Regime Change and Revolutionary Entrepreneurs

Ethan Bueno de Mesquita*

Abstract

I develop a model of regime change to study how a revolutionary vanguard may use violence to coordinate and mobilize members of a mass public by convincing them that the level off anti-government sentiment in society is high. The model is consistent with unexpectedly successful violence by vanguards sparking revolution, but also suggests that the role of vanguards in the micro-foundations of revolution is complicated and subtle. The model has multiple equilibria, some in which revolution is relatively likely and some in which it is relative unlikely or impossible. Within an equilibrium, structural factors affect the likelihood of revolution. Nonetheless, if two identical societies play different equilibria, they have very different likelihoods of experiencing revolution, creating a problem for empirical work seeking to identify the root causes of political violence or instability. This fact also suggests that standard empirical arguments about the importance of revolutionary vanguards may be problematic. In equilibrium, there are selection effects—all else equal, vanguard violence is higher in societies where, even without a vanguard, regime change would be relatively likely.

*Associate Professor, Harris School, University of Chicago, e-mail: bdm@uchicago.edu

I explore how violence by a revolutionary vanguard may facilitate coordination and mobilization of mass publics for the purpose of effecting regime change. The model highlights an informational mechanism by which revolutionary vanguards may achieve such coordination and mobilization. They use violence to convince the public that there is a high level of anti-government sentiment in society and thereby make participation more attractive. However, it also suggests ways in which standard empirical arguments about the importance of revolutionary vanguards may be problematic. In equilibrium, there are selection effects—even controlling for all relevant structural factors, vanguard violence is higher in societies that, even without a vanguard, would be relatively more likely to experience regime change. Hence, a correlation between the activity of revolutionary vanguards and mass mobilization for regime change may not constitute evidence for the causal impact of vanguards.

I develop a model of regime change with a prior stage in which a revolutionary vanguard (e.g., terrorist or guerillas) engages in publicly observable political violence. Successful regime change occurs only if a sufficient number of individuals participate. Individuals know their own level of anti-government sentiment (and thus how much they would benefit from regime change), but are uncertain of how anti-government their fellow citizens are. Individual levels of anti-government sentiment are positively correlated, so an individual's personal beliefs provide some information about the distribution of beliefs in society.

This situation creates a coordination problem—citizens of a given type want to participate in the revolution if and only if they are sufficiently anti-government and believe enough other citizens will also participate. The vanguard uses violence to convince citizens that anti-government sentiment is high, so they believe many of their fellow citizens will participate.

Violence is an effective tool for communicating the level of anti-government sentiment in society because the ability of the revolutionary vanguard (e.g., terrorists or guerillas) to produce attacks is a function of both their own costly effort and of their support in the public at large. Insurgents often depend on members of the population for material support, safe havens, information, and recruits. Moreover, members of the population can betray insurgents to the government. Thus, even though the revolutionary vanguard has no private information about public sentiment, successful acts of violence suggest higher levels of anti-government sentiment. (See Kalyvas (1999) for a discussion of the relationship between insurgents and populations.)

The model thus explores a mechanism by which violence by a vanguard may help to spark a successful revolution. Such a theory is important for at least two reasons. First, violent regime change is itself an outcome of considerable interest, with serious welfare consequences in terms of both political and economic development. Second, the revolutionary threat plays a major role in political economy explanations of a variety of important phenomena, including democratization, redistribution, regime stability, the organization of the state, corruption, and public goods provision (see, for example, Acemoglu and Robinson 2001, 2006; Bueno de Mesquita et al. 2003; Bueno de Mesquita and Smith 2008; Fearon 2006; Myerson 2007).

The results also contribute more broadly to ongoing debates regarding the origins of revolution and violent regime change.

A common critique of purely structural accounts (i.e., accounts based on features of a society such as economic growth, inequality, or international threats, to the exclusion of strategic behavior) of violent regime change is that the structural conditions characterizing societies that experience revolution often also characterize societies that do not experience revolution. The model presented here calls into question the validity of this empirical critique and its policy implications. The model has multiple equilibria—some where revolution is relatively likely and some where it is relatively unlikely or impossible. Within an equilibrium, comparative statics show that structural factors affect the likelihood of revolution. Nonetheless, if two structurally identical societies play different equilibria, they have very different likelihoods of successful revolution occurring.

This argument suggests a quite general problem both for the empirical literature on the root causes of political violence and for policymaking. In a world characterized by multiple equilibria, much of the variation in the data may be due to whatever cultural or historic factors determine equilibrium selection, rather than those structural factors that we often think are of first-order importance for explaining political violence and instability. Thus, structural factors may matter (for a given equilibrium selection) but be difficult to detect empirically because we cannot observe which equilibrium a society is playing. Moreover, from the perspective of policymaking, this implies that, even though the data are not well explained by structural variation, it may be that, within a given society (playing its particular equilibrium), changing key structural factors would reduce political violence or the likelihood of violent regime change.

