Tectonic Boundaries and Strongholds: The Religious Geography of Violence in Northern Ireland*

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Abstract

The conflict in Northern Ireland was an example of "complex warfare" with both insurgency and sectarian violence. We present a unified model that helps to identify these two forms of conflict from the spatial distribution of violence. The model predicts that *tectonic boundaries* between residential areas of opposed groups drive sectarian violence. Violence between the minority and state forces takes place in minority *strongholds*. We test the model with fine-grained data on religious composition and geo-referenced data on killings with detailed information on attackers and targets. We also show that sectarian violence can predict the placement of barriers (i.e. so-called "peace lines"). Finally, we analyze the effect of a troop surge in 1972 and the proximity to the Republic of Ireland on the two elements of the conflict.

Keywords: Conflict, Terrorism, Religious Tensions, Ethnic Diversity, Northern Ireland, Segregation, Insurgency, Counter-Terrorism.

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1 Introduction

Civil conflicts often blur the traditional distinction between insurgency and sectarian violence. The current conflicts in Syria, Iraq and Afghanistan, for example, share elements with traditional guerrilla warfare, but also feature a large amount of violence between different religious groups. A growing body of work has made inroads in understanding the motives behind such situations of "complex warfare" from a country perspective.[1] However, this literature does not address the large variation of violence within countries. This means it is almost impossible to translate current research into an optimal political and military strategy to achieve rapid and lasting peace.

This gap has triggered a boom of studies that use geo-localized data on political violence covering a variety of conflicts.[2] The promise of geo-localized data is that spatial variation in violence will help reveal the motives of violence. However, most studies link violence to characteristics within geographic units. In spatially disaggregated data this can lead to serious mistakes. Imagine, for example, a violent conflict between group A and B, where areas under control of group A attack regions controlled by group B. In the standard way of analyzing the data this will appear as a correlation between characteristics of group B and violence. But it is the interaction of group A and B across space that leads to violence.

This article suggests a simple framework which allows the researcher to relate spatial violence to local characteristics. We posit that a) the likelihood of achieving a group's military and political goals is an increasing function of the fatalities it causes, b) recruitment and support for paramilitary organizations active in conflict are local, c) specific individual characteristics (religion, ethnicity, socioeconomic status) determine the likelihood of supporting certain armed groups, d) chances of success are smaller when attacking targets that are further away, and e) greater availability of targets leads to greater violence. Building on these assumptions, our model

[1] See, for example, Brückner and Ciccone (2010), Besley and Persson (2011), and Esteban, Mayoral and Ray (2012).

[2] For details see the literature review. For two examples of impressive geo-referenced conflict datasets see the UCDP Georeferenced Event Data and the Armed Conflict Location and Events Dataset (ACLED).

predicts the occurrence of two distinct types of violence. First, there is sectarian violence between the population groups, taking place at the *tectonic boundaries* where residential areas of different groups clash. Second, there is insurgency violence between the state and the minority group, taking place in the *stronghold* residential areas of the minority group.

We use this simple framework to analyze the religious dimension of the Northern Irish conflict. Northern Ireland –being a rare example of a developed country experiencing an intense conflict– provides a unique setting that allows to match very precise conflict events and location data with fine-grained census data on the exact number of members from different religious groups in 582 local administrative wards. We make use of geo-referenced fatality data that reports both the perpetrator of violence and the group affiliation of the victim. This allows us to observe patterns of violence by state forces, republicans and loyalists separately.

We show that there was a clear religious dimension to killings. In particular, the conflict between loyalists and republicans, i.e. sectarian violence, takes place along religious *tectonic boundaries* - "Interface" areas where Protestant and Catholic neighborhoods meet. Violence involving state actors follows a very different logic. This insurgent and counter-insurgent violence takes place in Catholic strongholds irrespective of their neighborhood composition. We argue that this is due to the military balance between state forces and republican paramilitaries. Overwhelming military power meant that state activity did not require the proximity to Protestant communities.

We demonstrate the usefulness of our unified model in several applications. First, we show that the construction of peace walls on ward boundaries can be predicted by our definition of tectonic boundaries. This result holds up to controlling for ward fixed effects and within-ward religious composition on both sides of the ward boundary.

In section 7.2 we study the effect of a massive, focused, troop surge which took place on the 31st of July 1972. We find that the army surge in republican strongholds led to a particularly large drop in republican violence in wards neighboring these strongholds, as predicted by our theory. This lends support to the idea that local spillovers are important when analyzing counter insurgency strategies at this level of disaggregation.

As a final application of our setting we show that boundaries to the Republic of Ireland ceteris paribus features much more republican violence directed at UK state forces. This provides evidence for the known support of IRA action by individuals in the Republic, which is in line with the model's predictions on strongholds. Our results also support the idea that patterns of insurgent violence are strongly affected by military control.

The paper is organized as follows: Section 2 surveys the related literature, while Section 3 provides a discussion of the context of the "Troubles" in Northern Ireland. In Section 4 we set up a simple formal model, in Section 5 we present the data and empirical strategy, and in Section 6 we carry out the econometric analysis and present the results. In section 7 we use the model to shed light on several aspects of the conflict in Northern Ireland. Section 8 concludes.

2 Related literature

Our paper is related to the literature on ethnic and religious conflict between domestic groups. Most theoretical papers in economics model ethnic conflict as a strategic interaction between a small number of aggregate players on the nation level (Esteban and Ray, 2008, 2011; Caselli and Coleman, 2013). These frameworks are able to show that ethnic conflict is more salient than class conflict and that the risk of turmoil increases in ethnically polarized societies, i.e. in societies with a small number of sizeable groups. Rohner (2011) builds one of the rare models of ethnic conflict where interaction and social tensions happen at a disaggregate individual level, and finds that ethnic fractionalization, polarization and segregation fuel conflict. Recently, the nexus between ethnic conflict and trust has also received attention by the theoretical literature (Rohner, Thoenig and Zilibotti, 2013; Acemoglu and Wolitzky, 2012). In other strands of the theoretical conflict literature, Besley and Persson (2010, 2011) focus on the role of state capacity in civil wars, while Morelli and Rohner (2013) emphasize the impact of natural resources on civil conflict.

However, while all of these contributions study the overall, aggregate likelihood of conflict, none of them contains predictions of spatial violence patterns on the sub-national level. This paper offers a way to translate theories on the national level into predictions of spatial violence patterns. The simple idea is that, for a given level of motivation, violence is increasing in the number of targets and perpetrators of violence. To the best of our knowledge this, almost trivial, point has been disregarded up until now.

Most empirical studies of ethnicity and civil war focus at the country year level. While the impact of ethnic fractionalization on ethnic fighting has been found to be ambiguous (cf. Fearon and Laitin, 2003; Collier and Hoeffler, 2004; Collier and Rohner, 2008; Collier, Hoeffler, and Rohner, 2009), it has been found that ethnic polarization fuels the risk of civil war (Montalvo and Reynal-Querol, 2005; Esteban, Mayoral and Ray, 2012). Cederman and Girardin (2007) find that ethno-nationalist exclusion of minority groups increases the risk of ethnic conflict. Michalopoulos and Papaioannou (2011) find that the division of ethnic groups by arbitrary national boundaries leads to conflict.

There is an increasing number of papers that study violence at a disaggregate, local level (e.g. Rohner, Thoenig, and Zilibotti, 2012; Berman and Couttenier, 2013; Dube and Vargas, 2013), but most of these contributions do not contain a formal model of war and/or focus on geographical features related to characteristics of the terrain and the availability of natural resources. They typically do not take into account the local ethnic composition, usually due to data limitations, as it is extremely hard to find fine-grained and reliable data on ethnic group location and size for politically instable countries.

There are a few papers selecting an intermediate level of disaggregation and building a panel dataset on the ethnic group level covering a large number of countries (cf. for example, Buhaug, Cederman, and Rod, 2008; Esteban, Morelli and Rohner, 2012). However, their level of disaggregation is still much less fine-grained than in the current paper, and they do not focus on local ethnic cleavages and the interaction of ethnic groups across regions.

Research that studies insurgency and violence for one country at a very fine-grained level is still rather scarce. Kalyvas (2006) argues that fighting groups use a combination of persuasion and coercion to win support of the local population and to extract important intelligence information about their opponents. The insurgents and governing forces use –especially in regions of incomplete control– discriminate or indiscriminate violence in the goal of establishing control over an area. As indiscriminate violence is inefficient, armed groups prefer to apply discriminate violence whenever intelligence information permits. Kalyvas stresses the role of military control for recruitment into armed groups. Our work can be regarded as translating Kalyvas' ideas of military control into a context in which population characteristics affect the ease at which paramilitaries recruit. More importantly, perhaps, our model allows for an empirical study of the interaction of geographic units across space. We see this as a natural way of extending the idea of territorial control and bringing it to the data.[3]

There is a small literature in political science studying –inspired by the epidemiological literature on the spread of diseases– diffusion and clustering patterns of violence over space and time (Townsley, Johnson, and Ratcliffe, 2008, Schutte and Weidmann, 2011). Further, also Vector-Autoregression (VAR) models have been used to study cyclicality of fighting: For example, Jaeger and Paserman (2008) study whether there is "tit-for-tat" over time in the Palestinian-Israeli conflict. They find using VAR and Granger causality tests that while Israeli troops strike back promptly and strongly after Israeli fatalities, a similar retaliation is not observed for Palestinian fighters. Our study draws attention to the fact that Palestinian killings of Israelis trigger a response not locally but many kilometers away. Without a clear classification of victim and perpetrator of violence in the data this study would therefore not be possible.

