

From Sparks to Prairie Fires: Spatial Mechanisms of Group Mobilization*

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Abstract

Scholars have frequently mentioned the link between a group's settlement pattern and its involvement in violent conflict. In this paper, I develop a computational model to examine this relationship in detail. I argue that the settlement pattern of a group has an impact on group mobilization, because it determines how quickly mobilization can spread from a few extremists to the entire group population. All else being equal, groups with a settlement pattern which is favorable to the spread of mobilization should show a higher probability of conflict. I propose a simple geographical mobilization mechanism. Starting with a few mobilized individuals located in the major cities of a group, mobilization spreads by means of individuals traveling between cities. The model uses real-world geographic data of group territories and cities. This way, it is possible to artificially mobilize an ethnic group according to the proposed mechanism, and to measure the "difficulty" of mobilization of that group. This measure is then used as a predictor of conflict in a statistical analysis.

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1 Introduction

Much of the quantitative literature on civil war has so far adopted an aggregate level of analysis. By using state-level variables as predictors of civil war, prominent studies such as Fearon and Laitin (2003) and Collier and Hoeffler (2004) produced important insights into the macro-determinants of internal conflict. However, despite the fact that the majority of the conflicts in the post-World War II period have an ethnic element (Fearon and Laitin, 2003), we still know little about the role of ethnic groups in conflicts. This paper goes beyond analyzing ethnicity at the state level and focuses instead on the ethnic groups as the main actors.

Under which conditions do ethnic groups resort to violence? Previous research (Toft, 2002, 2003; Fearon, 1998; Posen, 1993) suggests a link between a group's geographic settlement pattern and its propensity to engage in violent conflict. I argue that in order to find out more about the relationship between group geography and conflict we will have open the "black box" of the group and take a closer look at intra-group mobilization processes. I do so by developing a computational model which is based on the assumption that the geographic connectedness of a group population is a determinant of the mobilization process.

The mobilization model that I propose tries to explain – like other models of collective action – how the action of some individuals can ultimately set in motion a collective effort of an entire group. This question is especially important in the context of ethnic conflict, where we see large numbers of people taking action, often without thorough organization but nevertheless devastating consequences. Whereas existing models of mobilization assume that people have full information about the current participation level of a movement, I argue that mobilization should rather be seen as a local process, based on local information and influence (Schelling, 1978).

The model operates on cities predominantly inhabited by the ethnic group as the basic units. Starting with a few extremists located in major urban centers, mobilization spreads over time across a group's cities, and eventually affects all of them. Here, I assume that proximity and population of two settlements are positively related to the movement of people between them and should therefore facilitate the travel of revolutionary ideas and activity. The settlement pattern of a group – where people live, and how

close they are to each other – can then facilitate interaction and therefore mobilization, but can also have a detrimental effect if the settlement pattern inhibits interaction. As a general tendency, we should then see a higher probability of conflict involvement for groups whose settlement pattern facilitates mobilization.

A best possible test of this proposed mechanism of mobilization “contagion” would require us to collect large amounts of data on observable mobilization events, both over space and time and also for different groups. I resort to a different way of assessing the empirical accuracy of the model: I model the hypothesized mobilization process on real-world data using computer simulation. The output of this model is a measure of the difficulty of mobilization of the group. In other words, it tells us how quickly mobilization would spread through the group population if the proposed mechanism was at work. What remains to be done is to compare this mobilization speed measure to the empirical outcome: Are groups with a high mobilization speed indeed more prone to conflict? This comparison is made statistically on a larger sample of groups, and is described in the final part of the paper.

The paper is structured as follows. The theoretical motivation for the model is given in Section 2. Section 3 introduces the model in detail, and illustrates it with two examples. In Section 4, I describe the empirical test of the model and report preliminary findings. Section 5 concludes the paper.