Critics of structural accounts further argue that a key additional explanatory variable is the activity of revolutionary vanguards (DeNardo 1985; Popkin 1988; Kurrild-Klitgaard 1997). Structurally ripe societies, the argument goes, have revolutions only if the right type of revolutionary leadership arises. Proponents of this argument point to a variety of examples of vanguards engaging in violence that appears to have inspired a larger insurrection. For instance, the FLN's (National Liberation Front) terrorist campaign helped spark the Algerian War of Independence (Kalyvas 1999). Violence by Argentine guerilla groups such as the Montoneros and the ERP (People's Revolutionary Army) in the late 1960s and early 1970s led to much larger scale insurgency by the mid-1970s (Gillespie 1995). And terrorist tactics and other forms of violent agitation by Russian revolutionaries helped set the stage for the 'spontaneous' uprisings of 1905 and 1917 (DeNardo 1985).

My model is supportive of the idea that successful vanguard violence can spark large-scale uprisings. However, it also renders the vanguard-based empirical critique of structural accounts problematic. In equilibrium there are selection effects. The vanguard engages in higher levels of violence in those societies that, all else equal, would have a higher probability of regime change even without a vanguard. Thus, even if the vanguard itself has no effect on the likelihood of successful revolution, there will be a positive correlation between vanguard activity and regime change. These selection effects must be taken into account before drawing inferences from the empirical relationship between vanguard activity and revolutions.

The model has a few additional substantive implications. I provide comparative statics on how factors such as regime capacity and the structure of incentives inside the revolutionary organization affect the likelihood of successful revolution. The model also predicts that participants in revolutions fomented by particularly active revolutionary vanguards are expected to be less anti-government than other revolutionaries.

Finally, from an applied theory perspective, the existence of multiple equilibria in this game may be of independent interest for the literature on global games of regime change (Morris and Shin 1998; Angeletos, Hellwig and Pavan 2006, 2007; Edmond 2007). The revolution stage of my model is closely related to a global game of regime change, although, as discussed below, it is not a global game. It turns out that relocating the locus of uncertainty from the regime's capacity to withstand an attack (the standard global game of regime change assumption) to the level of anti-regime sentiment (my assumption) makes it generically impossible to have a unique equilibrium in finite cutoff strategies (which is the standard result for global games of regime change).

The paper proceeds as follows. Section 1 describes the model and Section 2 defines and characterizes equilibrium. Section 3 discusses substantive implications for regime change and relates the mechanism for coordinating and mobilizing mass publics modeled here to other mechanisms discussed in the literature. Section 4 concludes.

1 A Model of Revolutionary Vanguards and Regime Change

There are a revolutionary vanguard and a continuum of population members of measure 1. At the beginning of the game, each member of the population i learns her type $\theta_i = \theta + \epsilon_i$. The common component θ is drawn by Nature from a normal distribution with mean m and variance σ_θ^2. The idiosyncratic components ϵ_i are independent draws by Nature from a normal distribution with mean 0 and variance σ_ϵ^2. Members of the population observe only θ_i, not θ or ϵ_i. After each population member observes her type, the vanguard, which has no private information, chooses a level of effort to expend on a campaign of violence (e.g., terrorist or guerrilla attacks). Individuals observe the level of violence and then decide whether or not to join an attempted revolution against the government. The game ends with the government either being overthrown or remaining in place.

I refer to the stage of the game in which the revolutionary vanguard engages in violence as the "vanguard stage" and the stage in which population members decide whether or not to participate as the "revolution stage".

The measure of people who join the revolution is N. The regime is replaced if and only if N is greater than or equal to a threshold $T \in (0,1)$.

A member of the population, i, takes an action $a_i \in \{0,1\}$, where $a_i = 1$ is the decision to participate. A person's type, θ_i, determines how much she values regime change. She derives a portion, $\gamma \in (0,1]$, of that value only if the revolution succeeds and the individual participated in it. The other portion, $1-\gamma$, is realized whether or not she personally participates in the revolution. The payoff to a failed revolution is normalized to 0. Participating imposes a cost $k > 0$ on the individual. These payoffs are represented in the following matrix, which gives the von Neuman-Morgenstern expected utility function for a population member i.

Player i		$N < T$	$N \geq T$
	$a_i = 0$	0	$(1-\gamma)\theta_i$
	$a_i = 1$	$-k$	$\theta_i - k$

Payoffs for a Representative Population Member i

Denote by $t \in [\underline{t}, \infty)$ (with $\underline{t} \geq 0$) the level of effort exerted by the revolutionary vanguard. The total level of violence is $v = t + \theta + \eta$, where η is drawn by Nature from a normal distribution with mean 0 and variance σ_η^2. As discussed in the introduction, the idea is that when the public has a higher level of anti-government sentiment, it is easier for the revolutionary vanguard to produce violence, since it will have the support of the population.

The vanguard benefits from mobilizing the population, even if regime change is not achieved, and finds effort costly. (Since the probability of successful revolution is increasing in participation, very similar results obtain in a model in which the vanguard cares only about successful revolution, rather than total mobilization. However, that model is more technically cumbersome.) Hence, the vanguard's payoffs are given by the following von Neuman-Morgenstern expected utility function:

$$U_v(t, N) = N - c(t),$$

where $c' > 0$, $c'' > 0$, and c' satisfies $\lim_{t \to \underline{t}} c'(t) = 0$ and $\lim_{t \to \infty} c'(t) = \infty$.