There are also papers studying the efficiency of particular counter-insurgency strategies: Lyall (2010) finds that village "sweep"operations carried out by pro-Russian Chechen forces are more efficient in reducing posterior retaliation attacks than similar "sweep" operations performed by Russian troops, which would be consistent with the view that a "coethnicity advantage" in counter-insurgency exists due to better information. Kocher, Pepinsky and Kalyvas (2011) find that U.S. aerial bombing –a form of indiscriminate violence– in Vietnam was counter-productive and resulted in an increased likelihood that the Viet Cong ultimately gained control of an affected area. Berman, Shapiro and Felter (2011) build a model with government, rebels and civilians,

[3] Bhavnani et al (2011) provide a model of control in geographic space with three groups but do not test this aspect empirically.

where the government has the choice between repression and public good provision. They then show empirically for Iraqian microdata that public good provision has reduced insurgency efforts. We show in one of our applications that the troop surge in Northern Ireland lowered republican violence beyond areas most directly affected. This externality is an important factor for studies using disaggregated data.

Novta (2013) builds a simulation-based model of how conflict spreads. Contrary to our setting that models a situation of insurgency and terrorism, her framework is designed to study traditional military warfare between two standing armies. The features of her model are found to be consistent with the spread of violence in the 109 municipalities of Bosnia. Novta models the armed groups in each municipality as separate, myopic players who can only attack in their home village while the focus of our, much simpler, framework lies precisely on the across-ward attacks.

Predicting spatial violence patterns is important because violence affects political and economic outcomes locally. Besley and Mueller (2012) show, for example, that there were distinct differences in the economic effect of the Northern Ireland conflict driven by differences in local violence levels. Compared to peaceful areas, housing in the most violent areas sold for between 2 and 17 percent less - depending on the level of violence. If ethnic tensions have an impact on countries then we would expect these to be biggest in the violent areas. And, depending on how predictable violence is, we might find areas with no violence to be completely unaffected.

3 Context of Conflict in Northern Ireland

The Northern part of Ireland, Ulster, has been religiously divided since its conquest by England and the Reformation, taking both place in the 16th century.[4] Since then the Catholic population from Gaelic Irish origin and the Protestant population of English and Scottish settlers have lived "separate lives" characterized by very stable patterns of land holdings and relatively

[4] This subsection draws heavily on Mulholland (2002).

few religiously mixed marriages (Mulholland, 2002). When the Republic of Ireland achieved independence from Britain in 1919, the six Northern counties of Ireland remained part of the UK.

In the early 1920s "Troubles" broke out with the Irish Republican Army (IRA) challenging British authority over Ulster and engaging in violent combats against the British troops and Protestant paramilitary organizations such as the Ulster Volunteer Force (UVF). The following decades were characterized by "home rule" and the new Parliament of Northern Ireland at Stormont near Belfast. The political divide persisted between the Catholic Nationalists (also called Republicans) who wanted to join the Republic of Ireland and the Protestant Unionists (also called Loyalists) who wanted to remain united with the UK.

While in the 1950s and early 1960s there were relatively low levels of political violence, in 1968 the situation became again more confrontational when the Civil Rights Movements asked for more rights for Catholic citizens. Some of the initially peaceful demonstrations and marches were met with repression and resulted in fatalities. From August 1969 onwards sectarian violence exploded. The first "Peace Walls" were erected at notorious interfaces between Protestant and Catholic communities and the British army was mobilized to restore law and order. In September 1969 radical militants took control of the previously dormant IRA and created its radical wing, the Provisional IRA. The "Provos" achieved an ever tighter grip of traditional Catholic working class strongholds like the Falls Road in Belfast or the Bogside in Derry. Barricades were erected in these areas and the state forces increasingly avoided entering in these territories controlled by the IRA, making them "no-go areas". The IRA benefitted from these no-go areas to rapidly increase its strength.

In the large-scaled Operation Motorman on the 31 July 1972 the state forces reestablished control of the no-go areas, which made it much harder for the IRA to recruit fighters and prepare bombing campaigns. In fact, *"since Operation Motorman, the republican movement had drifted into something of a strategic impasse. Their success rate in 1973 and 1974 fell dramatically as British army saturation policing winkled out valuable intelligence"* (Mulholland, 2002: 99).

Further, alarmed by the rise of the IRA and the seeming willingness of the UK government to make political concessions, also the loyalist paramilitary organizations stepped up in the 1970s, intimidating Catholic families from mixed and Protestant areas and starting a violent campaign against civilian Catholics.

After 1976 the UK built up a stronger Royal Ulster Constabulary (RUC) that together with the British Army and the SAS troops stepped up efforts to militarily weaken the IRA. This effort led the loyalist paramilitaries to lower their violence and the IRA to retrieve from large-scale open confrontations and to adopt a cellular structure common in terrorist organizations. The conflict moved from an insurgent war to terrorist campaign.

From 1981 onward the republican movement started a double strategy: While terrorist activities were maintained, now its political arm, Sinn Fein, started participating in elections. Political reform in Northern Ireland pursued during the Eighties, with the Anglo-Irish agreement of 1985 being a decisive step. While in the aftermath of this agreement loyalist protest and violence once again re-escalated, and the IRA exacted revenge, the peace process did not come to a halt. The Belfast Good Friday agreement in 1998 represented a balanced compromise acceptable to both religious communities and established wide-ranging power-sharing. Since then political tensions and violence have become much more sporadic and lower-scale.

4 Model

In what follows we model violence by three groups, two paramilitary groups that are supported by parts of the civilian population and one group of state forces who consist of professional agents deployed by a central authority. We believe this set-up to be quite general, and capture well situations in ethnically or religiously divided countries where one of the ethnic or religious groups controls the state. However, in order to make the translation to the data as simple as possible we will call the paramilitary groups republicans (RE) and loyalists (LO). We denote state forces by the letter S. We denote these groups of perpetrators as $X \in \{RE, LO, S\}$.

We focus on the religious dimension of the conflict on the ward level. A given ward $w = \{1, ..., W\}$ contains the number of Catholics C_w and the number of Protestants P_w. In addition, we have a matrix of neighborhood relationships N which allocates to each ward w some neighborhood wards $n(w)$. Our first, absolutely crucial, assumption is that republicans recruit themselves amongst Catholic civilians while loyalists recruit themselves amongst Protestants. This assumption will allow us to analyze the effect of C_w and P_w on violence.

We first focus on modeling violence conducted by the paramilitary groups, $X = RE, LO$. We decompose their violence propensity into two elements to separate the origin of violence from its target. For simplicity, we shall assume that within the Catholic population the net benefits (i.e. total benefits minus costs) of becoming a paramilitary are i.i.d. and follow a uniform distribution with the range $[-(1-\theta_{RE}), \theta_{RE}]$, where $0 < \theta_{RE} < 1$. Benefits of joining the paramilitaries include psychological gains (identity) and the opportunity to engage in lucrative criminal activities. The losses include among others the opportunity cost of lost salary income. Similarly, for the Protestants the net benefits (i.e. total benefits minus costs) of becoming a paramilitary are i.i.d. and follow a uniform distribution with the range $[-(1-\theta_{LO}), \theta_{LO}]$. Given that only people with net gains will join the paramilitaries, the likelihood for a Catholic to get radicalized and become a republican paramilitary becomes θ_{RE}. The likelihood for a Protestant to become a loyalist paramilitary equals θ_{LO}. The propensities θ are affected by a large set of factors. The cross-country literature has identified factors like political constraints of the executive, ethnic polarization on the country level, natural resources, the level of group-cohesion and wages. A fall in unemployment would, for example, decrease θ_{RE} and θ_{LO} due to a higher opportunity cost of paramilitary activity.

To model targeting we assume that an individual i of group $X = RE, LO$ conducts an attack on an individual j of group Y if

$$\lambda_{Y,X} \geq \rho_{ij}$$

where $\lambda_{Y,X} < 1$ is the net benefit for a member of group X from an attack on group Y. Clearly, $\lambda_{Y,X}$ depends on the motivation and cost of the different groups to attack another group. In addition, the ability to target a group will play an important role here. Where the ability to target is low we will see few killings. We assume that the targets Y can also include catholic civilians (CC) and protestant civilians (CP). The parameter ρ_{ij} captures i.i.d. cost draws following a uniform distribution with range $[0, 1]$.

We assume for simplicity that in each ward there is only one republican paramilitary cell and one loyalist one, and that these cells are constrained in their radius of action, i.e. that they can only attack in their home ward or in adjacent neighboring wards. We expect a positive transport cost of violence, which implies that attacks on neighboring wards are less likely to be successful than attacks in homewards. Hence we include decay of violence parameters for republicans (RE) and loyalists (LO), $k_{RE}, k_{LO} < 1$, discounting cross-ward violence (i.e. a given attack is successful with probabilities k_{RE}, k_{LO}). If for example the IRA has a more professional and efficient organization structure than the loyalist paramilitaries we would expect less decay for the IRA, i.e. $k_{RE} > k_{LO}$. Our empirical setup will permit to test whether indeed violence is to some extent local, as assumed.

