Modeling Selective Violence in the Guatemalan Civil War

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Abstract. Examination of detailed events data from the Guatemalan civil war between 1976 and 1985 reveal a complex, M-shaped relationship between ethnic mix and violence. This paper seeks to shed light on this seemingly mysterious relationship by presenting an agent-based model of civil violence that is inspired by an analytical approach developed by Kalyvas. This conception takes incumbent and insurgent levels of control as the main determinants of the level of violence. Violent acts are seen as a joint product of individual incumbent and insurgent actor decisions involving loyalty, defection, denunciation and counter-denunciation. They result from two conceptually distinct mechanisms: one that drives selective violence and another that drives indiscriminate violence. This paper focuses on the selective violence mechanism. The agent-based version of the model is able to reproduce the relationship observed in Guatemala more closely than its analytical predecessor. This study finds that the agent method is well suited to this approach to thinking about violence, allowing more flexibility in model construction and producing better qualitative fidelity to data, while retaining the same basic set of motivations. The model makes advances on two fronts. Firstly, it demonstrates how an agent-based model can be docked with an analytic model and then modified to better capture the path dependent, positive-feedback driven environment characteristic of civil violence. Secondly, it makes a direct link between a theoretical model and spatially explicit events data from a real conflict.

Keywords: Civil Violence, Civil War, Selective Violence, Agent-based Modeling, Model Replication.

1 Introduction

The relationship between control and violence is a recurring theme in the study of civil conflict. The subject has resisted empirical study because control is often highly localized and measuring it requires micro-scale data that is hard to collect – particularly in a conflict zone. The relationship is also inconsistent, with places that are very similar in terms of ethnic composition and government presence following divergent paths with respect to violence.

This paper seeks to elucidate the relationship between control and violence by examining pattern from the Guatemalan civil war and then seeking to reproduce them using an agent based model based on an analytical model presented by Stathis Kalyvas in his book *The Logic of Violence in Civil War* (Kalyvas, 2006). We will then leverage the flexibility afforded by the agent-based modeling methodology to extend the model so as to better comport with these data while retaining a measure of the simplicity and elegance of the original model.

1.2 Guatemala Observations

While the population of Guatemala as a whole is close to evenly divided between people who identify with indigenous Maya groups and Ladino's who claim at least some European heritage, very few Guatemalan communities reflect this mixed composition (Gulden, 2002). Instead, the distribution of ethnic mixes is distinctly U shaped, with many communities highly skewed toward ether Maya or Ladino majorities and only a small number in the center (grey bars in Figure 1).

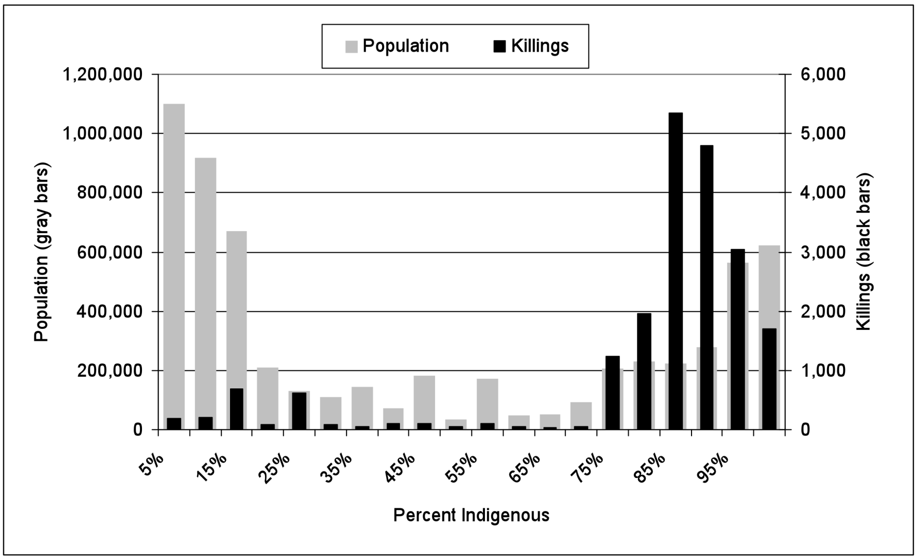

Fig. 1. Ethnic mix and killing in Guatemalan municipalities between 1977 and 1986.