1.1 A Comment on the Primitives

Several assumptions merit further comment.

First, there is some portion (γ) of the payoffs from revolutionary success that can only be accessed by those who participate in the revolution. As a matter of verisimilitude, the assumption seems reasonable. In many settings, those who actively participate in revolution gain privileged status after regime change occurs. This assumption relaxes the standard collective action problem, since there is the possibility of a private benefit to participation if the revolution succeeds. This fact is consistent with Kalyvas's (2007) argument that the collective action problem may be less binding in violent mobilization than most rational choice scholarship suggests. Here, fairly natural assumptions on payoffs have the effect of relaxing the collective action problem and focusing instead on coordination.

Second, there is heterogeneity in the level of anti-government sentiment, but population members' views are positively correlated. The idea here is that particularly bad (resp. good) governments are likely, on average, to generate more (resp. less) anti-government sentiment.

It is also worth pointing out that, although the revolution stage of this model is similar to a global game of regime change (Angeletos, Hellwig and Pavan 2006, 2007; Edmond 2007), it is not a global game. In particular, unlike in those papers, the model here does not satisfy the "limit dominance" property of global games (Morris and Shin 1998)—there is no θ_i such that participation is a dominant strategy.[1]

Third, I assume that vanguard violence is an increasing function of both effort and anti-government sentiment in society. As mentioned in the introduction, a supportive population is important for the operation of a revolutionary vanguard for a variety of reasons. The

[1]Typically, global games of regime change assume that the value of regime change (my θ) is fixed and known, but there is uncertainty over the threshold of participation needed for success (my T), which has full support on the real line. Players have dominant strategies for sufficiently low or high Ts, resulting in equilibrium uniqueness as long as the prior is sufficiently diffuse and signals sufficiently informative. For the application to revolutions, such a setup requires that a player assign positive probability to the event that she alone could topple the regime and that, conditional on receiving an extreme signal, she assign a very high probability to this event. In the case of political regime change, this seems unrealistic. Thus, my model, while related to that literature, is not a global game. For more on the relationship between payoff and threshold uncertainty in games of regime change, see Bueno de Mesquita (2009).

vanguard is likely to rely on the surrounding population for intelligence, safe houses, recruits, and resources. Moreover, it is difficult for vanguards to function in an environment where the surrounding population is hostile to their efforts and likely to turn them in to the authorities. For all these reasons I assume that vanguard violence is increasing in anti-government sentiment, and, therefore, informative about such sentiment. The particular additive functional form that I adopt for v is, of course, a just a tractable reduced form.

It is also worth noting that the outcome v can be interpreted more broadly than as violence. Any publicly observable action that is increasing in both effort and anti-government sentiment could play a similar role. In repressive regimes, violence is one of the few strategies available that satisfies all these conditions—i.e., is both observable by the general population and informative about anti-government sentiment in the broader society.

Finally, the informational structure merits comment. In particular, I assume that the vanguard chooses its effort without a private signal of the level of anti-government sentiment (the informational structure is, thus, related to Holmström's (1999) classic model of 'career concerns'). The idea, here, is to focus on violence as an inherently informative act (since its production requires support) and the incentives that creates for investment in violence. If the vanguard had private information the issue would be muddied, since then we would have to focus on the the vanguard's strategy as itself an informative act within a separating equilibrium of a signaling game. Situations in which vanguards have private information are certainly of interest (for examples, see, Ginkel and Smith (1999) for a model with costly signaling and Baliga and Sjostrom (2009) for a model with cheap talk). However, since the situation in which the vanguard does not have a large informational advantage over the population is also descriptive of many cases, it is also worth studying the pure informational value of violence generation in the absence of private information.

2 Equilibrium

A pure strategy for the vanguard is a choice of effort directed at violence, t. A pure strategy for a member of the population is a mapping $s(\theta_i, v) : \mathbb{R} \times \mathbb{R} \to \{0, 1\}$, from observed levels of personal anti-government sentiment and vanguard violence into a decision of whether or not to participate.

The solution concept is pure strategy Perfect Bayesian Equilibrium (PBE). Since, for any choice t, there is no state θ that is inconsistent with any observation v or θ_i, no event is off the path. Thus, the solution concept simply requires that beliefs be consistent with the strategy profile and Bayes' rule, and that the strategies be optimal given the beliefs and the strategies of the other players.

I further restrict the set of equilibria in two ways. First, I restrict attention to those pure strategy equilibria of the full game in which, in the game that constitutes the revolution stage, players use cutoff strategies of the form, "choose $a_i = 1$ if and only if $\theta_i \geq \hat{\theta}(v, t^*)$," where $v = \theta + \eta + t$ is the level of violence and t^* is the population's common belief about the level of effort by the vanguard.