The likelihood that a given individual in group X successfully attacks a given other individual in group Y is then given by

$$Prob_{Y,X} = \lambda_{Y,X},$$

if they are in the same ward and

$$Prob_{Y,X} = \lambda_{Y,X} \times k_X,$$

if they are in the same neighborhood but not in the same ward. Based on these likelihoods we can formulate empirically testable equations that link religious composition to the expected number of killings. We label expected fatalities in a ward w caused by attacks on group X by group Y as $F_{w,Y,X}$. The expected number of loyalists killed by republicans, and the number of republicans killed by loyalists are then, respectively,

$$F_{w,LO,RE} = \left(C_w + k_{RE} \sum C_{n(w)}\right) \times \theta_{RE} \times \lambda_{LO,RE} \times P_w \times \theta_{LO}, \tag{1}$$

$$F_{w,RE,LO} = \left(P_w + k_{LO} \sum P_{n(w)}\right) \times \theta_{LO} \times \lambda_{RE,LO} \times C_w \times \theta_{RE}. \tag{2}$$

Intuitively, the expression (1) corresponds to the product of the total number of potential perpetrators ($\left(C_w + k_{RE} \sum C_{n(w)}\right) \times \theta_{RE}$) times the total number of potential victims ($P_w \times \theta_{LO}$), and everything multiplied by the parameter $\lambda_{LO,RE}$ that captures how often republican paramilitaries find a window of opportunity for an attack on loyalist paramilitaries. All other combinations of killings can be constructed analogously.

Note that we are agnostic about whether civilian casualties are the product of strategic decisions, in which case they would be driven by analogous equations of our model, or whether they are due to non-planned collateral damage. In case of deliberate targeting, the respective target size of Catholic civilians, for example, is $C_w \times (1 - \theta_{RE})$. Our empirical estimations allow us to judge to what extent civilian killings are deliberate. In particular, we will take as starting point the stand of deliberate attacks on civilians and run the corresponding specifications. If civilian killings are indeed deliberate strategic actions our key variables should be significant, while if the specifications yield non-robust or inclusive results this indicates that civilian killings are largely driven by collateral damage.

When we bring this model to the data we will use the unweighted contiguity matrix N to calculate $\sum C_{n(w)}$ and $\sum P_{n(w)}$. We can then interpret the impact of each inhabitant in the neighborhood $n(w)$ analogously to the impact of inhabitants of ward w.[5]

Besides the loyalist and republican cells, the third military actor involved in the conflict are the state forces (military, police). We assume that the state forces are not recruited locally so that local group sizes do not matter here. As we do not have data on the local strength of state forces we assume that there is the number of S in each ward. Of course, this way of modelling state involvement is only justified if the state does not simply intervene where paramilitaries fight each other. We will discuss this assumption below. The number of killings of state forces by republicans is given by

$$F_{w,ST,RE} = \left(C_w + k_{RE} \sum C_{n(w)}\right) \times \theta_{RE} \times \lambda_{ST,RE} \times S. \tag{3}$$

The crucial difference to equation (1) is that the presence of armed forces, by assumption, cannot be explained by the number of Protestants. We expect state forces to be sent into wards

[5] The use of an unweighted space matrix is uncommon but follows from our theory. This is the approach suggested by Plümper and Neumayer (2010).

in which Catholics are strong. This central allocation of state forces leads to violence that is driven by the number of Catholics alone.

Similarly, the number of republicans killed by state forces are

$$F_{w,RE,ST} = S \times \lambda_{RE,ST} \times C_w \times \theta_{RE}. \tag{4}$$

The difference between killings of state forces and killing by state forces is that the neighborhood plays an important role in the first case but not in the latter. This makes clear that the model is able to provide some sense of direction of violence.

In this way the model provides a way to analyze the two parallel conflicts in Northern Ireland. The conflict between Republican paramilitaries and the state and the conflict between Republican and Loyalist paramilitaries. Our framework highlights that these two conflicts have very different predictions for the relationship between religious composition and violence. The sectarian element of the conflict can be predicted with interaction terms like $C_w \times P_w$ or $\sum P_{n(w)} \times C_w$. The insurgent element of the conflict arises in the interaction between the Catholic minority and state forces and therefore follows C_w and $\sum C_{n(w)}$.

It is important to stress that this framework can be extended easily to give more structure to the motives behind killings and the interaction between groups. For example, we could treat civilian killings as connected to the fight between armed groups, either as collateral damage or as an attempt of intimidation.[6] If state forces do not target civilians, for example, the parameter $\lambda_{CC,S}$ would be an increasing function of θ_{RE}. This would capture the fact that with more paramilitaries in the Catholic civilian population, state forces will target this group more. We provide suggestive evidence for this mechanism in section 7.2.

In what follows we will take this model to the data. We will first present the data on religious composition and violence and discuss the detailed information on perpetrators and victims.

[6] We also disregard strategic interactions between armed groups to keep the model simple. It is, for example, possible that the increased danger of being killed or arrested as a paramilitary enters negatively in θ_X.

5 Data

5.1 Data on Religious Composition

We use two main data sources. Data on religious composition is from the UK 1971 census and is provided by NISRA. Most data on violence comes from Sutton (1994) and has been updated by the Conflict Archive on the Internet (CAIN) website. We use address data in the description of killings to derive geo-references data. We then use these references to match killings to wards. It should be stressed that the violence data is unique as it reports the religion of each victim (unless for members of the state forces) and the group that attacked him or her.

We have data on 582 wards to which we aggregate the data on killings. Table 1 shows the summary statistics of all relevant variables. The first two variables are in thousands and show the number of Catholics C_w and Protestants P_w from the 1971 census. We also show the summary statistics of the variables on Catholics and Protestants in the neighborhood, $\sum C_{n(w)}$ and $\sum P_{n(w)}$ respectively. The average ward was inhabited by 700 Catholics and 1200 Protestants and had 3900 Catholic neighbors and 7100 Protestant neighbors. In order to facilitate the interpretation of our results we also report the interaction term $P_w \sum C_{n(w)}$ which has the same mean as $C_w \sum P_{n(w)}$.

5.2 Violence Perpetrators and Targets

Table 1 also summarizes our data on conflict-related casualties. The special feature of this data is that it reports both perpetrators and victims of violence. This allows us to test our ideas about the data in detail. The conflict clearly had a religious dimension with loyalists and state forces targeting primarily Catholics (republicans and/or civilians) and republicans primarily targeting Protestants (state forces and civilians). If we frame violence this way we capture between 75 and 85 percent of the violence. We therefore focus on this division line.

However, the pattern of violence across religious boundaries should not bar the view on significant infighting. These killings are hard to attribute to a particular religious motivation. Paramilitary groups imposed their control over areas with violence, conducted indiscriminate terror attacks, abused their power for private ends or simply made mistakes. In many of these cases we would expect internal violence to be either random or correlated with violence across groups.[7] We show in the appendix that while internal loyalist violence is broadly in line with our model, internal killings by republican paramilitaries seem to follow a pattern similar to their violence against state agents.

From Table 1 it would clearly not be appropriate to think of the security forces as a player who fights loyalists and republicans equally. On the contrary, there is hard evidence which suggests that parts of the security forces colluded with loyalists.[8] Hence, we exclude the violent interaction between loyalists and state forces in our analysis.

It is important to note that the state forces did not only enjoy high capacities S, but were also constrained by the British and worldwide public opinion. While valuable intelligence reports would tend to increase $\lambda_{RE,ST}$, the presence of journalists would tend to reduce $\lambda_{CC,ST}$, as killing civilians can be prohibitively costly for democracies. Indeed, we can see a shift away from civilians towards IRA members across time.

6 Violence and Religion in Northern Ireland

In this section we present our main results. We first introduce the functioning of the model with aggregate violence data on the ward level. This uses data of the type that is now widely available for a large set of conflicts. In section 6.2 we then use the detailed information on violence targets and perpetrators to test the validity of our model in the context of Northern Ireland. Our results illustrate the importance of tectonic boundaries and minority strongholds. Section 6.3 discusses the validity of our assumptions regarding the decay of violence potential across space.

[7] Note that causality is an issue here. Faeron and Laitin (2001), for example, argue that internal conflict is a major cause of violence between groups.

[8] A report published by the Police Ombudsman Nuala O'Neal in 2007 makes this clear. She reports, amongst other things, covering of loyalist crimes, withholding of information on attacks and provision of false information to courts.

6.1 Results with Aggregate Data

The model presented in section 4 suggests one main difference between violence patterns when state forces are involved. Killings that involve state forces do not arise from an interaction of Catholics and Protestants but from an interaction between Catholics with a central authority.

Table 2 shows two regressions that capture this difference under two sets of assumptions. We first assume that there is no cross-border violence, $k_{RE} = k_{LO} = 0$ and no within-group targeting so that total killings are given by

$$F_{w,total} = \alpha_1 C_w \times P_w + \alpha_2 C_w + \alpha_3 P_w + \varepsilon_w \quad (5)$$

where our theory predicts

$$\begin{aligned}
\alpha_1 &= \theta_{RE} \times [\lambda_{LO,RE} \times \theta_{LO} + \lambda_{CP,RE} \times (1 - \theta_{LO})] \\
&\quad + \theta_{LO} \times [\lambda_{RE,LO} \times \theta_{RE} + \lambda_{CC,LO} \times (1 - \theta_{RE})] \\
\alpha_2 &= \theta_{RE} \times [\lambda_{ST,RE} \times S] \\
&\quad + S \times [\lambda_{RE,ST} \times \theta_{RE} + \lambda_{RE,ST} \times (1 - \theta_{RE})] \\
\alpha_3 &= 0.
\end{aligned}$$

The coefficient on the interaction term α_1 captures the targeting of Protestants (loyalist paramilitaries and civilians) by republican paramilitaries and the targeting of Catholics (republican paramilitaries and civilians) by loyalists. The coefficient α_2 captures the involvement by state forces - both as victims of republican violence and as perpetrators. We expect $\alpha_3 = 0$ if Protestants were not targeted by state forces.