Violence during the period between 1977 and 1986 (the worst of the civil war) follows a somewhat different distribution – it is roughly M shaped, though heavily skewed toward the areas with higher indigenous population levels (black bars in Figure 1). We see less violence at the extremes of ethnic dominance, where more than 90% of the population is of one group or the other, and more violence in the area of incomplete dominance, between 70% and 90%. In the center – between 30% and 70%, we see relative calm (Gulden, 2002; CEH, 1999).

Several things must be observed when comparing these data to the models that follow. First, the killing in the Guatemalan conflict was extremely one sided – with the state and its agents committing the vast majority of the violence (Ball, 1999). Thus, the violence is skewed toward the right hand side of the histogram in figure 1. Most of the victims of violence were Maya, and most of the Maya are in communities on right hand side of the figure.

Second, Figure 1 shows a combination of the selective violence described by the models presented here and indiscriminate violence that can properly be described as genocide. Various authors, including Gulden (2002) and Kalyvas (2006) suggest that these two forms of violence are generated by different mechanisms. The data may support a rough separation of the data in terms of these classes, but this analysis has not yet been undertaken. It may also be possible to incorporate a model of indiscriminate violence into the models presented below – indeed, Kalyvas presents the rough outlines of such a model – but this is beyond the scope of the current paper.

Finally, it should be noted that the models below are stated in terms of state control and the information available to the state and to the insurgents. In the Guatemala dataset we do not measure this directly, but instead measure ethnic composition. It is reasonable, as a first order assumption, to say that the state had more control and information in areas with a higher percentage of Ladino residents, and little of each in areas with a high percentage of Maya. However, the strength of this correlation should not be naively taken for granted, as there were certainly many Maya collaborators and Ladino insurgents. A thorough exploration of the ethno-political dynamics of the conflict, as well as the stylized facts of the dynamics of denunciation and counter-denunciation in various types of settings is a worthy project that also lies beyond the scope of this paper

1.2 Kalyvas selective violence model

Kalyvas (2006) presents a model of selective violence that produces a strikingly similar pattern. In this model, individuals balance risk and reward in the joint production of violence. The model predicts limited or no violence in areas where one side or the other has full control and violence in areas where one group or the other has significant, but not complete control. Somewhat surprisingly, this model predicts no violence in areas where control is evenly balanced – in those areas that would normally be thought of as the front lines of a civil war. Kalyvas presents some evidence for this phenomenon based on micro-scale data from the Greek civil war. We also find evidence of this phenomenon in data from the Guatemalan civil war as presented above.

Kalyvas presents the logic of selective violence in civil war as a two-stage, boundedly rational decision process: first, a decision to “defect” and collaborate with a combatant party and, second, a decision to denounce a defector figuring in both the satisfaction gained from such a denunciation as well as the risk of counter-denunciation by the family and friends of the denounced party.

He conceives of the interaction space as a spectrum of government control (k), see figure 2. On the left hand side, we have complete government control, on the right hand side, we have complete control by the insurgents, and in the center we have an equal balance of control between the two parties. It is important to note that this is an interaction space rather than an explicitly physical space. As the balance of control shifts in a particular location, it may move from one interaction regime to another.

The payoff (u) for defecting to a given side is inversely proportional to the degree of control (k) of that side. Thus, the government is willing to offer little in return for collaboration (defection from the insurgents) in areas where it has a high degree of control, but is willing to offer much more in areas where it has little control and the insurgents are dominant. u is proportional to $(1 - k)$

On the other side of the defection equation is the cost of being caught defecting (i). This is presumably quite serious so that the cost of being caught is generally much higher that the reward for defecting ($u << i$).

These two factors are balanced by the probability of being detected, denounced, and punished (p). The probability of being caught by the government is highest where the government has most control and lowest where it has least control. The case is symmetrical for the insurgents. Thus the decision to defect involves balancing the reward for defecting, the penalty for being caught defecting, and the probability of being caught. An actor will defect if $pu > (1 - p)i$.