Second, for some values of v and t^*, the game that constitutes the revolution stage turns out to have multiple equilibria in cutoff strategies: one with an infinite cutoff (i.e., no participation) and two with finite cutoffs. I focus on equilibria of the full game in which players play the same selection—i.e., the low cutoff, the high cutoff, or the infinite cutoff—whenever there are multiple equilibria. This imposes continuity in v on the cutoff rule (almost everywhere)—small changes in v do not result in large changes in the cutoff rule by changing the equilibrium selection, except at the minimal v needed for a finite cutoff rule to exist, where there can be a discontinuous jump from zero to positive participation.

The idea behind this second requirement is twofold. First, which equilibrium selection is likely to be a fact about the culture and history of a society.(Chwe 1998, 2001). I do not allow small changes in revolutionary violence to alter the fundamental conjectures citizens of a country have about one another's behavior—that is, to change society's focal equilibrium (Schelling 1960). Second, the model explores how revolutionary violence can affect mobilization. It would be stacking the deck in favor of finding a large effect to assume that small changes in revolutionary violence could change mobilization by changing the type of equilibrium that is played. Instead, I examine how violence affects mobilization by shifting the cutoff rule, holding fixed the selection of a cutoff rule from among those consistent with equilibrium.

I refer to a pure strategy PBE that satisfies these two criteria as a *cutoff equilibrium.*

2.1 Beliefs

Applying Bayes' Rule for the case of normal priors and normal signals (DeGroot 1970), a population member of type θ_i, after observing her type but not the level of violence v, has posterior beliefs about θ that are distributed normally with mean

$$\overline{m}_i = \lambda\theta_i + (1 - \lambda)m$$

and variance

$$\sigma_1^2 = \lambda\sigma_\epsilon^2,$$

with

$$\lambda = \frac{\sigma_\theta^2}{\sigma_\theta^2 + \sigma_\epsilon^2}.$$

Suppose it is common knowledge that the population members believe that the level of effort by the revolutionary vanguard was t^*. Then the members of the population believe that $v - t^*$ is a mean θ normally distributed random variable with variance $\sigma_\theta^2 + \sigma_\eta^2$. After observing a level of violence, a person of type θ_i has posterior beliefs about θ that are normally distributed with mean

$$\overline{\overline{m}}_i = \psi(v - t^*) + (1 - \psi)\overline{m}$$

and variance

$$\sigma_2^2 = \psi(\sigma_\theta^2 + \sigma_\eta^2)$$

with

$$\psi = \frac{\sigma_1^2}{\sigma_1^2 + \sigma_\theta^2 + \sigma_\eta^2}.$$

2.2 The Revolution Stage

I begin the analysis at the end of the game, solving for equilibria in (almost everywhere) continuous cutoff rules at the revolution stage.

An individual participates if and only if:

$$\Pr(N \geq T|\theta_i, v)\theta_i - k \geq \Pr(N \geq T|\theta_i, v)(1 - \gamma)\theta_i,$$

which can be rewritten

$$\Pr(N \geq T|\theta_i, v)\gamma\theta_i \geq k. \tag{1}$$

No individual, on her own, can topple a regime. Thus, if a member of the population believes no one else will participate, she also does not want to participate. Given this, for any beliefs about θ, there is always an equilibrium of the revolution stage where no one participates, regardless of type (i.e., with an infinite cutoff rule).

Lemma 1 *There is always an equilibrium of the game characterizing the revolution stage in which no player participates.*

All proofs are in the Appendix.

I now look for pure strategy equilibria in cutoff strategies in the revolution stage with positive participation. Fix a belief t^* and a realization of v and suppose there is such a finite cutoff rule, $\hat{\theta}(v-t^*)$. Given a realization of θ, a person will participate if $\epsilon_i \geq \hat{\theta}(v-t^*)-\theta$. The level of participation will be $N(\theta, \hat{\theta}(v-t^*)) = 1 - \Phi\left(\frac{\hat{\theta}(v-t^*)-\theta}{\sigma_\epsilon}\right)$, where Φ is the cumulative distribution function of the standard normal. The revolution succeeds if $N(\theta, \hat{\theta}(v-t^*)) \geq T$. For a fixed $\hat{\theta}(v-t^*)$, $N(\theta, \hat{\theta}(v-t^*))$ is strictly increasing in its first argument—the more anti-government sentiment, the greater participation. Thus, for a given cutoff rule and a fixed $v-t^*$, the minimal level of anti-government sentiment necessary for regime change to be acheived is $\theta^*(\hat{\theta}(v-t^*))$, defined by:

$$N(\theta^*, \hat{\theta}(v-t^*)) = 1 - \Phi\left(\frac{\hat{\theta}(v-t^*)-\theta^*}{\sigma_\epsilon}\right) = T$$

or

$$\theta^*(\hat{\theta}(v-t^*)) = \hat{\theta}(v-t^*) - \Phi^{-1}(1-T)\sigma_\epsilon. \tag{2}$$

From the perspective of a member of the population of type θ_i, given a $v-t^*$ and a cutoff rule $\hat{\theta}(v-t^*)$, the probability of victory is

$$\Pr(\theta \geq \theta^*(\hat{\theta}(v-t^*))|\theta_i, v) = 1 - \Phi\left(\frac{\theta^*(\hat{\theta}(v-t^*)) - \overline{\overline{m}}_i}{\sigma_2}\right).$$