Column (1) shows that violence can be explained both by an interaction of religious groups within ward and the presence of Catholics alone. As expected, a rise in the Protestant population of a ward does not lead to an increase in violence unless the ward is also inhabited by Catholics. A purely Catholic ward with a population of 4000 in 1971 would, for example, experience 19 killings during the troubles and a ward with 4000 Catholics and 1000 Protestants in 1971 would experience 22 killings.

Column (2) does not impose $k_{RE} = k_{LO} = 0$. Violence is now explained by the interaction of the two religious groups within and across ward boundaries. Our model suggests the following regression

$$\begin{aligned} F_{w,total} &= \alpha_1 C_w \times P_w + \alpha_2 C_w + \alpha_3 P_w \\ &+ \alpha_4 P_w \sum C_{n(w)} + \alpha_5 C_w \sum P_{n(w)} \\ &+ \alpha_6 \sum C_{n(w)} + \alpha_7 \sum P_{n(w)} + \varepsilon_w \end{aligned} \tag{6}$$

where we have the additional coefficients are

$$\begin{aligned} \alpha_4 &= k_{RE} \times \theta_{RE} \times [\lambda_{LO,RE} \times \theta_{LO} + \lambda_{CP,RE} \times (1 - \theta_{LO})] \\ \alpha_5 &= k_{LO} \times \theta_{LO} \times [\lambda_{RE,LO} \times \theta_{RE} + \lambda_{CC,LO} \times (1 - \theta_{RE})] \\ \alpha_6 &= k_{RE} \times \theta_{RE} \times [\lambda_{ST,RE} \times S] \\ \alpha_7 &= 0. \end{aligned}$$

The coefficient α_4 captures the danger of becoming targeted by a republican attack for Protestants in Catholic neighborhoods. Similarly, α_5 captures the danger for Catholics in Protestant neighborhoods. Table (2), column (2) shows that both of these concerns seem to be relevant. There is a significant amount of violence across ward boundaries if these host separate religious communities. We cannot reject the hypothesis that $\alpha_6 = 0$ which suggests less cross-boundary attacks on state forces. As predicted by the theory we cannot reject $\alpha_7 = 0$.

The relevance of cross-boundary attacks can be seen when we calculate the average number of attacks attributable to cross-boundary interactions. Over 40 percent of all violence in the average ward can be explained by the interaction terms $P_w \sum C_{n(w)}$ and $C_w \sum P_{n(w)}$ alone.[9] This strongly suggests that violence is particularly high where protestant areas meet catholic areas. In order to give this an analogue from geography we call this phenomenon *tectonic boundaries*.

Note that in Table 2, column (2) we can distinguish killings that involve state forces from those that do not. From the model we know that interactions between local Protestant and

[9] On average, internal killings account for $1.122 * 0.7736 + 3.265 * 0.698$ killings while killings across boundaries account for $0.169 * 5.8327 + 0.243 * 5.8327$ killings.

Catholic populations are what distinguishes sectarian violence from violence triggered by the conflict between state forces and republicans. The share of violence explained by the coefficients α_3 and α_6 can therefore be regarded as a measure of the involvement of state forces in the conflict. From the detailed information we have on killings we can also calculate the actual involvement of state forces as either perpetrators or victims of violence.

This allows us to check whether our model captures the involvement of state forces correctly. For this purpose we run the specification in table 2, column (2) for three cross sections in the 1970s - the time of the conflict with particularly high levels of violence. Figure 1 summarizes the findings. The dashed line shows the shares of killings with state involvement throughout the 70s. In the period 70-73 the state was relatively involved with more than half killings involving the state. This involvement falls in the mid 1970s, mostly due to a surge in sectarian violence around this time. Then, as violence levels fell, relative state involvement increased considerably towards the end of the 1970s.

The solid line in figure 1 shows the model prediction of state involvement. We estimate state involvement through the amount of violence that is predicted by the number of Catholics, parameters α_2 and α_6 in regression 6. This is compared to the number of killings predicted by the coefficients α_1, α_4 and α_5 There is a surprisingly good fit between the predicted state involvement and actual state involvement as suggested by the data. In particular, our model manages to capture both the relative decline and rise of state involvement.

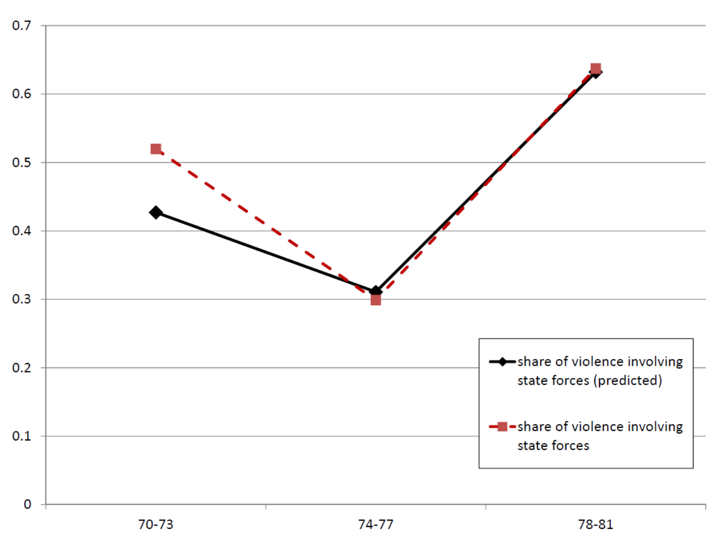


Figure 1: Prediction of state involvement

Note that here state involvement is predicted from the way in which local violence correlates with ward characteristics. The move in the mid-70s was driven, for example, by a shift of violence from purely Catholic neighborhoods to more diverse neighborhoods. The prediction that this had to do with the involvement of the state in killings is only possible because we made assumptions on how state forces differ from paramilitaries.

It is important to note that these shifts in the composition of violence patterns were not random deviations around a mean but meant important changes in the way in which paramilitaries and state forces interacted. In particular, the high relative involvement of the state forces remained until the end of the 1980s. However, robust estimates of this are not possible since the fall in violence increases standard errors significantly.

6.2 Results with Disaggregate Data

We now use the full information on victim and perpetrator available in our data. As discussed in section 5.2 we focus on the conflict between religions and ignore the conflicts within the two groups. We also attribute the state forces to the side of the loyalists.

In Table 3 we display the baseline results for two sets of specifications. In panel A, we only include variables predicted by our theory. In panel B, we include all variables used in equation 6 as a robustness check.

We find that all coefficients of all specifications in Table 3, panel A, have the correct sign and are statistically significant. In fact, only the coefficients predicted by the theory are significant. In columns (1) and (2), for example, we find no effect of the number of Catholics in (the neighborhood of) ward w other than through the number of Protestants in ward w.

Column 1 in panel A explains killings of Loyalists by Republicans with the specification

$$\begin{aligned} F_{w,LO,RE} &= \alpha_1 C_w \times P_w + \alpha_2 C_w + \alpha_3 P_w \\ &\quad + \alpha_4 P_w \sum C_{n(w)} + \varepsilon. \end{aligned} \tag{7}$$

As predicted by our model, we find that $\alpha_1 > 0$ and $\alpha_4 > 0$, and all other coefficients are insignificant. The coefficients indicate that the spatial decay of fighting potential is relatively large, with $\frac{\alpha_4}{\alpha_1} = k_{RE} \approx 1/9$. However, even with this relatively large decay the estimated share of killings across ward borders is at 45 percent. The same explanatory variables are highly significant for the killings of Protestant civilians by republicans in column (2). Now $\frac{\alpha_4}{\alpha_1} = k_{RE} \approx 1/6$ which is slightly higher than before.

If we contrast columns (1) and (2) to columns (3)-(5) it becomes clear that the different logic of violence with state involvement carries through to the disaggregated data. Violence towards and from state forces follows large Catholic populations, irrespective of the presence of Protestants. These results are robust to additional controls in panel B. The only caveat here is that there is a, quantitatively small, rise in violence in Catholic wards with Protestant neighbors. It is tempting to interpret this as an indicator of some cooperation between state forces and the Protestant community which would make state action easier in the proximity of Protestant strongholds.