The second step in Kalyvas' logic of selective violence is the decision to denounce a defector. This decision involves balancing the reward (x) for eliminating a rival against the penalty to be paid for that denunciation (y) given the probability (q) of being counter-denounced to the group with which that rival was collaborating. This probability (q) is a function of the degree of control (k) that the denounced actor's group has in the area. Because these concepts apply both to the incumbents and to the insurgents, we need to differentiate k and q as applied to the actor's party from k and q as applied to the rival groups party. Thus kA is the control that the actor's party has, while kB is the control that the rivals group has. Similarly, qA is the probability of the actors own group counterdenouncing and eliminating a rival denouncer while qB is the probability of the friends of the denounced rival counterdenouncing and eliminating the actor. Generally, the reward (x) for denouncing a rival will be much less than the penalty (y) for being caught and counterdenounced, which is presumably death.

Kalyvas ably handles the full justification and mathematics behind this and derives the equilibrium that an actor will find the risk worth taking and denounce a defector when $x \geq qB(kA)y$.

From this analytical model, Kalyvas predicts that there will be little violence in zones one and five, where one party or the other has complete control, so the chance of being denounced is extremely high and the risk of a denouncer being counterdenounced is extremely low. Actors thus have very little incentive to defect against the group in control. In zones 2 and 4, where parties have substantial, but unequal control, Kalyvas predicts violence – as some people find it worth while to defect, yet denouncers still feel safe enough to denounce them. In zone 3, with balanced control, Kalyvas predicts little violence. This is rather surprising as this is the most contested area – the front line – with many people defecting in each direction. Denunciations do not happen here, however, because the probability of being counterdenounced is quite high and the penalty for counterdenunciation is sufficiently high that it is not worth denouncing so long as $x < y * qB$.

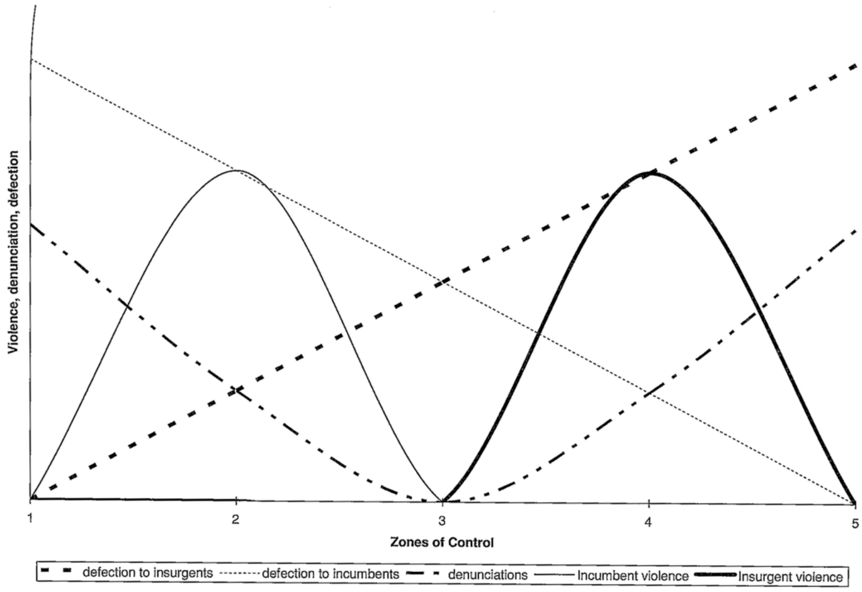

Fig. 2. Predicted pattern of selective violence, defection, and denunciation. Reproduced from Kalyvas 2006.

Kalyvas presents the sketch diagram reproduced here as figure 2, but actually produces analytical results only for the five zones, predicting no violence in zones 1 and 5, violence in zones 2 and 4, and no violence in zone 3.

2 Methods

We implement an agent-based version of the selective violence model that allows for a more thorough exploration of the model predictions and also for extension and modification of the model. We have done this using the NetLogo modeling environment (Wilensky, 1999). We present three versions of this model: model 1 is an agent-based version of Kalyvas' model as presented above, model 2 is a slight generalization of this model, and model 3 preserves the general thrust of Kalyvas' analysis but modifies the agent logic in order to achieve greater simplicity and better qualitative agreement with the empirical findings from Guatemala.