2 Social Interaction and Group Mobilization

Threshold models of collective behavior (Granovetter, 1978; Kuran, 1989, 1991; Chwe, 1999) provide an account of how mobilization of an entire group can develop from a few initial extremists. It is assumed that both benefits and costs of rebellion are assessed in terms of the total number of people that have already joined the movement. However, the assumption that people have complete information about the actual number of participants requires full connectedness across the population, which, as Granovetter (1978, p. 1431) himself mentions, is often not appropriate. This criticism should apply especially to ethnic groups that usually cover large areas. Instead, an individual’s face-to-face contacts and social networks seem to be crucial in affecting an individual’s participation decision. We can distinguish between two ways by which direct social interaction can foster the spread of mobi-

lization from some mobilized individuals to others: First, it can have motivational consequences on an individual's attitude towards rebellion, and second, it can affect the practical feasibility of joint collective action.

The first effect – the social impact on individual motivation – has frequently been emphasized by scholars of collective action (see for example Tarrow, 1994). People's immediate networks seem to have a high influence on someone's opinion, especially regarding participation in a social movement. Social impact theory, developed in the 1980s primarily by the social psychologist Bibb Latané (Latané, 1981; Nowak et al., 1990) states the effect of a group on an individual's opinion to be a function of the strength, the immediacy and the number of influencers, where immediacy is the spatial and temporal proximity of the influencing individual. Again, "close" individuals have a higher impact in convincing an individual of participation. The opinion-influencing effect is especially relevant in the context of ethnic mobilization: If a single group member feels discriminated against, this is not a collective grievance until others feel the same, and the group is collectively aware thereof. Hardin (1995) reasons that repeated social interactions are crucial for developing a shared feeling of discontent. Essentially, by fostering the development of shared grievances in a group population, social interactions help prepare the motivation for violent action.

Apart from the opinion-influencing effect mentioned above, the possibility of direct interaction with one's peers can have practical consequences on the feasibility of rebellion. Lichbach (1995) examines the "rebel's dilemma" from a collective action perspective and emphasizes close interaction between participants as an advantage for a rebel organization. This is due to a number of reasons: First, closely linked dissidents can much better monitor contributors and noncontributors and thus provide rewards or apply punishments effectively. Second, organizational costs for collective action are reduced, such that organization and coordination of activities becomes easier. In general, spatial proximity between dissidents is likely to have practical advantages for a movement.

Having discussed the importance of direct social interaction for conflict mobilization, how does the geographic settlement pattern of a group affect its interaction opportunities, and ultimately the difficulty of mobilization? I examine the spread of mobilization on a large scale, i.e. between cities as the basic geographical units. A city is a close community of a large number of

people. Such an environment facilitates mutual radicalization of individuals, but also the monitoring of defectors not willing to join a movement. Whereas the spread of mobilization *within* a city should be quick, its diffusion *to other cities* should be more difficult and depend on the social exchange between them.

Zipf’s (1946) results on the intercity movement of persons show that the number of people traveling between two cities is proportional to the populations of both cities, and inversely proportional to the distance between them. Correspondingly, the strength of social network ties between cities should be declining with their distance. Studies by Hägerstrand (1967) found a similar relationship for phone calls between villages, with a frequency that declines proportional to the distance that separates them.

In sum, the proposed arguments suggest a modified model of mobilization, where – like in the Granovetter model – individuals still base their decision on their peers, but do not have full connectedness. Instead, we can hypothesize mobilization to spread geographically from a few extremist cities through the population of the group, similar to Hägerstrand’s (1967) model of the geographic spread of innovation. The next section introduces this model in detail.