Columns (6) and (7) show our results for loyalist violence. The killing of Republicans by loyalists is supposed to follow

$$F_{w,RE,LO} = \alpha_1 C_w \times P_w + \alpha_2 C_w + \alpha_3 P_w + \alpha_4 C_w \sum P_{n(w)} + \varepsilon. \quad (8)$$

with $\alpha_1 > 0$ and $\alpha_4 > 0$. Our results in panel A follow this prediction of the theory completely. In particular, it is now Catholics close to Protestant neighborhoods that predict violence. This is particularly striking in direct comparison with columns (1) and (2) which show that Protestants in Catholic neighborhoods predict republican violence. In column (6) we find a decay parameter $\frac{\alpha_4}{\alpha_1} = k_{LO} \approx 1/7$ close to our estimates for Republican violence. The specification in column (7) in in table 3 comes undone by inclusion of additional controls in panel B. As discussed earlier, the finding of less robust coefficients for the specifications for civilian casualties suggests that at least part of civilian fatalities can be seen as collateral damage rather than deliberate strategic attacks.

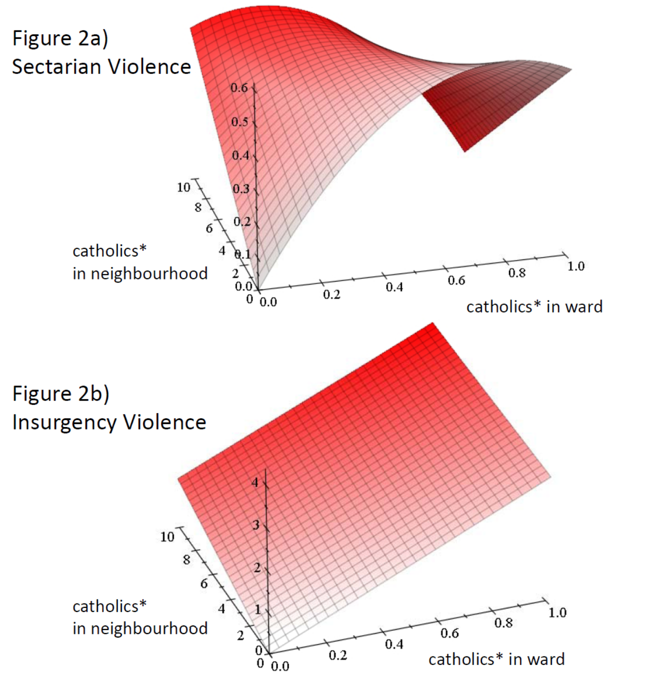
The contrast between columns (6) and (7) and columns (4) and (5) illustrates the difference between loyalist violence and state forces. State forces were most active in Catholic strongholds and operated largely independently from Protestant populations. If UK state forces had been militarily weaker we would expect a pattern similar to the one found for loyalist violence.

Note that the use of a model allows us to use ward characteristics to get a sense of direction of attacks. Most insurgent violence takes place within wards as state forces get attacked and attack Catholic strongholds. The interaction term $P_w \sum C_{n(w)}$ predicts violence if Protestants are attacked by republican paramilitaries. If Catholics are attacked by loyalists the term $C_w \sum P_{n(w)}$ predicts violence. Similarly, the main difference between the state as a perpetrator of violence and as a victim is the term $\sum C_{n(w)}$. Attacks on state forces by republican paramilitaries originate from neighboring wards, which makes it possible to link them to local characteristics.

Figure 2 visualizes the difference between violence without state involvement (sectarian violence) in figure 2a and violence with state involvement (insurgency violence) in figure 2b. Both graphs show the simulated violence in a ward w from an interaction of this ward with its neighborhood $n(w)$. We assume that one (thousand) persons live in ward w and ten (thousand) live in the neighborhood $n(w)$. The axis called "Catholics in ward" shows the composition of the ward w in terms of Catholics. At point 0.0 only Protestants live in this ward and at 1.0 only Catholics. The axis "Catholics in neighborhood" shows the composition for the neighborhood. At point 0, ten thousand Protestants live in the neighborhood and at point 10 only Catholics.

Figure 2a shows the predicted number of sectarian killings from table 3, i.e. from columns (1),(2),(6),(7) combined. Sectarian violence is minimized in either purely Protestant or purely Catholic neighborhoods. If the composition of ward w differs from the composition of its neighbors $n(w)$ violence rises.[10] Figure 2a is therefore a visualization of our idea of *tectonic boundaries*. Sectarian violence is largest where Catholic and Protestant neighborhoods meet.

[10] The worst sectarian violence arises if a majority of Catholics in ward w interacts both with some Protestants in the same ward and a purely Protestant neighbourhood $n(w)$.



*Graphs hold total population constant so that the number of protestants = 1-catholics.

Figure 2: Geography of Violence

Figure 2b illustrates the different logics of insurgent violence. It displays the violence coming from table 3, columns (3) to (5). Violence involving state forces is monotonically increasing in the number of Catholics. Violence involving state forces is largest in Catholic wards that are surrounded by other Catholic wards - Catholic strongholds. This is because state forces are most likely to be attacked here.

6.3 Distance and Violence

An important assumption for our regression analysis in Table 3 is that violence is local, i.e. the risk of being attacked by an individual decays with distance. In order to confirm this assumption we ran a series of regressions following Table 3, panel A but varied the definition of what constitutes a neighborhood. We run regressions for neighborhoods defined by a 1, 2, 3... up to 10 km radius around the centre of a ward.[11] This led to a large variation in what constitutes a neighborhood. At the 1 km definition only about 0.1 percent of all 340,000 ward combinations are neighbors

[11] Appendix table A2 provides the equivalent of table 3 for the 2km radius.

while at the 10 km definition about 5 percent are.[12]

Figure 3 summarizes the results of this exercise. It shows the 10 coefficients on the interaction terms $C_w \sum P_{n(w)}$ and $P_w \sum C_{n(w)}$ for republican and loyalist violence. The four solid lines depict the point estimates. The dotted lines depict the error bands at 90 percent confidence. At all definitions of a neighborhood, except for 1 km, the coefficients on the interaction terms are significant and positive for all four types of killings. This is re-assuring as it demonstrates that our previous findings on tectonic boundaries were not driven by something specific to contiguity.

The coefficients monotonically decrease with growing distance and are close to our main estimates in table 3 at the 1 and 2 km neighborhood size. This illustrates the decay of violence capacity across space. In particular the coefficient on the interaction terms are 4 to 11 times smaller in regressions with 10 km radius than in the regressions with 2 km radius.

Figure 3a) Republican killings per Protestant in ward and Catholic in neighbourhood*

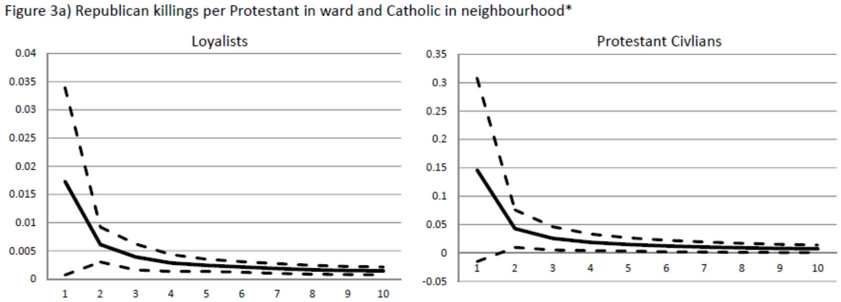
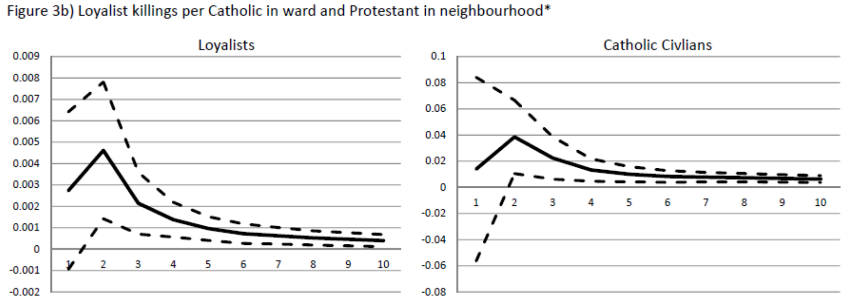


Figure 3b) Loyalist killings per Catholic in ward and Protestant in neighbourhood*



*Neighbourhood size is given in km. Graphs follow regressions in table 3, panel A.

[12] For comparison, our definition through contiguity implies that 1 percent of all ward combinations are neighbours.

7 Applications

In this section we apply our model to shed light on several features of the Northern Irish conflict. We first show that "peace lines", barriers that were meant to restrict movement and line of sight, were constructed on ward boundaries which featured high cross-boundary violence. This is even true if we control for high within ward violence.

Secondly we analyze the effect of a local troop surge which took place in July 1972 - Operation Motorman. This surge had the purpose of clearing so-called "nogo" areas, i.e. wards of high republican military control. We expect the surge to change the violence dynamics considerably. We test this in a ward level panel on the monthly level.

Finally, we show that a border to the Republic of Ireland raised the military capacity of republican paramilitaries significantly but left loyalist capacity unchanged. This is consistent with the view that republican paramilitaries found support across the border.

7.1 Tectonic Boundaries and Barriers

In this subsection we want to check if indeed tectonic boundaries at Interfaces between predominantly Catholic and predominantly Protestant wards played a role in sectarian violence. If the predictions of our model are correct and if the empirical results of the previous section are not just spurious correlations, we would expect that the famous barriers separating different streets and areas in Northern Ireland (i.e. the so-called peace lines or peace walls) should be built on tectonic boundaries. In this subsection we will aim to explain the location of peace lines with measures derived from our theory.