2.1 Model 1: An Agent-based Implementation of the Selective Violence Model

The logic of the initial agent-based implementation (here called "model 1") is as close as possible to what Kalyvas describes. In model 1 the agents wander at random in a space that ranges from total state control in the first zone, to no state control in the last zone. Agents have an underlying loyalty that varies uniformly between 0 and 1 – indicating their inherent preference for loyalty to the state. They also have a level of risk aversion, also varying uniformly between 0 and 1.

The agent decision to defect is a multi-step process following Kalyvas' logic. The agent calculates the payoff for defecting to the incumbent (u) as a function of his loyalty to the incumbent (l) and the level of control of the insurgents (p) – and thus the value of his defection to the incumbents. He then calculates his risk of being caught by the insurgents as a function of the insurgent level of control. Using these two calculations, he calculates his tendency to collaborate as $t = (1 - p)u - p$ and defects if this tendency exceeds his level of risk aversion (r).

The agent then examines a three-cell radius and if he sees an agent defecting to the opposing group he decides whether to denounce that agent. Following Kalyvas, the agent will denounce if the payoff for eliminating a rival (x), is greater than or equal to the probability of being counterdenounced (qB) times the cost for being caught denouncing (y). If the agent decides to denounce, an incidence of violence is recorded in that zone.

2.2 Model 2: Agent-based Implementation with Finer Zonal Granularity

Model 2 is the same as model 1 except that it has 20 zones of control rather than five. This is done in order to allow for better comparison to the data from Guatemala presented above. Implementing this in the NetLogo agent-based environment is trivial, requiring only a revised division of the interaction space and the proportional recalculation the level of control enjoyed by the state vs. insurgents.

2.3 Model 3: Extending the Agent-based Approach

We further leverage the flexibility of the agent-based methodology by endogenizing some elements of the model while retaining (or perhaps increasing) its simplicity and transparency. We begin by making two changes: 1) Shifting "control" from an exogenous quality that pertains to a zone, to a numerical ratio of agents with different loyalties in that zone. 2) Changing the calculations of risk and reward underlying denunciation and counterdenuciation to be based on the number of friends and enemies that each agent can see based on his 3-cell vision radius.

In this formulation, the zones have hard boundaries. Agents move randomly throughout their zone, but do not move from one zone to another. At setup, each zone is initialized with some percentage of its agents having a loyalty greater than 0.5. All of the agents in the first zone have loyalty greater than .5, whereas in the center zone, half are above 0.5 and half are below. Agents with loyalty greater than 0.5 are tagged as "loyalists" – though they may still find it worthwhile to collaborate with the insurgents if the situation calls for this. This mix of loyalties in each zone corresponds to Kalyvas' notion of control while also having a clear analogy to the ethnic makeup of Guatemalan municipalities.

The calculation of tendency to collaborate remains as it was (t = (1 – p)u – p), but the its constituent factors are determined differently. Each agent examines a 10-cell radius, counting its friends (fellow loyalists or non-loyalists) and its enemies (their compliment). The risk of being caught and punished by the opposing side (p) is now proportional to the percentage of enemies in the neighborhood. Similarly, the payoff for defecting (u) is also proportional to this percentage. If t > 0, the agent will collaborate or defect depending on which side it is allied with.

The decision to denounce is also simplified. As before, the agent will denounce if the payoff for eliminating a rival (x), is greater than or equal to the probability of being counterdenounced (qB) times the cost of being counterdenounced (y). The probability of being counterdenounced, now, however, is again simply the percentage of enemies in the agent's vision.

3 Results

3.1 Model 1: Docking of the Basic Agent-based Implementation

The basic implementation the Kalyvas model (model 1) produces violence in zones 2 and 4, and no violence in zones 1, 3 and 5.

