 1$ if units *i* and *j* are neighbors and $\delta_{ij} = 0$ if units *i* and *j* are non-neighbors, $x_i = 1$ if unit *i* is a *B* unit, $x_i = 0$ if unit *i* is a *W* unit, and *A* is the total number of joins in the data (Cliff and Ord 1981, 11).

In our application, states are *B* units if they experienced an internal conflict in a given year and are *W* units if they did not. Two principal questions animate our analysis.

⁶ A search for “join count” among political science journals in JSTOR, for example, returns no uses of the statistic within the indexed political science journal articles.

Is there spatial clustering in the *BB*, *BW*, and *WW* join counts among contiguous states in a given year? And if spatial clustering is identified, what form does it take? If the spatial dependence reflects positive spatial clustering, the number of *BB*, *BW*, or *WW* joins at neighboring locations is larger than would be expected under the null hypothesis of spatial randomness. Alternatively, if the spatial dependence reflects negative spatial clustering, the number of joins at neighboring locations is smaller than would be expected if the values were randomly distributed with regard to space.

We choose the period from 1991-2004 as the time frame for our analysis. This period allows us to examine spatial dependence among states after the dissolution of the Soviet Union and the reunification of Germany. Our data were obtained from the Peace Research Institute, Oslo (PRIO) Dataset on Armed Conflicts, Version 3-2005b (Gleditsch et al. 2002).

Before examining spatial dependence in civil wars, it is useful to examine the spatial distribution of civil wars. Figure 1 presents the occurrence of internal conflict within states from 1991 through 2004. States experiencing internal conflict during this period are mapped in red while states not experiencing an internal conflict are mapped in white. As can be seen, internal conflict is not a rare occurrence in the international system. Overall, 35.8 percent of states experienced an internal conflict during this period. Visually, the map suggests some spatial patterning in these civil wars, with internal conflicts particularly common in Africa, Asia, and, to a lesser extent, South America.

The human eye, however, favors identifying structure even where none may exist. As a result, we should not rely on a visual inspection alone for evidence of spatial clustering in civil wars. Instead, we need to employ the join count statistics to determine

whether there was spatial clustering of internal conflicts during this period. We turn to this analysis next.

SPATIAL DEPENDENCE IN CIVIL WARS, 1991-2004

For each year from 1991 through 2004, we calculated the number of *BB*, *BW*, and *WW* joins and compared the frequency of these joins to the expected number of joins if civil wars were spatially random. Rather than assuming normality, we employed a permutation approach, in which the occurrences and non-occurrences of civil wars in each year were randomly permuted across states in the world. This randomization with regard to spatial location corresponds to the null hypothesis of spatial randomness. We then calculated the number of *BB*, *BW*, and *WW* joins for each permutation, repeating the process for a total of 999 permutations. We thus created an empirical reference distribution under the null of spatial randomness and examined the observed numbers of joins for contiguous neighbors in the data to determine whether these counts differed from the expected value under the null.⁷

Table 1 presents the results of our analysis. For each year, we report the observed number of each type of join for contiguous neighbors (in the Count column), the mean of the empirical reference distribution formed through the permutation process (in the Permutation Mean column) and the standard deviation of the reference distribution.

Pseudo-significance is reported for two-tailed tests.

Consistent with Alcock's war disease, civil wars exhibit spatial dependence. In 9 of the 14 years examined, contiguous states exhibit spatial clustering in civil wars (the *BB* joins in the table). Moreover, in each of these years, the clustering is a positive spatial

⁷ We conducted the analysis using SpaceStat™ 1.91.

clustering, as the observed *BB* join counts are significantly larger than the expected value under the null of spatial randomness, the mean of the empirical reference distribution. In a majority of years since the end of the Cold War, states have been more likely to experience civil wars if their contiguous neighbors were also experiencing civil wars.

The positive spatial clustering of civil wars is also supported by the findings regarding the non-occurrence of civil wars. In 12 of the 14 years, non-occurrences of civil wars (*WW* joins) also cluster spatially. Note, however, that where the clustering in civil wars is always positive, the clustering in non-occurrences of civil wars is always negative. That is, when statistically significant, the observed number of neighbors that have successfully avoided civil wars is lower than we would expect under the assumption of spatial randomness. Civil wars, in short, are more common than we would expect and the successful avoidance of civil wars is less common than we would expect among neighboring states if spatial location were irrelevant for internal conflict.

This finding of fewer “safe havens” from civil wars than would exist if geography were unimportant for internal conflict is reinforced by the findings regarding *BW* joins. Remember that *BW* joins reflect instances in which a state not experiencing a civil war is contiguous to a state that is in a civil war. There has been an increased spatial patterning of such cases in recent years. In each of the final five years in our series, *BW* joins were more common than would be expected under spatial randomness. In only two earlier years was this the case. States that have successfully avoided internal conflict, in short, are increasingly finding themselves bordered by countries that are experiencing civil wars. This raises concerns that civil wars could spread over time to peaceful neighbors. At the same time, this trend also carries the possibility that states avoiding internal

conflicts may have a pacifying effect on their conflict-riddled neighbors.