First, we collected data on the location of the peace lines. For this we drew on various lists of peace lines containing geographical information (Jarman, 2005; BBC, 2009; Belfast Interface Project, 2012), on the geo-referenced map of peace lines from NISRA (2006) and on correspondence with the Department of Justice of Northern Ireland, which provided us with additional information in response to our freedom of information request DOJ FOI 12/136.

Combining all this sources and using a geo-referenced map of all wards of Northern Ireland, we have been able to put together a novel dataset on the location of peace lines. Peace lines running parallel to borders between two wards and lying either directly on the ward border or in-between the ward border and the nearest street are counted as peace lines separating two wards. Peace lines located in only one ward and not meeting the above criterion are counted as within-ward peace lines. We have not encountered problematic cases that could not be associated to neither of the two categories above (i.e. there have not been peace lines running perpendicular to ward borders and crossing them etc).

Our dataset contains 118 peace lines, out of which 72 are located between wards and only 46 are within wards. This suggests that indeed wards are a politically salient unit in the Northern Ireland conflict.

Building on the peace line data, we construct a cross-sectional dataset on the level of ward-pairs (i.e. dyads). Each ward pair only appears once in the dataset (which avoids double-counting). Given that all variables are "symmetric", it does not matter which of the two wards of a dyad is called A and which B. We have as dependent variable a dummy of whether for a given ward pair ever at least one peace line has been erected between these two wards. In 36 out of our 1603 ward-pairs (i.e. in about 2.2% of cases) this variable takes a value of one.

Our main independent variable is called "tectonic tension" and corresponds to the number of Catholics multiplied by the number of Protestants in the dyad partner plus the number of Protestants multiplied by the number of Catholics in the dyad partner,

$$\textit{tectonic tension} = \; P_w C_{n(w)} + C_w P_{n(w)}.$$

Note that for the construction of all variables the numbers of Catholics and Protestants are expressed in Thousands. Hence, if for example in ward A of a dyad only 1000 Catholics and no Protestants live and in partner ward B of this dyad there are 1000 Protestants and no Catholics, the tectonic tension variable would take a value of 1.

We include in all specifications ward fixed effects (which we are able to do, as a given ward has several neighbors and hence appears in several dyads), and in some of the specifications we control for the total number of Catholics in the dyad, for the total number of Protestants in the dyad and for within-ward tectonic tension, which is defined as the number of Catholics in ward A of the dyad multiplied by the number of Protestants in A plus the number of Catholics in ward B of the dyad multiplied by the number of Protestants in B.

The results are displayed in Table 4. Column 1 runs the benchmark regression with only tectonic tension as independent variables. All wards throughout Northern Ireland are included. "Tectonic tension" is a strong, positive predictor of the construction of a peace line between two wards. It is significant at the 1% level and quantitatively important. Adding 1000 Protestants to one ward and 1000 Catholics to its partner ward would almost double the baseline risk of peace line construction.

In column 2 we control for the total number of Catholics and of Protestants in both wards of the dyads. The coefficient of our variable of interest is unchanged. In column 3 we show that the result is also unchanged when controlling for religious tension within the ward boundaries.

Columns 4-6 are the mirror image of columns 1-3, but restricting the analysis to the city of Belfast, where most of the peace lines are located. The results are very similar, with the coefficient of "tectonic lines" being even a bit larger and still through all specifications statistically significant at the 1% level.

7.2 Nogo Areas and Operation Motorman

There is little doubt that state forces had military control over most areas in Northern Ireland. An exception were the so called "nogo areas", traditional Catholic working class strongholds like the Falls Road in Belfast or the Bogside in Derry. These areas were heavily contested in the early part of the conflict and only brought under state control after a military operation in July 1972. The operation was called Operation Motorman and involved, in total, 30,000 state forces, making Motorman the biggest deployment of British forces since the Second World War. The operation did not encounter much IRA resistance which makes clear that military confrontation at this point was useless from the perspective of the IRA.

In terms of our model we expect S to have increased in nogo areas after operation Motorman. At the same time the whole purpose of the operation was to inhibit Republican operations. This effect can be captured by a decrease in θ_{RE}. Theoretically, the effect on killings between state forces and Republicans is therefore ambiguous.

Table 5 shows the results of panel regressions on the ward/month level. We use data from July 1971 till August 1973, i.e. going from one year before operation Motorman until one year after operation Motorman. We use interaction effects to create a difference-in-difference analysis of the impact of the operation. The regression in column (2) of table 5, for example, displays the impact of operation Motorman on the killings of civilian Protestants by republican paramilitaries

$$\begin{aligned} F_{w,CP,RE}(t) &= \alpha_w + \eta_t + \alpha_1 C_w \times P_w \times nogo_w \times boM(t) \\ &\quad + \alpha_2 \sum \left(C_{n(w)} * nogo_{n(w)} \right) \times P_w \times boM(t) + \epsilon_{wt} \end{aligned}$$

where $nogo_w$ is a dummy that takes the value of 1 if ward w was a nogo area and $boM(t)$ is a dummy which takes a value of 1 before operation Motorman (between July 1971 and July 1972). We find that $\alpha_2 > 0$. This means that operation Motorman made life for Protestant civilians around nogo areas safer.[13]

This shows that counter-insurgency efforts in one area can have a significant impact on violence elsewhere. This finding adds a level of complexity to existing studies on the effect of counter-insurgency efforts. While the exact conclusions will depend on the level of aggregation our findings imply that existing studies could underestimate the overall effect of troop presence.

We also find more killings of Catholic civilians by state forces before operation Motorman. This suggests a reduction of $\lambda_{CC,ST}$ with operation Motorman. This would be consistent with a model that links civilian killings by state forces to the presence of Republican paramilitaries, i.e. $\lambda_{CC,ST}(\theta_{RE})$ and $\lambda'_{CC,ST}(\theta_{RE}) > 0$.

7.3 The Effect of a National Boundary on Violence

It has been suggested by Michalopoulos and Papaioannou (2011) that a split of ethnic groups by national boundaries increases ethnic conflict. Our data allows for a test of the mechanism behind

[13] Similar regressions for loyalist violence suggast an insignificant increase in violence with operation Motorman which indicates that this is not just due to differential violence trends.

their finding in the context of Northern Ireland. Table 6 reproduces our main regressions in table 3 with the additional control of a border dummy. None of our previous findings are affected.

The table shows clearly that the national boundary increased republican attacks on state forces by 4 - this is roughly an entire standard deviation. Interestingly, the growing strength of the Republican paramilitaries is not matched by an increase in killings by UK state forces. Instead, we find that state forces kill less Catholic civilians in border wards. Attacks by loyalists were not affected.

These findings lead to the conclusion that the proximity of the Republic of Ireland strengthened republican paramilitaries and inhibited UK state force violence. This suggests that there was at least some support for the IRA in the Republic. Anecdotal evidence supports this.[14]

8 Discussion

Most theories of conflict model the motivation for conflict in detail but do not make predictions on the spatial distribution of violence on the local level. Our theory takes the motivation for violence as given but models the link to local characteristics in more detail. In this way our framework aims to give a spatial interpretation to current theories of conflict.

This complementarity is best illustrated at the example of Esteban and Ray (2011) who also study the impact of ethnic characteristics and violence. Their model centres on relative measures of ethnic composition, like fractionalization and polarization, exactly because it analyzes the (per capita) motivation for violence. We model how, taking motivation as fixed, local violence can be best predicted by local religious composition. This is why we focus on the number of potential targets and perpetrators.

We derive two main predictions regarding the spatial distribution of violence in Northern Ireland. First, areas next to tectonic boundaries are particular violent because the political support

[14] See, for example, the BBC news article 18 October 2012, "*Smithwick Tribunal: Senior gardai 'passed information to IRA'*" which describes the involvement of two officers in the Republic of Ireland.

in the civilian population creates the base from which attacks are launched. The descriptions of attacks support this notion of operational centres based on religion. Dillon (1999) describes an IRA operation in October 1972 as follows:

"The intelligence officer of the 1st Battalion said Twinbrook was the best for an assault on the laundry van [...]. He reckoned that if the van was attacked in Twinbrook an IRA unit could make an escape with ease and be in the safety of the Andersontown district within a matter of five to ten minutes."(Dillon 1999, page 42).

The 1971 census data we used for our analysis confirms that this attack followed the logic of tectonic boundaries. In Andersontown the census counted 5588 Catholics and 51 Protestants. The quote shows that the IRA was operating from and around this Catholic ward. Our results suggest that loyalist violence followed a similar logic. Loyalist attacks occurred around Protestant neighborhoods so that Catholics close to Protestant neighborhoods were particularly likely to be attacked by loyalists.

Second, areas in which only the Protestant majority live remain relatively peaceful because violence of state agents is targeted at areas who support insurgents. Minority areas, on the other hand, always face violence because of the insurgent element of the conflict. Our findings here relate to Besley and Persson (2011) who show that the control of the state by a group leads to asymmetries in the extent of violence.

Our ideas complement existing work that links violence to the degree of military control within geographic units.[15] We show that what defines military influence depends on the type of actor. Insurgent and sectarian violence originates in ethnically defined areas of control. The ability to project this power decays with distance. State actors are typically less constrained in their military capacity and can therefore strike regardless of local political support. Even if state actors are recruited from one group their larger operational radius therefore breaks the link between local characteristics and military power. In other words, the decay of the ability to

[15] See, for example, Kalyvas (2006) and Berman et al (2011).

conduct violence shapes the link to local characteristics.