3 Simulating Group Mobilization

3.1 Introducing the Model

The mobilization model is based on the assumption that mobilization geographically spreads through the settlements of a group population. It operates on a set of cities $C = \{c_1, \dots, c_n\}$ with given populations $s(c_1), \dots, s(c_n)$. The settlements are located at a certain distance from each other, denoted by $d(c_i, c_j)$. At a given point in time, each of these settlements is either in state “mobilized” or “unmobilized”. I refer to the set of mobilized and unmobilized cities as M and U , respectively. Obviously, $M \cap U = \emptyset$ and $C = M \cup U$. The model starts with an initial set M_0 of mobilized settlements, and then simulates the spread of mobilization to the remaining ones U . In the following, I introduce the initialization phase and the subsequent mobilization phases in detail.

Initialization phase

During the initial phase of the model, extremists are placed randomly in cities of the group. This is done by selecting a small proportion of the entire population as extremists (0.002 percent¹) and then placing them randomly in the cities. I classify a city as mobilized as soon as it has at least one mobilized individual.

Mobilization steps

In each time step, an unmobilized city is selected randomly from U and is evaluated if it should switch its status to “mobilized”. This decision is made based on the influence of the other settlements of the group. The influence of another settlements is proportional to the movement of people. As described in Zipf (1946), the number of people traveling between two cities is proportional to the sizes of the cities, and inversely proportional to the distance between them. In the notation introduced above, the mobilizing influence of city c_i on city c_j is therefore given as

$$I_{i,j}^+ = \frac{s(c_i)s(c_j)}{d(c_i, c_j)}. \quad (1)$$

However, apart from transmitting radical ideas from one city to the other, intercity movement can also have a mobilization-inhibiting influence. In other words, the connectedness of a settlement to many others which do not share rebellious ideas might prevent this settlement from getting radicalized itself. This inhibiting influence is also hypothesized to be proportional to the exchange of people between the cities as introduced above.

To summarize, the total mobilizing influence I^+ on an unmobilized settlement c is simply the sum of all mobilizing influences

$$I^+ = \sum_{m \in M} \frac{s(c)s(m)}{d(c, m)} \quad (2)$$

and correspondingly for the total inhibiting influence,

¹This value is a somewhat arbitrary choice. For very high proportions, all cities would be mobilized initially, and no geographic spread would take place. On the contrary, if a low value is chosen the result would be very few initially mobilized cities. It will have to be checked how much the results of the model depend on the choice of this value.

$$I^- = \sum_{u \in U-c} \frac{s(c)s(u)}{d(c, u)}. \quad (3)$$

The probability for the selected settlement c of flipping from “unmobilized” to “mobilized” takes into account both the mobilizing and inhibiting influences of all the other group settlements. It is assumed to be proportional to the ratio of the total mobilizing influence I^+ to the total influence $I^+ + I^-$. This mobilization procedure is repeated until time t_f when there are no more unmobilized settlements left. In other words, the mobilization process in all cases reaches all settlements eventually, but will take many time steps to do so if the settlement pattern is not favorable for social interaction.

What we are interested in is how quickly mobilization can spread through the entire group population. Essentially, we need a measure for the speed of mobilization in the group population. I compute this speed as the average number of settlements mobilized during a time step of the simulation, or

$$v_{mob} = \frac{|C|}{t_f}. \quad (4)$$

In summary, the outcome of the mobilization model is determined by an interplay of two features of the settlement pattern. First, this is the distribution of the city sizes. If the distribution is close to uniform, we will find extremists located in many of them which facilitates a quick spread to the remaining ones. On the other hand, if there are few cities considerably larger than the others, extremists will be confined to these and inhibit mobilization. Second, obviously the distance of cities matters. If located close to each other, spread of mobilization is likely. Related to the latter issue is the spatial concentration of a group: Settlements of a concentrated group are located close to each other, enabling the group to mobilize quickly (Toft, 2003). However, the contrary need not hold for dispersed groups, settling in different clusters throughout the country. If there is a large city located in a cluster, it is likely to be populated by extremists and makes mobilization of this cluster feasible.