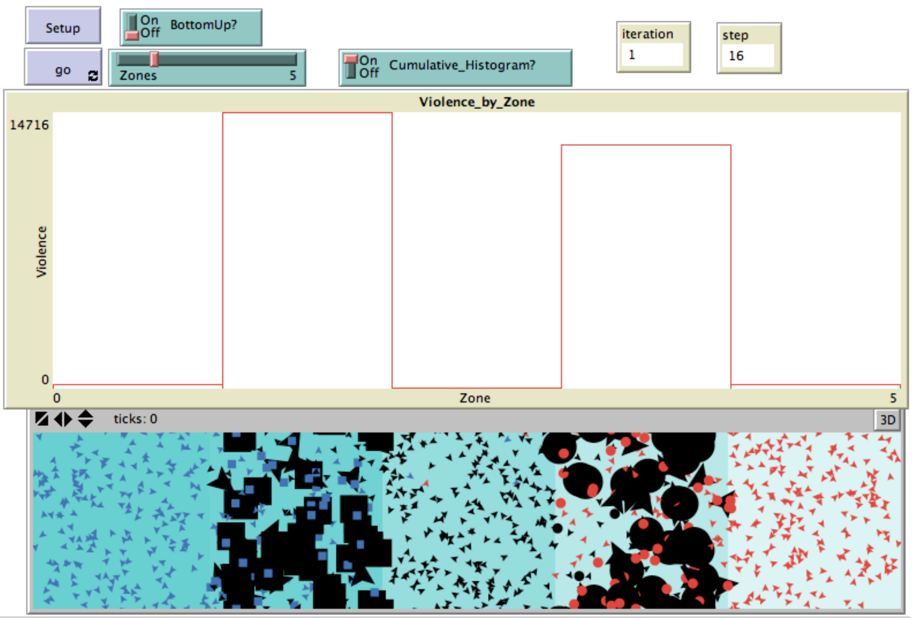

Fig. 3. Model 1: a five-zone agent-based implementation of Kalyvas selective violence model

3.2 Model 2: Beyond Maxima and Minima

When we extend the model by going from the five zones containing the extrema to 20 zones corresponding to the bins used in the Guatemala data analysis, we find that the basic M-shaped distribution of violence is preserved. The first, last, and center zones remain very low-violence, while there is substantial violence in the zones half way between them. However, we note a strong asymmetry. Whereas the falloff in predicted violence is gradual toward the edges, it is quite sharp toward the center – falling from its maximum to zero in crossing a single zone boundary.

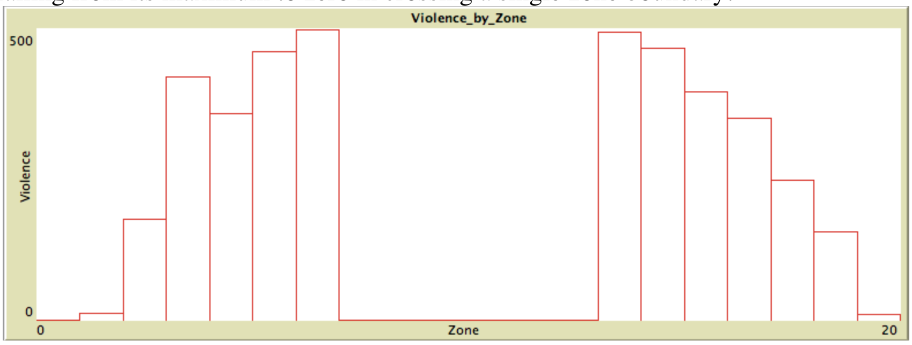

Fig. 4. Model 2: agent-based selective violence model with 20 zones corresponding to bins used in Guatemala analysis (cf. Figure 1, above).

3.3 Model 3: An Agent-Based Refinement

Model 3 displays a much smoother M-shaped distribution that falls off gradually from maxima in the 6/20 and 16/20 zones toward minimum values a the extremes and in the center.