This suggests a fruitful direction for research on the spatial distribution of violence and their link to local characteristics. Depending on military technology of the opposed parties we would expect different patterns of violence.

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A Internal Killings

Our model would predict that internal killings follow the square of religion as both target and perpetrator of violence come from the same religion. Table A1 shows that this pattern can be found robustly for internal loyalist violence. Columns (3) and (4) imply, for example, that Protestants were much more likely to be targeted by loyalists if they lived in wards with many Protestants.

However, republican violence does not seem to follow the equivalent pattern. Instead, we find some evidence that republican internal violence follows the similar patterns as their killings of state forces. This could reflect the fact that internal killings were part of what we label insurgent violence. From the mid 1970s onwards, UK state forces increasingly managed to infiltrate the IRA. This led to a significant number of internal republican killings.

The fact that none of the cross-boundary interactions are significant speaks for the fact that internal killings are a within ward phenomenon. They are most likely linked to the establishment of control through violence by paramilitary groups.

B Alternative Neighborhood Definition

Appendix table A2 replicates table 3 with the only difference that now the definition of a neighborhood $n(w)$ is that the ward centroid is no more than 2 km away from the centroid of ward w. We chose 2 km as this seems most comparable with our previous definition of a neighborhood. The main caveat is that wards in less densely populated areas have no neighborhood. This is only correct if the violence decay is in less densely populated areas is similar to densely populated areas.

Table A2 shows that the main results hold up. However, they are somewhat less robust and many control variables in panel B become significant in this specification. In our view this speaks for the view that defining a neighborhood through political units - even if they differ in size - fits reality better.

Table 1: Summary Statistics for Ward Level Data				
Variable	Mean*	Std. Dev.	Min	Max
catholics	0.6983677	0.9708239	0	9.402
protestants	1.203443	1.260957	0	9.759
catholics in neighbourhood	3.893469	4.171351	0.096	30.009
protestants in neighbourhood	7.054512	6.363957	0.051	41.085
catholics * protestants	0.773604	1.720076	0	21.92528
protestants * catholics in neighbourhood	5.832723	18.471	0	232.9825
state forces killed by republicans	1.69244	4.144122	0	46
protestant civilians killed by republicans	0.6701031	2.114884	0	27
catholic civilians killed by republicans	0.3848797	1.439417	0	13
republicans killed by republicans	0.233677	0.8822401	0	9
loyalists killed by republicans	0.0584192	0.3757122	0	5
catholic civilians killed by loyalists	1.156357	3.581068	0	37
protestant civilians killed by loyalists	0.2302405	0.9137954	0	10
loyalists killed by loyalists	0.1237113	0.5883153	0	7
republicans killed by loyalists	0.0395189	0.2492366	0	3
state forces killed by loyalists	0.024055	0.1641922	0	2
catholic civilians killed by state forces	0.2749141	1.485451	0	17
republicans killed by state forces	0.2182131	0.9120412	0	11
protestant civilians killed by state forces	0.0343643	0.2321519	0	4
catholic loyalists killed by state forces	0.0274914	0.2920641	0	6
state forces killed by state forces	0.0223368	0.1977047	0	3
total killings	5.190722	11.89338	0	96
*Protestants and Catholics are in thousands.				

Table 2: Aggregate Killings and Religion

	(1)	(2)
VARIABLES	total casulties	total casulties
catholics * protestants	2.703***	1.122**
	(0.507)	(0.542)
catholics	4.785***	3.265***
	(0.777)	(1.242)
protestants	0.493	-0.590
	(0.603)	(0.996)
protestants * catholics in neighbourhood		0.243***
		(0.0418)
catholics * protestants in neighbourhood		0.169***
		(0.0620)
catholics in neighbourhood		0.165
		(0.262)
protestants in neighbourhood		-0.0486
		(0.156)
Observations	582	582
R-squared	0.607	0.707

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The numbers of Catholics and Protestants are in all variables expressed in 1000 people. "Catholics (Protestants) in neighbourhood" is the sum of all Catholics (Protestants) in wards that have a boundary with the ward.

Table 3: Disaggregate Killings and Religion

PANEL A: Minimal Set of Controls

VARIABLES	(1) loyalists killed by republicans	(2) protestant civilians killed by republicans	(3) state forces killed by republicans	(4) republicans killed by state forces	(5) catholic civilians killed by state forces	(6) republicans killed by loyalists	(7) catholic civilians killed by loyalists
catholics * protestants	**0.0846***	**0.251***				**0.0306****	**0.622****
	(0.0513)	(0.148)				(0.0147)	(0.279)
protestants * catholics in neighbourhood	**0.00928*****	**0.0424****					
	(0.00358)	(0.0182)					
catholics	0.000893	0.185	**1.877*****	**0.411*****	**0.782*****	0.0166	0.0940
	(0.0520)	(0.237)	(0.338)	(0.0742)	(0.151)	(0.0271)	(0.260)
catholics in neighbourhood	-0.00585	0.0112	**0.130****				
	(0.0117)	(0.0626)	(0.0542)				
catholics * protestants in neighbourhood						**0.00395****	**0.0497***
						(0.00190)	(0.0293)
protestants	-0.0250	0.0253				-0.0180	0.372
	(0.0251)	(0.154)				(0.0169)	(0.396)
protestants in neighbourhood						0.000514	0.0222
						(0.00246)	(0.0525)
Observations	582	582	582	582	582	582	582
R-squared	0.433	0.370	0.411	0.274	0.383	0.270	0.504

PANEL B: Full Set of Controls

VARIABLES	(1) loyalists killed by republicans	(2) protestant civilians killed by republicans	(3) state forces killed by republicans	(4) republicans killed by state forces	(5) catholic civilians killed by state forces	(6) republicans killed by loyalists	(7) catholic civilians killed by loyalists
catholics * protestants	**0.0757**	**0.184**	0.0998	-0.0131	-0.0613	**0.0317****	**0.407**
	(0.0616)	(0.176)	(0.245)	(0.0876)	(0.112)	(0.0143)	(0.321)
protestants * catholics in neighbourhood	**0.00799****	**0.0343*****	0.00829	0.00585	0.00453	-8.59e-05	0.122***
	(0.00348)	(0.0124)	(0.0156)	(0.00494)	(0.00839)	(0.00208)	(0.0261)
catholics	-0.0300	-0.0342	**1.138****	**0.263****	**0.447***	-0.00818	0.751*
	(0.0330)	(0.174)	(0.476)	(0.127)	(0.271)	(0.0310)	(0.405)
catholics in neighbourhood	0.000271	0.0502	**0.204***	0.00851	0.0292	0.00662	-0.114
	(0.0107)	(0.0379)	(0.106)	(0.0330)	(0.0590)	(0.0117)	(0.0730)
catholics * protestants in neighbourhood	0.00249	0.0176	0.0476***	0.0120	0.0305**	**0.00433****	**0.0230**
	(0.00401)	(0.0133)	(0.0158)	(0.0120)	(0.0149)	(0.00201)	(0.0263)
protestants	0.0164	0.274	-0.160	-0.0432	-0.101	-0.0215	-0.744**
	(0.0585)	(0.474)	(0.191)	(0.0840)	(0.0961)	(0.0131)	(0.310)
protestants in neighbourhood	-0.00800	-0.0467	-0.0432	-0.00567	-0.0160	-0.000422	0.123***
	(0.00796)	(0.0691)	(0.0294)	(0.0128)	(0.0161)	(0.00311)	(0.0468)
Observations	582	582	582	582	582	582	582
R-squared	0.439	0.377	0.438	0.313	0.459	0.275	0.644

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The numbers of Catholics and Protestants are in all variables expressed in 1000 people. "Catholics (Protestants) in neighbourhood" is the sum of all Catholics (Protestants) in wards that have a boundary with the ward. Bold numbers highlight coefficients that are predicted as positive according to our theory.

Table 4: Tectonic Boundaries and the Construction of Barriers

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: Creation peace lines between the two wards of a dyad					
Tectonic tension between wards	**0.0144***	**0.0144***	**0.0143***	**0.0152***	**0.0152***	**0.0151***
	(0.0031)	**(0.0031)**	**(0.0030)**	**(0.0034)**	**(0.0034)**	**(0.0034)**
Total number of catholics in dyad		-0.0538***	-0.0692***		-0.1556***	-0.1646***
		(0.0174)	(0.0187)		(0.0198)	(0.0198)
Total number of protestants in dyad		-0.0039	-0.0148		-0.1063***	-0.1114***
		(0.0203)	(0.0217)		(0.0250)	(0.0252)
Tectonic tension within wards			0.0175			0.0153
			(0.0114)			(0.0123)
Ward Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Sample	All	All	All	Belfast	Belfast	Belfast
Observations	1603	1603	1603	176	176	176
R-squared	0.729	0.729	0.733	0.745	0.745	0.749

Note: The unit of observation is the dyad. OLS regressions with robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The numbers of Catholics and Protestants are in all variables expressed in 1000 people. "Tectonic tension between wards" A and B is the number of Catholics in A multiplied by Protestants in B plus the number of Protestants in A multiplied by the number of Catholics in B. "Tectonic tension within wards" is the number of Catholics in A multiplied by the number of Protestants in A plus le number of Catholics in B multiplied by the number of Protestants in B.