3.2 Running the Model on Geographic Data

The real-world geography of a group is used to run the mobilization process introduced above. Two types of data are required for the model: Data on the primary settlement regions of the marginalized ethnic groups, and data on the primary settlements located in the territory of the respective group.

Data on the settlement regions of groups is taken from the GREG project (Cederman et al., 2007), conducted by the International Conflict Research group at ETH in collaboration with the Norwegian University of Science and Technology in Trondheim. The aim of this project was to create a global GIS dataset of the locations of ethnic groups. The information stems from the Atlas Narodov Mira (Bruk, 1964), a comprehensive collection of ethnic maps. In the current version, the dataset consists of roughly 9'000 polygons covering the entire globe.

Since the original data – now represented as GIS polygons – had been collected at different resolutions for different countries, a generalization procedure was employed to bring the maps to an equal resolution. First, the polygon maps were rasterized at a fine resolution of 2.5 arc-minutes. In a subsequent step, raster cells were combined into larger ones such that groups with a larger population share prevail. The result of this process is a raster dataset with a resolution of roughly 30x30 km where the raster cells are occupied by the predominant groups.

Data on the settlement points of single groups is taken from the Global Rural-Urban Mapping Project (GRUMP), conducted by CIESIN (2004). The dataset contains a worldwide list of cities and towns with a population estimate of at least 1'000 as well as with their geographic location. Based on the GREG data about settlement regions as introduced above, the cities of an ethnic group are filtered out. They constitute the basic set C of settlements on which the model is run as described in the previous section. The population estimates $s(c_i)$ were also obtained from the GRUMP dataset. The distance $d(c_i, c_j)$ between two settlements is approximated by the distance “as the crow flies” on a spherical earth.

The development of the model uses the GROWLab toolkit for Java (Weidmann and Girardin, 2006) that has built-in support for GIS applications and fully includes the data on countries, groups and group cells as required for this model.

3.3 Illustration of the Model: Two Examples

This section shows the execution of the mobilization model for two examples. The purpose of this exercise is not to be a test of the model, but only to illustrate its inner workings. The examples have been selected as to show different outcomes: I apply the model to (1) the Kurds in Iran, which is an example of a fairly quick mobilization of a large population, and (2) to the Welsh in the UK, where the hypothetical mobilization process is fairly slow due to the geographic arrangement of the settlements.

For both examples, the hypothetical mobilization process is displayed both on a map, and as a chart with the percentage of the mobilized population per time step. This way, it is possible to follow the modeled process both geographically and in terms of the population affected. Obviously, the model contains random elements (random selection of initial cities, random decision if mobilization spreads), so every run of the model on the same data looks different. For illustration purposes, both examples shown in this section are based on only one run of the model (seed 1 of the random number generator).

The Kurds in Iran

The Kurdish settlements in Iran are primarily located along the western border of the country, and in the north-eastern part. Figure 1 shows the settlement areas in grey. Major cities as contained in the GRUMP dataset are shown as black dots, with the size proportional to the log of the city's population. Mobilized settlements are circled.

[Figure 1 about here]

Initially, the models start off with quite a few of the larger cities mobilized. Note that there are also mobilized cities in the smaller region in the north-east such that the mobilization of the remaining city in this region is not difficult because there are large, mobilized cities nearby. Without the presence of a large city in a small disconnected region of a group, mobilization of this region becomes much more difficult (see the example of the Welsh below).

[Figure 3 about here]

In subsequent time steps, we observe a quick spread of mobilization across the entire Kurdish population. This visual observation is supported by Figure 3, showing the proportion of the mobilized population over time. The mobilized population increases steadily, reaching full mobilization already after 9 time steps. In sum, the model assessment predicts a fairly rapid spread of mobilization of the Kurdish population.

The Welsh in the UK

The Welsh territory in the UK is located in the south-west of Britain. Large parts of Wales especially in the north and in center are mountainous, so the larger settlements in Wales can be found primarily in the north, and in the south of the country (see Figure 2).