From Equation 1, such a person will choose to participate if

$$\left[1 - \Phi\left(\frac{\theta^*(\hat{\theta}(v-t^*)) - \overline{\overline{m}}_i}{\sigma_2}\right)\right]\gamma\theta_i \geq k.$$

Since $\overline{\overline{m}}_i$ is increasing in $\overline{m}_i$, which is increasing in θ_i, the left-hand side of this inequality is increasing in θ_i. This monotonicity implies that if a person with type $\theta_i = \hat{\theta}(v-t^*)$ participates, then so will a person with $\theta_i > \hat{\theta}(v-t^*)$. Substituting for $\overline{m}_i$ and $\overline{\overline{m}}_i$, if such a cutoff rule exists, for a given $v-t^*$, it is defined by:

$$\left[1 - \Phi\left(\frac{\theta^*(\hat{\theta}) - \psi(v-t^*) - (1-\psi)\lambda\hat{\theta} - (1-\psi)(1-\lambda)m}{\sigma_2}\right)\right]\gamma\hat{\theta} = k.$$

A mapping, $\hat{\theta}(\cdot)$, giving equilibrium cutoff rules must satisfy this equality and Equation 2. Substituting from Equation 2, it is possible to implicitly define a mapping $\hat{\theta}(\cdot)$ that satisfies both these requirements in one condition:

$$\left[1 - \Phi\left(\frac{(1-(1-\psi)\lambda)}{\sigma_2}\hat{\theta} - \frac{(1-\psi)(1-\lambda)m + \sigma_\epsilon\Phi^{-1}(1-T) + \psi(v-t^*)}{\sigma_2}\right)\right]\gamma\hat{\theta} = k \tag{3}$$

It will be useful to define the following:

$$f(x, v - t^*) \equiv \alpha x - \beta,$$

where $\alpha = \frac{(1-(1-\psi)\lambda)}{\sigma_2}$ and $\beta = \frac{(1-\psi)(1-\lambda)m + \sigma_\epsilon \Phi^{-1}(1-T) + \psi(v-t^*)}{\sigma_2}$. It will also be useful to define

$$G(x, v - t^*) \equiv (1 - \Phi(f(x, v - t^*)))\gamma x.$$

This derivation yields the following result:

Lemma 2 *Consider a pure strategy, $s : \mathbb{R} \times \mathbb{R} \to \{0, 1\}$, for population members, under which there is a positive probability of positive participation. The strategy s is consistent with a cutoff equilibrium if and only if:*

$$s(\theta_i, v - t^*) = \begin{cases} 1 & \text{if } \max_x G(x, v - t^*) \geq k \text{ and } \theta_i \geq \hat{\theta}(v - t^*) \\ 0 & \text{else,} \end{cases}$$

with $\hat{\theta}(v - t^*)$ continuous and satisfying

$$G(\hat{\theta}(v - t^*), v - t^*) = k,$$

for all $v - t^*$ such that $\max_x G(x, v - t^*) \geq k$.

An equilibrium with a positive probability of successful revolution only exists if it is possible for the condition in Lemma 2 to be satisfied. Since the model is only interesting if this is possible, I assume parameters are such that there exist realizations of the random variables θ and η yielding an equilibrium finite cutoff rule. (Lemma 8 will formalize exactly what realizations suffice.)

Assumption 1 *Define $x^*(v - t^*) \equiv \arg\max_x G(x, v - t^*)$.*[2] *Then $\max_{v-t^*} G(x^*(v - t^*), v - t^*) \geq k$.*

Given that an equilibrium finite cutoff rule is feasible, it is possible to study some characteristics of such a rule. First, such a cutoff rule must be positive, since no player with a negative value from regime change would participate.

Lemma 3 *For any $v - t^*$, any $\hat{\theta}$ satisfying $G(\hat{\theta}, v - t^*) = k$ is strictly positive.*

[2]Lemma 4 guarantees that x^* is unique.

Given a realization of $v - t^*$, the function $G(x, v - t^*)$ represents the payoff to a person of type x if x is adopted as the cutoff rule by all members of the population. Understanding this function is key for characterizing equilibrium in the revolution stage.

Lemma 4 *For all parameter values, $G(\cdot, \cdot)$ has the following properties:*

1. *For $x > 0$, $G(x, v - t^*)$ is increasing in x if and only if $\frac{1-\Phi(f(x,v-t^*))}{x\phi(f(x,v-t^*))} \geq \alpha$.*
2. *For $x > 0$, $G(x, v - t^*)$ is single peaked in x.*
3. $\lim_{x\to\infty} G(x, v - t^*) = 0$.
4. *$G(0, v - t^*) = 0$.*

Lemma 4 establishes that for all parameter values, $G(x, v-t^*)$ is non-monotonic and has a single peak in x for positive values of x. The point where, for a fixed $v - t^*$, it reaches this peak is $x^*(v-t^*)$ as defined in Assumption 1. Moreover, since G goes to zero both to its left and its right, in general (with the exception of a knife edge case) if $v-t^*$ is high enough that $G(x, v-t^*)$ crosses k once, it crosses k twice. Thus, almost always if there is one finite cutoff rule consistent with equilibrium there are two. This fact is illustrated in Figure 1. The first panel shows a realization of $v-t^*$ such that the only equilibrium in cutoff strategies involves no participation. The second panel shows the knife edge case where there is a single finite cutoff rule consistent with equilibrium. The third panel shows the case where there are two finite cutoff rules consistent with equilibrium.