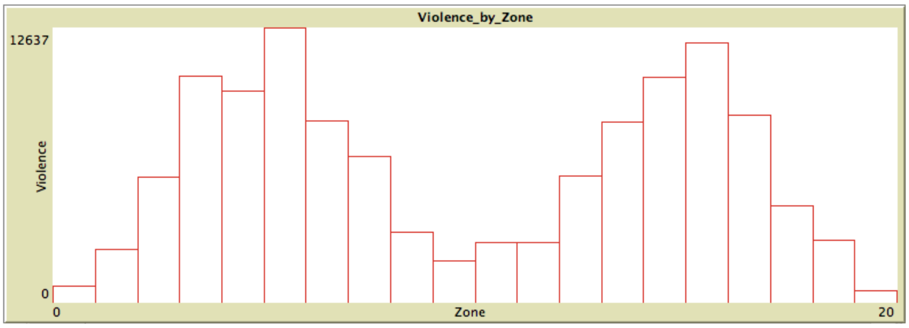

Fig. 5. Model 3: a bottom-up version of 20-zone agent-based model showing better qualitative agreement with data from Guatemala.

4 Analysis

The basic, five-zone implementation of the Kalyvas model (model 1) produces results that accord with his analytical findings as can be seen by comparing figures 2 and 3. Model 1 predicts violence in zones 2 and 4 (where one side has a majority of control, but not total control), and no violence in zones 1, 3 and 5 (where one side has total control, or control is evenly mixed). This corresponds exactly to Kalyavs' analytical result, where he finds that violence is at a maximum in zones 2 and 4 and at minimum in zones 1, 3 and 5.

A powerful advantage of the agent-based methodology is that it allows generalization of the model in ways that would be difficult using analytical methods alone. It should be noted that figure 2 (above, reproduced from Kalyvas) includes an M shaped curve, but the details of the shape of this curve are not explicitly derived. Rather, its minima and maxima are derived and the curve is then sketched through these points. Using analytical methods, it is difficult to do more than this.

In contrast to the analytical situation, extending the agent-based model to zones that lie between extrema is trivial, requiring only the creation of more zones with finer gradations of control. Doing this allows us to characterize the distribution of violence relative to control and to make more meaningful comparisons to real data.

Examining the distribution of violence among zones of control in the 20-zone model (model 2), we see that the basic M shaped character of the distribution holds, but we gain a better understanding of its shape. Most notably, we see that the drop in violence as we approach the center zone is extremely abrupt. The width of this gap depends on x, the payoff that an agent receives for eliminating a rival, disappearing completely when x exceeds .5 (or when the value of eliminating a rival is more than one half the penalty for being caught doing so). While this parameter can adjust the size of the violence-free center zone, there is no parameter in the Kalyvas formulation (or in this agent implementation of it) that produces the kind of smooth decline in violence toward the center that we see in the data from Guatemala as shown in Figure 2 or, indeed that we see in Kalyvas' sketch, reproduced in Figure 1.

Model 3 endogenizes the idea of control as a function of a mix of loyalty inclinations. This formulation is inspired by the Guatemala case, where municipalities have differing mixes of ethnic Ladino and Maya ethnic groups – the Ladino having more affinity for the state (which is heavily Ladino controlled) and Maya having less. As described above, individual agents estimate the state of control in their zone based on the agents they see around them. This leads to somewhat heterogeneous estimates of control within each zone because each agent sees a slightly different mix of fellow agents. Risk and reward are also calculated more directly based on the counts of friend and enemy agents within the field of vision of each agent.

The result of these modifications is a better qualitative fit with the data from Guatemala. The sharp cutoff between the violent area of partial dominance and the safe area of more even mixing is now much softer – though the basic observation of relative calm in the most mixed area is retained. The observation that there is less violence in areas with strong dominance by one party or the other is also retained.

5 Discussion

The exercise of developing an agent-based implementation of an analytic model and then proceeding to use the flexibility of the agent approach to simplify and extend the model demonstrates that agent-based modeling can be a powerful complement to analytical modeling. Kalyvas' representation of the decision to denounce based on its reward and the probability of being counterdenounced took on a functional form which made analysis possible, but which also introduced qualities into the resulting distribution of violence that are not supported by empirics.

The agent approach further allowed a more detailed characterization of the distribution of violence. Whereas the analytic approach was well suited for characterizing the maxima and minima of violence, and hence the five representative zones of Kalyvas' presentation, the agent approach makes it simple to present an arbitrary number of zones – greatly facilitating validation against data.