[Figure 2 about here]

Upon initialization, the larger Welsh cities are mobilized, primarily located in the southern part of the territory. In the immediate steps after initialization, we do not see a quick spread of mobilization as in the Kurdish example above. However, after mobilization has reached a major city in the north (top left corner) it does not take much time for it to spread also to the other remaining settlements located nearby. Correspondingly, the mobilization curve (Figure 4 shows a plateau during the first time steps, and does not take off before time step 7.

[Figure 4 about here]

Because of the geographic arrangement of their settlements, the mobilization model predicts a lower probability of quick and successful mobilization for the Welsh as compared to the Kurds. In numerical terms, the mobilization speed introduced above (Equation 4) is 2.1 cities per time step for the Kurds, and exactly half of it (1.05 cities per time step) for the Welsh.

The examples presented in this section illustrate the workings of the model in detail for two cases. However, after close examination, one could suspect that only the number of cities rather than their geographic positions is responsible for the outcome: If there is a large number of cities for a group, many might be chosen initially as mobilized, which again facilitates the quick spread of mobilization through the entire group (as in the Kurdish example).

It will therefore be important in the large-N analysis to control for the total number of settlements of a group.

4 Empirical Test of the Model

In the final part of the paper I assess the predictive performance of the model empirically. If the hypothesized mechanism of mobilization spread was indeed operating, we should see a higher speed of mobilization to be related to a higher risk of conflict. I test this statistically using data from Buhaug et al. (2006). They code political status (included – excluded), conflict and a set of demographic and geographic variables for a sample of politically marginalized ethnic groups, currently covering Europe and Asia. Note that for technical reasons, I have not been able to test my model on the full sample. The results I present here must therefore be considered preliminary and should be treated with caution.

The focus of this paper is on aggrieved ethnic groups and their struggle against the state. Therefore I first select groups which are coded as politically marginalized by Buhaug et al. (2006). Second, in order to allow for a reasonable amount of variation in the mobilization procedure, I select groups with at least 5 cities in their settlement region. This narrows the sample down to 83 groups from 26 countries. At the present stage of this project I employ a cross-sectional design, comparing groups across the entire post-WWII period. More precisely, the dependent variable takes a value of 1 if a group was involved in violent ethnic conflict in the period from 1946 (or the first year of the existence of their state) to 2005. The conflict variable was coded from the Armed Conflict Dataset (Gleditsch et al., 2002), identifying the ethnic character of a conflict according to Fearon and Laitin (2003). For further details, see Buhaug et al. (2006).

The mobilization speed measures used for the empirical test are averages over 20 model runs with different random seeds. This average mobilization speed measure is added to the statistical model of Buhaug et al. (2006). The model includes the following independent variables: the dyadic *power balance* between the peripheral group in question and the central group, computed as the ratio of the marginalized group's population to the total population of the marginalized group and the group in power; a population-weighted logged *distance* measure of the group's territory to the capital;

and a measure of *roughness of terrain* the group lives in, computed from elevation data. Furthermore, they add two measures at the country level: logged GDP per capita values and a dummy variable for democracy based on Polity IV, either for 1950 or the year of independence.

[Table 1 about here]

Table 1 shows the descriptives and the correlations of the variables. I employ logit models to test the influence of mobilization speed on ethnic conflict². Standard errors are clustered by country to control for possible dependency of conflict observations. The results are given in Table 2.

[Table 2 about here]

Model 1 repeats the original analysis in Buhaug et al. (2006) with my restricted sample. The power balance has a positive effect, so the larger the marginalized group in relation to the ethnic group in power, the higher the risk of dyadic conflict. Terrain roughness also seems to foster conflict, as indicated by the positive coefficient. The distance of a group from the capital has a positive but insignificant effect. GDP seems to have no effect, but the positive significant sign of democracy is somewhat counter-intuitive to our expectations.