In this third case, the intuitions for the two positive participation equilibria are as follows. Consider the effect on the function G of increasing the stringency of the cutoff rule (i.e., requiring a higher level of anti-government sentiment for participation). Making the cutoff rule more demanding has two competing effects on the expected payoffs from participation to a person whose type is just at the cutoff. On the one hand, as the cutoff rule becomes more stringent, for fixed realizations of the random variables, expected participation decreases and so the probability of victory is lower. This effect, which I call the *probability of winning effect*, tends to make participation less attractive to a person of type $\hat{\theta}$. On the other hand, as the signal required becomes more strict, the signal received by the person whose signal is just at the cutoff rule is better, so this person thinks victory is more likely and thinks the payoff from victory is higher. This effect, which I call the *marginal participant effect*, tends to make participation more attractive to a person of type $\hat{\theta}$.

The presence of two competing effects results in G being non-monotonic, which leads to multiple positive participation equilibria. In one of these equilibria, all players use a low threshold (i.e., they begin participating at a relatively low level of anti-government

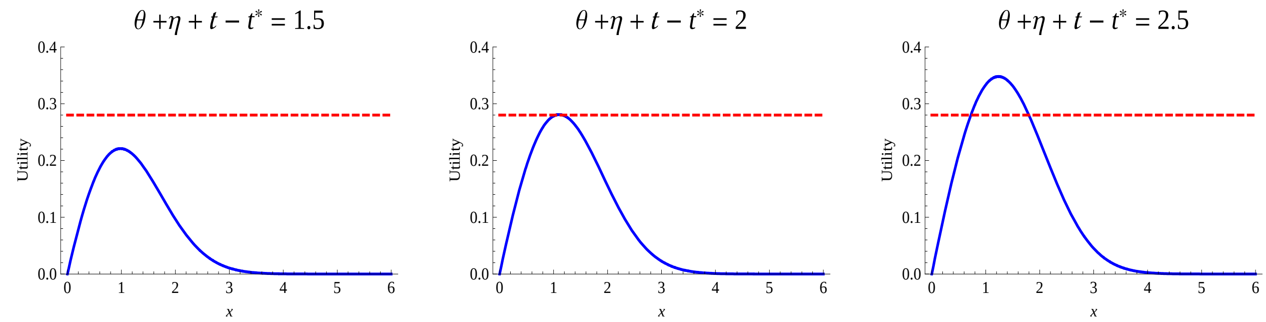

Figure 1: The solid curve represents $G(x, v - t^*)$—the payoff to a player of type x, should x be adopted as the cutoff, given a $v - t^*$. The dashed line represents the costs of participation. Intersections, where $G(x, v - t^*) = k$, are finite cutoff rules that are consistent with equilibrium. The first panel is the case with no finite (i.e., positive participation) cutoff equilibria. The second panel shows the knife edge case where there is a single finite cutoff rule consistent with equilibrium. The third panel shows the case where there are two finite cutoff rules consistent with equilibrium. For all three panels, parameter values are $m = 2, T = 0.3, \sigma_\epsilon^2 = \sigma_\theta^2 = \sigma_\eta^2 = 1$.

sentiment), therefore they believe the probability of a successful revolution is high, therefore they are willing to use the low threshold. In the other, players use a high threshold (i.e., they only participate if they are quite anti-government), therefore they believe the probability of a successful revolution is low, therefore they want to use the high threshold.

I label these two cutoff rules $\hat{\theta}_L(v - t^*)$ and $\hat{\theta}_H(v - t^*)$ for the lower and higher cutoff values, respectively.

Definition 1 *If $G(x^*(v - t^*), v - t^*) \geq k$ then*

- $\hat{\theta}_L(v - t^*) = \inf \{x \in \mathbb{R}^+ : G(x, v - t^*) = k\}$
- $\hat{\theta}_H(v - t^*) = \sup \{x \in \mathbb{R}^+ : G(x, v - t^*) = k\}$

The following fact will be useful.

Lemma 5 *$G(x^*(v - t^*), v - t^*)$ is increasing in $v - t^*$.*

Let G_1 denote the first derivative of the function G with respect to its first argument. Then the single-peakedness of G implies the following:

Lemma 6 *$G_1(\hat{\theta}_L(v - t^*), v - t^*) > 0$ and $G_1(\hat{\theta}_H(v - t^*), v - t^*) < 0$.*

Jointly these Lemmata characterize equilibrium play in the revolution stage.