Table 5: Operation Motorhead and Violence

	(1)	(2)	(3)	(4)	(5)
VARIABLES	state forces killed by republicans	protestant civilians killed by republicans	loyalists killed by republicans	republicans killed by state forces	catholic civilians killed by state forces
catholics * nogo area * before operation Motorman	0.0123			-0.00149	0.0201**
	(0.0180)			(0.00878)	(0.00872)
catholics in neighbouring nogo area * before operation Motorman	0.00429				
	(0.00311)				
catholics * protestants * nogo area * before operation Motorman		-0.00557	0.000622		
		(0.00490)	(0.00426)		
catholics in neighbouring nogo area * before operation Motorman * protestants		0.00162**	8.30e-05		
		(0.000744)	(0.000129)		
ward fixed effects	yes	yes	yes	yes	yes
time fixed effects	yes	yes	yes	yes	yes
Observations	13,386	13,386	13,386	13,386	13,386
R-squared	0.004	0.012	0.003	0.003	0.005
Number of wards	582	582	582	582	582

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The numbers of Catholics and Protestants are in all variables expressed in 1000 people. "Nogo area" is a dummy variable that takes the value of 1 if the ward was a nogo area in 1971. "Before operation Motorman" is a dummy that takes a value of 1 before August 1972. "Catholics in neighbouring nogo area" is the sum of Catholics in wards bordering the ward which are also nogo areas.

Table 6: Effect of Boundary on Violence

VARIABLES	(1) loyalists killed by republicans	(2) protestant civilians killed by republicans	(3) state forces killed by republicans	(4) republicans killed by state forces	(5) catholic civilians killed by state forces	(6) republicans killed by loyalists	(7) catholic civilians killed by loyalists
border ward	-0.0118	0.306*	4.385***	-0.101	-0.334*	0.0105	-0.297
	(0.0249)	(0.177)	(1.598)	(0.0999)	(0.199)	(0.0369)	(0.221)
catholics * protestants	0.0846	0.252*				0.0306**	0.621**
	(0.0514)	(0.148)				(0.0147)	(0.278)
protestants * catholics in neighbourhood	0.00926**	0.0429**					
	(0.00360)	(0.0183)					
catholics	0.000810	0.187	1.847***	0.414***	0.791***	0.0160	0.111
	(0.0521)	(0.237)	(0.347)	(0.0759)	(0.154)	(0.0281)	(0.268)
catholics in neighbourhood	-0.00571	0.00754	0.103*				
	(0.0119)	(0.0630)	(0.0563)				
catholics * protestants in neighbourhood						0.00398**	0.0490*
						(0.00192)	(0.0294)
protestants	-0.0249	0.0239				-0.0181	0.374
	(0.0252)	(0.154)				(0.0169)	(0.396)
protestants in neighbourhood						0.000520	0.0220
						(0.00246)	(0.0525)
Observations	582	582	582	582	582	582	582
R-squared	0.433	0.371	0.460	0.275	0.386	0.270	0.504

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The numbers of Catholics and Protestants are in all variables expressed in 1000 people. "Catholics (Protestants) in neighbourhood" is the sum of all Catholics (Protestants) in wards that have a boundary with the ward. "Border ward" is a dummy that takes a value of 1 if the ward has a boundary with the Republic of Ireland.

Table A1: Internal Killings

VARIABLES	(1) catholic civilians killed by republicans	(2) republicans killed by republicans	(3) protestant civilians killed by loyalists	(4) loyalists killed by loyalists	(5) catholic civilians killed by republicans	(6) republicans killed by republicans	(7) protestant civilians killed by loyalists	(8) loyalists killed by loyalists
catholics * catholics	**0.0870**	**0.0581***			**0.0749**	**0.0491**	-0.00153	0.0119
	(0.0668)	(0.0325)			(0.0735)	(0.0360)	(0.0206)	(0.0198)
catholics * catholics in neighbourhood	**0.00626**	**-0.00936**			**0.00628**	**-0.00911**	-0.00500	-0.00371
	(0.0292)	(0.0123)			(0.0305)	(0.0133)	(0.00600)	(0.00612)
catholics	0.227	0.193			0.380**	0.300**	0.0327	-0.0969
	(0.141)	(0.130)			(0.166)	(0.139)	(0.0886)	(0.0834)
catholics in neighbourhood	0.0276	0.0265			0.00683	0.0121	0.0302	0.0255
	(0.0213)	(0.0195)			(0.0324)	(0.0235)	(0.0194)	(0.0248)
protestants * protestants			**0.107***	**0.0936***	0.00735	0.0212	**0.0995***	**0.0876***
			(0.0143)	(0.0121)	(0.0222)	(0.0195)	(0.0138)	(0.0146)
protestants * protestants in neighbourhood			**-0.000995**	**-0.00937***	0.0103	0.00227	**0.00151**	**-0.00859**
			(0.00577)	(0.00542)	(0.00802)	(0.00527)	(0.00595)	(0.00607)
protestants			-0.246***	-0.161***	-0.119	-0.0872	-0.261***	-0.155***
			(0.0493)	(0.0427)	(0.109)	(0.0785)	(0.0553)	(0.0425)
protestants in neighbourhood			0.0262***	0.0238***	-0.0134	-0.00502	0.0151	0.0203
			(0.00980)	(0.00797)	(0.0248)	(0.0174)	(0.0123)	(0.0131)
Observations	582	582	582	582	582	582	582	582
R-squared	0.446	0.316	0.602	0.531	0.468	0.338	0.614	0.542

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The numbers of Catholics and Protestants are in all variables expressed in 1000 people. "Catholics (Protestants) in neighbourhood" is the sum of all Catholics (Protestants) in wards that have a boundary with the ward. Bold numbers highlight coefficients that are predicted as positive according to our theory.

Table A2: Main Results with Neighbourhood Defined as 2km

PANEL A: Minimal Set of Controls

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	loyalists killed by republicans	protestant civilians killed by republicans	state forces killed by republicans	republicans killed by state forces	catholic civilians killed by state forces	republicans killed by loyalists	catholic civilians killed by loyalists
catholics * protestants	**0.0852***	**0.184**				**0.0197**	**0.664*****
	(0.0496)	(0.134)				(0.0185)	(0.234)
protestants * catholics	**0.00612*****	**0.0428****					
in neighbourhood	(0.00188)	(0.0201)					
catholics	-0.00560	0.505***	**2.118*****	**0.411*****	**0.782*****	-0.00944	0.0952
	(0.0277)	(0.187)	(0.237)	(0.0742)	(0.151)	(0.0127)	(0.248)
catholics in	-0.00284	-0.0734*	**0.0713***				
neighbourhood	(0.00756)	(0.0434)	(0.0418)				
catholics * protestants						**0.00462****	**0.0386****
in neighbourhood						(0.00194)	(0.0170)
protestants	-0.0196	0.0490				-0.00709	0.576*
	(0.0212)	(0.0817)				(0.00939)	(0.342)
protestants in						0.000767	-0.0229
neighbourhood						(0.00233)	(0.0456)
Observations	582	582	582	582	582	582	582
R-squared	0.452	0.411	0.406	0.274	0.383	0.366	0.509

PANEL B: Full Set of Controls

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	by republicans	civilians killed	killed by	killed by state	civilians killed	killed by	civilians killed
catholics * protestants	**0.0648**	**0.163**	0.114	-0.0140	-0.0226	**0.0165**	**0.589****
	(0.0558)	(0.143)	(0.258)	(0.0790)	(0.111)	(0.0179)	(0.265)
in neighbourhood	**0.00637*****	**0.0398****	0.0124	0.000792	-0.00683	0.000810	0.0197
	(0.00171)	(0.0195)	(0.0145)	(0.00293)	(0.00640)	(0.00111)	(0.0192)
catholics	-0.0339	0.336*	**1.840*****	**0.185*****	**0.262**	-0.00105	0.228
	(0.0211)	(0.174)	(0.359)	(0.0538)	(0.178)	(0.0209)	(0.321)
neighbourhood	-0.00575	-0.0447	**0.0344**	0.0176	0.0725	-0.00204	-0.0178
	(0.00650)	(0.0421)	(0.105)	(0.0191)	(0.0513)	(0.00540)	(0.0550)
in neighbourhood	0.00317	0.0122**	0.0295***	0.0129*	0.0254***	**0.00460****	**0.0380****
	(0.00254)	(0.00550)	(0.0104)	(0.00751)	(0.00944)	(0.00196)	(0.0173)
protestants	0.00270	0.232**	0.0416	0.0213	-0.0243	-0.0117	0.452
	(0.0283)	(0.114)	(0.132)	(0.0412)	(0.0656)	(0.00826)	(0.395)
neighbourhood	-0.00254	-0.0503***	-0.0678***	-0.0143**	-0.0245**	0.000930	-0.0275
	(0.00445)	(0.0172)	(0.0224)	(0.00598)	(0.0103)	(0.00175)	(0.0497)
Observations	582	582	582	582	582	582	582
R-squared	0.470	0.424	0.427	0.347	0.518	0.368	0.519

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The numbers of Catholics and Protestants are in all variables expressed in 1000 people. "Catholics (Protestants) in neighbourhood" is the sum of all Catholics (Protestants) in wards that have a boundary with the ward. Bold numbers highlight coefficients that are predicted as positive according to our theory.