In Model 2, I add the (logged) mobilization speed measure computed by the computational model. It shows that the effect of mobilization speed has a positive sign as hypothesized and reaches the 5% percent significance level. The effect corresponds to an increase in the predicted probability of conflict from 0.03 to 0.24 when changing the mobilization speed from its 5th percentile to its 95th while keeping all other variables at their means.³

Model 3 adds the total number of settlements of a group as a control and shows that it seems to have no discernible effect. In other models (not shown), I checked robustness with respect to the inclusion of the total population of the group, and the number of groups in a country. This led to no substantial change in the results. However, I found the effect of mobilization speed to be fairly sensitive to model specification. This finding and the counter-intuitive results for the some of the independent variables limit the conclusions we can draw from the analysis. I will be able to produce a more reliable test once the model has been run on the full sample of cases.

²Software: Stata SE 9.2

³Computed using the Clarify extension for Stata (King et al., 2000).

5 Summary and Conclusion

In this paper I examined the impact of geography on group mobilization. I proposed a mechanism of ethnic mobilization with a spatial dimension, operating on cities as the primary settlements of a group. In the model, mobilization initiated by a few extremists spreads geographically to other previously unaffected settlements. The spread is dependent on the interaction between the settlement, which is approximated by the number of people traveling between the settlements. For certain groups, the settlement pattern should favor mobilization and therefore conflict involvement of that group.

A full test of the proposed mechanism would require data on outbreaks of violence, both over space and time and for different groups. Instead, I used a computational model to artificially “mobilize” a group and to generate a measure for the observed speed of mobilization of that group. The model operates on real geographic data about a group’s settlement region and its cities. The relation of mobilization speed to conflict was then assessed in a statistical analysis. Preliminary results show that mobilization speed seems to be associated with a higher risk of conflict, but the results did not prove to be very robust and must not be treated as final evidence in favor of the model.

My approach for this paper was to start with a simple model, and there are obviously assumptions that require further refinement. For example, it might not be realistic to treat entire cities as either mobilized or not. One could rather work with a mobilization threshold (Granovetter, 1978) which would allow some extremists to be present without the city completely flipping to full mobilization. Furthermore, the contagion mechanism could be tested on real data about connectedness instead of using the geographic distance for a crude approximation. For example, data on road networks would be a better indicator for the movement of people between cities.

This paper shows how computational modeling can be used for the empirical testing of hypothetical mechanisms. Although my empirical test only looks at the “input” (group geography) and the “output” (conflict) side of a process (Hedström and Swedberg, 1998), the black box in between the two is made explicit. However, the model also generates predictions for the intermediate steps of a process, which could be compared to empirical

evidence if data is available. In general, the computational approach to empirical testing of mechanisms has some advantages. If one is to revise the hypothesized mechanism, this can easily be implemented and subsequently subjected to empirical testing without a new collection of data. Therefore, a computational model can be considered as an operational specification of a process because it is able to generate the consequences entailed by the process accurately and systematically.