Proposition 1 *There are three strategies for the population members in the revolution stage that are consistent with a cutoff equilibrium of the full game:*

$$s^{\infty}(\theta_i, v - t^*) = 0 \text{ for all } \theta_i \text{ and } v - t^*$$

$$s^H(\theta_i, v - t^*) = \begin{cases} 1 & \text{if } G(x^*(v - t^*), v - t^*) \geq k \text{ and } \theta_i \geq \hat{\theta}_H(v - t^*) \\ 0 & \text{else.} \end{cases}$$

$$s^L(\theta_i, v - t^*) = \begin{cases} 1 & \text{if } G(x^*(v - t^*), v - t^*) \geq k \text{ and } \theta_i \geq \hat{\theta}_L(v - t^*) \\ 0 & \text{else.} \end{cases}$$

2.3 The Vanguard Stage

By engaging in violence, the revolutionary vanguard attempts to change the beliefs of population members about the level of anti-government sentiment in society, in order to foment revolution. As such, the vanguard is only willing to invest in costly violence insofar as doing so increases mobilization. Clearly, if the population is playing the strategy s^{∞}, such that there will be no participation in the revolution stage no matter what, then this is not possible, so the vanguard will not engage in violence.

Lemma 7 *If the population members use the strategy s^{∞}, then the revolutionary vanguard exerts minimal effort in the vanguard stage ($t = \underline{t}$).*

Suppose instead that the population members use a strategy with positive probability of positive participation (i.e., s^H or s^L). Vanguard violence now has two effects on the level of mobilization. First, in order for there to be positive participation, it must be that $G(x^*(v - t^*), v - t^*) \geq k$. The greater the level of violence the more likely this inequality is to hold. Hence, whether the population plays s^H or s^L, increased violence makes positive participation more likely. This fact is formalized in the following lemma.

Lemma 8 *If the population plays s^H or s^L, then there exists a finite $\mathring{\theta}(\eta + t - t^*)$ such that there is positive participation in the revolution stage if and only if $\theta \geq \mathring{\theta}(\eta + t - t^*)$. Moreover $\mathring{\theta}(\eta + t - t^*)$ satisfies*

$$G(x^*(\mathring{\theta} + \eta + t - t^*), \mathring{\theta} + \eta + t - t^*) = k \tag{4}$$

and is decreasing in t and η.

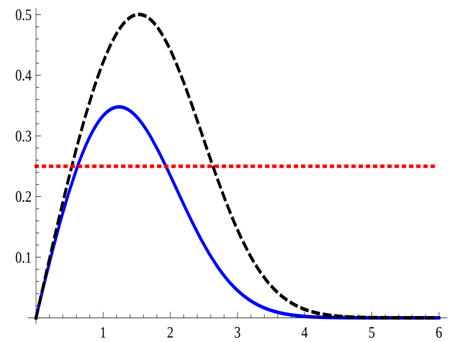

Figure 2: The solid and dashed curves represent $G(x, v-t^*)$ for lower and higher realizations of $v - t^*$, respectively. The line represents the cost of participation. An equilibrium finite cutoff rule, for a given $v - t^*$, is a point where the line and the relevant curve intersect. The lower cutoff rule, $\hat{\theta}_L$, is decreasing in $v-t^*$. The higher cutoff rule, $\hat{\theta}_H$, is increasing in $v-t^*$.

Second, given that there is enough vanguard violence to yield positive participation, the level of violence changes the cutoff rule itself and, thus, the level of participation. The direction of this effect depends on the strategy used in the revolution stage.

Consider the case where the population uses the strategy s^H and suppose vanguard violence is high enough to yield positive participation. Now, the higher the level of violence, the higher the level of anti-government sentiment the population believes there is. As a result, increased violence makes population members believe revolution is more likely to succeed, for a given cutoff rule. The result is that some population members who were not participating want to participate. This increase in participation means that even lower types are willing to participate, and the equilibrium unravels. To sustain the higher cutoff rule as an equilibrium, when beliefs about the level of anti-government sentiment increases, the cutoff rule has to be *increased*, so that fewer population members will participate. Surprisingly, that means that, from the vanguard's perspective, beyond the level of violence needed to insure any positive participation, violence is counterproductive.

Next suppose the population plays the strategy s^L. Here increased violence increases the probability of their being positive participation and, conditional on this occurring, also increases the level of mobilization. Thus, in this equilibrium, both effects of violence benefit the vanguard.

These facts are illustrated in Figure 2 and formalized in the following lemma.

Lemma 9 *Fix $\theta > \mathring{\theta}(\eta + t - t^*)$. The cutoff rule $\hat{\theta}_L(v - t^*)$ is monotonically decreasing in $v - t^*$ and the cutoff rule $\hat{\theta}_H(v - t^*)$ is monotonically increasing in $v - t^*$.*

Given a cutoff rule, $\hat{\theta}$, and realizations of the random variables such that it exists, the level of mobilization is $1 - \Phi\left(\frac{\hat{\theta}(v-t^*)-\theta}{\sigma_\epsilon}\right)$. The vanguard's objective is found by integrating over θ and η, which are unknown at the time the vanguard chooses the level of violence:

$$\max_t \int_{-\infty}^{\infty}\int_{\mathring{\theta}(\tilde{\eta}+t-t^*)}^{\infty}\left(1-\Phi\left(\frac{\hat{\theta}(\tilde{\theta}+\tilde{\eta}+t-t^*)-\tilde{\theta}}{\sigma_\epsilon}\right)\right)\frac{1}{\sigma_\theta}\phi\left(\frac{\tilde{\theta}-m}{\sigma_\theta}\right)\frac{1}{\sigma_\eta}\phi\left(\frac{\tilde{\eta}}{\sigma_\eta}\right)d\tilde{\theta}\,d\tilde{\eta}-c(t). \tag{5}$$

This implies the following.