The existence or clustering of civil wars, then, can be an indicator of “bad neighborhoods.” This finding complements research that has focused on a state’s “politically relevant international environment” (PRIE), an area that a state’s decision makers see as important in their calculations of both opportunity and willingness (e.g. Maoz 1996 or Gleditsch 2002). For most states this involves their contiguous neighbors, and perhaps the neighbors of those neighbors. Thus, states are usually most concerned with their geographically proximate regions, or “neighborhoods.” These, in turn, may be “good neighborhoods” or “bad neighborhoods.” An example of the former is found in the diffusion of democracy, looking at the effect of democracies on the prospects of democracy in their non-democratic neighbors (e.g. see Simon and Starr 2000, or Starr and Lindborg 2003). Examples of the latter can be seen in the clusters of “failed” or “failing” states, and what we are investigating here—the diffusion or clustering of civil wars (see the strong evidence of Buhaug and Gleditsch 2008).

CONCLUSION: WHAT’S NEXT?

As the an initial exploration in a larger research project, we have here taken first steps in revisiting the question of whether, and to what extent, domestic conflict in the form of civil war diffuses from one state to another. Using diffusion broadly—as either clustering or spreading through positive spatial processes—we have produced findings that support the notion that civil war clusters/diffuses. One contribution of this paper is the use of “join count” methods to demonstrate spatial autocorrelation/spatial dependence—that the occurrence of a civil war in one location will make the occurrence

of civil war in other locations more likely. The use of exploratory spatial data analysis (or ESDA) can be found in the work of geographers (e.g. Anselin 1995). While the use of ESDA in political science has been growing, the use of the specific technique of “join counts” is still quite rare.

Use of ESDA allows us to confirm previous analyses which investigated different time periods, different measures of domestic conflict, and which employed different methodologies. Having confirmed the presence of diffusion effects, the next steps will involve digging more deeply into the different forms of diffusion such as distinguishing between clustering and positive spatial diffusion (or contagion), and looking more closely at the mechanisms by which diffusion occurs. One major task will be to investigate diffusion using multiple measures of distance or proximity. While here we have used contiguity as our indicator of proximity, there are other ways to look at distance. Ward (2005), for example, has noted that we could use contiguity, a nearest neighbors measure, ranks of distance, the length of borders, or the inverse distance from some inner point, among other measures. The last possibility could be illustrated by capital-to-capital distance or a centroid measure between states. We also want to use the Gleditsch and Ward minimum-distance database, which measures “the shortest distance between the two closest physical locations for every pair of independent entities between 1875 and 1998” (2001, 744).⁸ Given that distance is a central factor in the working of diffusion processes, it is important to understand what differences, if any, exist among alternative measures of distance.

Similarly, different methodologies might be capturing different aspects of diffusion processes. Following the lead of Anselin (e.g. 1999), political scientists as well

⁸ Note that in future extensions we will expand our time frame back to 1960.

as geographers have added more and more sophisticated techniques to their methodological toolboxes for uncovering diffusion processes—see, for example Ward (2005), Ward and Gleditsch (2002), O’Loughlin and Wittmer (2005) for some of these methods. Here we have presented a little used ESDA technique, join count analysis. More needs to be done in the evaluation of which techniques are best suited to which spatially oriented research problems.

We are also interested in determining whether geographic distance remains a predictor of civil war occurrence in the presence of other covariates. In this regard we can start with some of the “usual suspects”—actually some “standard” variables which would be indicators/surrogates of a “gravity” model type approaches: population size, size of economy, trade linkages (see Buhaug and Gleditsch 2008). Polity type, given the extensive literature on democracies and the democratic peace, would also be important. As a start, these are appropriate, and a useful place to initiate an investigation of the effect of covariates on geographic distance. Once we account for others such factors affecting civil war occurrence, we can determine to what extent geography still matters; appoint brought into question by some of the results in Buhaug and Gleditsch (2008).

To end where we began—with an epidemiological analogy—if we are confronted with a condition that causes death, destruction and other important consequences, then it is crucial to understand how a “disease” spreads. To that end there is more to be done.

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Table 1**Join Count Statistics, 1991-2004**

Year	Join Type	Count	Permutation Mean (Spatial Randomness)	Standard Deviation
1991	BB	20*	12.11	3.74
	BW	107	93.32	9.16
	WW	150*	171.57	10.50
1992	BB	18	11.36	3.63
	BW	103	91.47	9.78
	WW	157	175.17	10.93
1993	BB	18**	8.97	3.27
	BW	101	85.03	9.55
	WW	170*	195.00	10.67
1994	BB	19*	10.97	3.60
	BW	110*	91.20	9.94
	WW	160*	186.83	11.14

1995	BB	12	7.81	2.99
	BW	99*	80.62	9.31
	WW	178*	200.57	10.38
1996	BB	16**	7.27	2.85
	BW	94	78.17	9.59
	WW	179*	203.56	10.57
1997	BB	16**	7.15	2.86
	BW	83	78.25	9.57
	WW	190*	203.60	10.54
1998	BB	11	6.10	2.66
	BW	81	73.38	9.56
	WW	197	209.52	10.49
1999	BB	14**	5.61	2.55
	BW	87	70.93	9.26
	WW	188*	212.46	10.15
2000	BB	11**	4.73	2.29
	BW	89**	65.65	8.89

	WW	189**	218.62	9.65
2001	BB	11*	5.25	2.37
	BW	89*	68.26	8.83
	WW	189**	215.49	9.58
2002	BB	14**	4.75	2.29
	BW	82*	65.96	8.65
	WW	193**	218.29	9.36
2003	BB	7	3.51	1.96
	BW	76*	58.08	8.57
	WW	206*	227.41	9.08
2004	BB	6	3.82	2.06
	BW	84**	60.72	8.82
	WW	199**	224.46	9.45
* p < .05, ** p < .01, two-tailed tests				

Figure 1: Internal Conflict, 1991-2004