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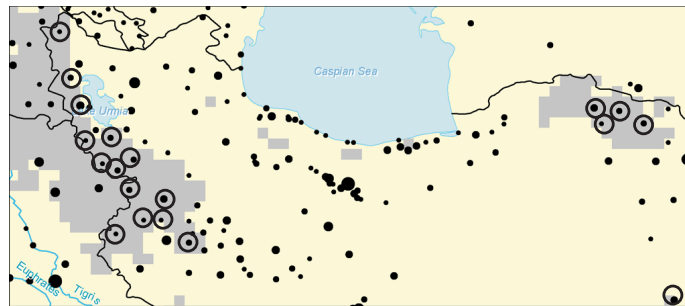
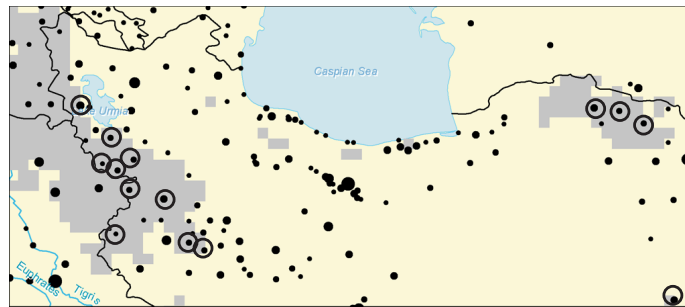
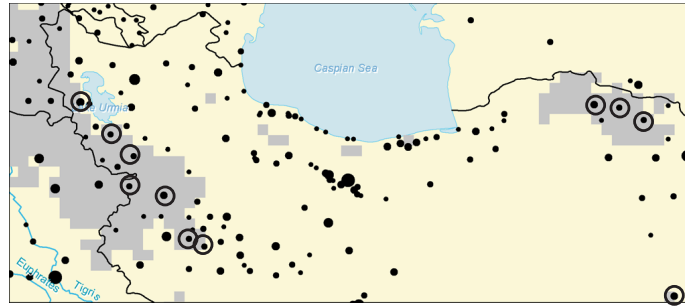


Figure 1: Mobilization model run for the Kurds in Iran. The maps display the model outcome after the time step 1 (initialization), 4, and 9.

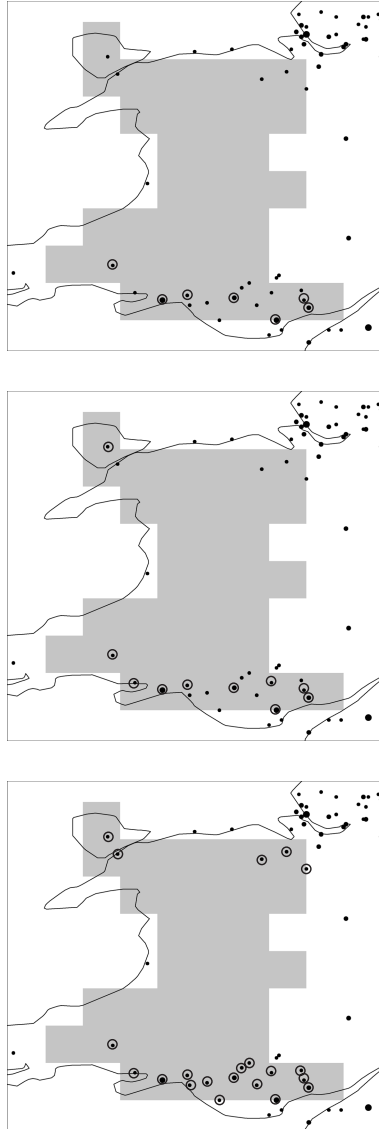


Figure 2: Mobilization model run for the Welsh in the UK. The maps display the model outcome after the time step 1 (initialization), 7, and 16.

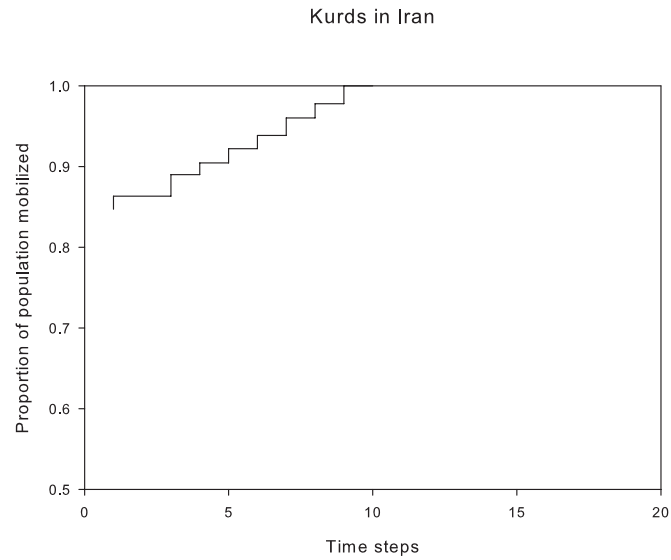


Figure 3: Mobilization curve of a sample run of the mobilization model for the Kurds in Iran.