While this model has real advantages over its analytic predecessor, much remains to be done to produce a useful model of the Guatemalan civil war. In the current model, no effort has been taken to represent the unequal ability of the two sides to commit violence. As mentioned above, agents of the Guatemalan state carried out the vast majority of the killing in the course of the war because they were far better armed and organized. This model will lend itself well to adaptation to reflect this situation. Also, this model is an agent-based variation on the Kalyvas' model of selective violence, whereas much of the violence in the Guatemalan conflict was indiscriminate. Kalyvas presents a less explicitly developed theory of indiscriminate violence that may provide a strong basis for extending this framework to cover the whole of the conflict.

This paper has sought to lay a foundation on which further work can be done to systematically explore and integrate theories of selective and indiscriminate violence – placing such theories in the context of event data from real conflicts. We have demonstrated that the agent-based approach allows for systematic exploration of theory and for a level of comparison with data that is difficult if not impossible to achieve using analytical methods. Future work will include the incorporation of a model of indiscriminate violence as well as an explicit model of the impact of differing capacity for violence between state forces and insurgents.

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ODD Description of Agent-based Model of Selective Violence

1 Overview

1.1 Purpose

The purpose of the model is to reimplement, validate, and extend an existing analytical model of selective violence in civil war. In particular, the model is intended to allow for comparison to empirical event data from the Guatemalan civil war and to provide the modeling flexibility required to achieve qualitative agreement between these event data and model output while maintaining a solid footing in social science theory.

1.2 Entities, State Variables, and Scales

The model is made up of structurally similar agents that differ only with respect to their values of several key variables and their placement in the environment. The environment is divided into several zones of control. In the base case of the model (models 1 and 2), the agents read the level of control directly from the part of the environment (i.e. NetLogo patch) in which they currently reside, whereas in the variant case (model 3) agents with different settings are constrained to certain zones and they infer government control by examining other agents within their field of view.

Agents have three parameters (i, x, and y) that are set globally and shared by all agents. They have a radius in which denunciations can be carried out, and in model three they also have a larger radius in which the assessment of government control (risk of denunciation) is assessed.

They also have two parameters (Risk aversion and Loyalty) that are randomly (uniformly) heterogeneous across agents.

Overview of parameters and state variables			
Parameter	**Model 1**	**Model 2**	**Model 3**
Properties of Environment			
Number of Zones	5	20	20
Control in each zone	0,0.25,..,1	0,0.05,..,1	NA
Fraction of rebels in each zone	NA	NA	0,0.05,..,1
Agents can cross zones	True	True	False
Properties common to all agents			
Cost of being caught defecting (i)	1	1	1
Payoff for denouncing a rival (x)	.33	.33	.33
Cost of being counterdenounced(y)	1	1	1
Risk assessment vision radius	NA	NA	10

Denunciation vision radius	3	3	3
Properties heterogeneous among agents			
Risk aversion	Rnd(0..1)	Rnd(0..1)	Rnd(0..1)
Loyalty	Rnd(0..1)	Rnd(0..1)	Rnd(0..1)

There are no persistent state variables – agents choose whether to denounce a rival in each round based on their initialization parameters (listed above) and their surroundings. In models 1 and 2, the surroundings consist of the level of government control in the current patch and the defection status of surrounding agents. In model 3, the surrounding consists in the ratio of like to unlike agents (with respect to government loyalty) and the defection status of surrounding agents. The relative positions of the agents change from time step to time step according to a random walk. In models 1 and 2, this walk is bounded only by the interaction space (with reflecting, non-torroidal walls). In model three, the walk is confined to the agent's original zone.

The decision to defect and the decision to denounce a defector are at the core of the model. These denunciations are the violent events under study. In general terms, the decision to defect is a function of the agent's level of loyalty and the payoff for defecting, balanced against the risk of being denounced and the agent's level of risk aversion. Similarly, the decision to denounce a defector weights the payoff for denouncing a defector against the risk of being counterdenounced. The details of these calculations are slightly different between models 1 and 2 on the one hand and model 3 on the other. These details will be stated below in the details section.

1.3 Process overview and scheduling

The model proceeds in abstract time steps. It should be emphasized that no attempt is made in this model to link model steps to any kind of real time (days, hours, etc.). The point here is to understand the origin of the qualitative, M-shaped distribution of violence relative to ethnic concentration observed in Guatemala – not to make any specific, temporal predictions.