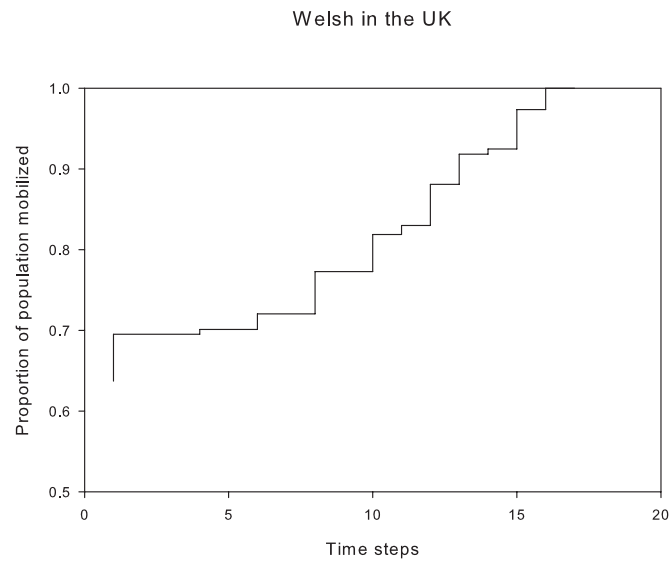


Figure 4: Mobilization curve of a sample run of the mobilization model for the Welsh in the UK.

Variable	Mean	Std. Dev.	Min.	Max.	N
Conflict	0.169	0.377	0	1	83
Mobilization speed	1.923	1.108	0.6	6.21	83
Power balance	0.072	0.098	0	0.374	83
Terrain roughness	0.497	0.345	0	0.99	83
Distance	6.371	1.169	3.1	7.97	83
GDP	1.501	1.892	0.12	7.48	83
Democracy	0.301	0.462	0	1	83
No. of cities	23.602	41.676	5	247	83

	Conflict	Mob. speed	Power bal.	Rough terrain	Distance	GDP	Democracy	No. of cities
Conflict	1.000							
Mob. speed	0.089	1.000						
Power bal.	0.128	0.429	1.000					
Terrain roughness	0.236	-0.137	-0.175	1.000				
Distance	0.036	-0.003	-0.578	0.230	1.000			
GDP	0.011	0.099	0.015	-0.443	-0.097	1.000		
Democracy	0.125	-0.401	-0.060	-0.162	-0.170	0.016	1.000	
No. of cities	-0.063	-0.028	0.161	-0.153	-0.009	-0.140	0.146	1.000

Table 1: Descriptive statistics and correlation matrix.

	Model 1	Model 2	Model 3
	b/se	b/se	b/se
Mob. speed		1.488*	1.488*
		(0.655)	(0.641)
No. of cities			-0.000
			(0.007)
Power bal.	12.624*	10.333	10.334
	(5.690)	(6.424)	(6.445)
Terrain roughness	4.894**	5.733**	5.733**
	(1.884)	(2.030)	(2.154)
Distance	0.824	0.645	0.645
	(0.445)	(0.474)	(0.476)
GDP	0.511	0.506	0.506
	(0.263)	(0.269)	(0.287)
Democracy	1.922*	2.658**	2.657**
	(0.789)	(0.806)	(0.817)
Constant	-12.306**	-12.571**	-12.570**
	(4.499)	(4.717)	(4.757)
Log-likelihood	-28.919	-27.114	-27.114
N	83	83	83

Table 2: Results of the logit models, standard errors clustered by country.
 $*p < 0.05$, $**p < 0.01$.