Agents activate in random order. First, all agents move one step in a random direction (more than one agent can occupy the same square, making collisions irrelevant). All agents then assess the level of government control for their current location and decide whether to defect (i.e. to collaborate with one or both sides). With this assessment complete for all agents, they then examine their vision radius for agents collaborating with the other side. If any are found, they decide whether to denounce one of them.

Denunciations are tallied for each zone over the course of the model run in order to assess the levels of violence in each zone of control.

2 Design Concepts

Emergence: The level of violence in each zone emerges from the model, whereas the level of government control is fixed in all three implementations. In the five-zone model, the emerged level of violence agrees with results that can be derived analytically from the stated behavior. In the 20-zone implementations, the emerged behavior is similar, though the analytical result would be hard to derive.

Sensing: Agents know their own inherent loyalty to the government, the risks and rewards of cooperating with each side, and their own level of risk aversion. In models 1 and 2, they know the degree of government control with precision, in model 3, they estimate this level of control based on the mix of agents within their risk assessment vision.

Interaction: Agents decide whether to defect and whether to denounce a defecting agent based on their perceived risk. In models 1 and 2, this risk is fixed – being derived directly from the environment. In model three, the perception of risk is based on agent interaction, it being based on a count of friends and enemies within the agent's vision. Actual denunciations are also interactive. A denunciation takes place when a defecting agent is seen by a non-defecting agent who finds it to be worth the risk to make the denunciation.

Stochasticity: The local density of agents with various degrees of loyalty and risk aversion is critical to the dynamics of this model. These local densities are constantly shifting because the agents move each round according to a bounded random walk.

Collectives: Agents are initialized with an inherent loyalty greater or less than 0.5. Those with loyalty greater than 0.5 are dubbed "loyalists." Those with loyalty less than or equal to 0.5 are dubbed "non-loyalists." However, based on their surroundings, agents may find it worthwhile to collaborate with the opposite group. Agents who are actively collaborating with the government are referred to as "collaborators" and those collaborating with the rebels are called "insurgents." It is possible (though less likely) for a loyalist to act as an insurgent and for a non-loyalist to act as a collaborator. In model three, it is also possible for an agent to collaborate with both sides – though this is risky, as it is in a real conflict situation.

3 Details

3.1 Initialization

In models 1 and 2, zones are initialized with government control starting at zero in the first zone and proceeding in even increments to one in the last zone. For model 1, these levels are 0.0, 0.25, 0.5, 0.75, and 1.0. For model 2, these zones are similar but there are 20 of them with increments of 5% in order to facilitate examination of non-extreme points and comparison with the data from Guatemala. The same idea is represented in model 3 by fixing the ratio of loyalists to non-loyalists for each of the

20 zones and letting the agents estimate the level of control based on the mix of agents they can see.

3.2 Input data

Because this model is highly abstract and is used as a way of testing and refining theory, it has no input beyond the initialization of government control zones (above) and the initialization of agents according to the parameters expressed above and the details in the section below.

3.3 Submodels

Models 1 & 2
Decision to defect (for Insurgent):
    Payoff = ((1-Loyalty)) * (1-Government_control_level))^0.2
    Risk = (Government_control_level / 2) * Cost_of_being_caught
    Insurgency_level = ((1 – Risk) * Payoff) – Risk
    If Insurgency_level > Risk_aversion, Insurgent = true, else Insurgent = false
    The case for Collaborators is symmetrical.

Decision to denounce (for Loyalist):
    If defector is in vision:
    Risk = (1-Government_control_level)* Cost_of_being_counterdenounced
    If Payoff_for_denouncing_rival >= Risk, denounce = true
    The case for Non-Loyalists is symmetrical.

Model 3 is same as models 1 and 2 except:
Decision to defect (for Insurgent):
    Payoff = (1-Loyalty) * (enemies/(friends + enemies + 1))
    Risk = (enemies / (friends + enemies + 1))

Decision to denounce (for Loyalists):
    Risk = (enemies / (friends + enemies + 1))