Lemma 10 *If the population uses a strategy*

$$s(\theta_i, v-t^*) = \begin{cases} 1 & \text{if } \max_x G(x, v-t^*) \geq k \text{ and } \theta_i \geq \hat{\theta}(v-t^*) \\ 0 & \text{else,} \end{cases}$$

with $\hat{\theta} \in \{\hat{\theta}_L, \hat{\theta}_H\}$, and the vanguard has a pure strategy best response, $t^*(s)$, it is unique and characterized by:

$$\begin{aligned} &-\int_{-\infty}^{\infty}\left(1-\Phi\left(\frac{\hat{\theta}(\mathring{\theta}(\tilde{\eta})+\tilde{\eta})-\tilde{\theta}}{\sigma_\epsilon}\right)\right)\frac{1}{\sigma_\theta}\phi\left(\frac{\mathring{\theta}(\tilde{\eta})-m}{\sigma_\theta}\right)\frac{\partial\mathring{\theta}(\tilde{\eta})}{\partial t}\frac{1}{\sigma_\eta}\phi\left(\frac{\tilde{\eta}}{\sigma_\eta}\right)d\tilde{\eta} \\ &\quad -\int_{-\infty}^{\infty}\int_{\mathring{\theta}(\tilde{\eta})}^{\infty}\phi\left(\frac{\hat{\theta}(\tilde{\theta}+\tilde{\eta})-\tilde{\theta}}{\sigma_\epsilon}\right)\frac{\partial\hat{\theta}(\tilde{\theta}+\tilde{\eta})}{\partial t}\frac{1}{\sigma_\theta}\phi\left(\frac{\tilde{\theta}-m}{\sigma_\theta}\right)\frac{1}{\sigma_\eta}\phi\left(\frac{\tilde{\eta}}{\sigma_\eta}\right)d\tilde{\theta}\,d\tilde{\eta}=c'(t^*). \end{aligned} \tag{6}$$

The lemma states that, if there is a pure strategy cutoff equilibrium, the vanguard's most preferred level of effort is unique and given by the first-order condition in Equation 6. However, to insure that the vanguard does have a pure strategy best response requires imposing some additional structure on the objective function. In particular, the function giving the cost of effort, c, must be sufficiently convex. This insures that any convexity that enters into the vanguard's objective through the normal distribution is more than compensated for by the concavity in $-c$.. Although more convexity is needed than is provided by the standard Inada conditions, the next lemma shows that there is an open set of cost functions such that a pure strategy best response exists.

Lemma 11 *There exists an open set of cost functions, $\mathcal{C}$, such that the vanguard has a pure strategy best response to s^L or s^H.*

For the duration of the analysis I assume that the cost function is sufficiently convex such that a pure strategy best response exists for the vanguard.

Assumption 2 *The cost function c is in the set $\mathcal{C}$.*

Equation 6 shows that increasing the level of violence, relative to expectations, has three effects on the revolutionary vanguard's welfare. Increased violence increases the population's beliefs about the level of anti-government violence. This has two effects. First, as shown in Lemma 8 there is a greater probability of a finite cutoff rule consistent with equilibrium existing (and, thus, positive participation), which is a marginal benefit from the vanguard's perspective. This effect can be seen in the first term of the left-hand side of Equation 6. Second, as shown in Lemma 9, given that a finite cutoff rule consistent with equilibrium exists, the cutoff rule itself shifts in response to violence. This shift results in increased participation if the population is using the lower cutoff rule ($\hat{\theta}_L$) and decreased participation if the population is using the higher cutoff rule ($\hat{\theta}_H$). This effect is a marginal benefit under s^L and a marginal cost under s^H. It can be seen in the second term of the left-hand side of Equation 6. Finally, there are costs to resources expended on violence, which can be seen on the right-hand side of Equation 6.

The fact that the second effect of increased violence can be positive or negative, depending on which strategy the population uses at the revolution stage, implies that the level of violence pursued by the vanguard depends on the population's strategy. It will be convenient to have notation for these two cases.

Definition 2 *Let $t^*(s^L)$ be the t^* satisfying Equation 6 when $\hat{\theta} = \hat{\theta}_L$. Similarly, let $t^*(s^H)$ be the t^* satisfying Equation 6 when $\hat{\theta} = \hat{\theta}_H$.*

Now it is possible to characterize all of the cutoff equilibria of the game.

Proposition 2 *Fix parameters and let Assumptions 1 and 2 be satisfied. The game has three cutoff equilibria.*

1. *The population plays s^∞ and the vanguard chooses minimal effort, $\underline{t}$.*
2. *The population plays s^H and the vanguard chooses a level of effort, $t^*(s^H)$.*
3. *The population plays s^L and the vanguard chooses a level of effort, $t^*(s^L)$.*

3 Implications for Violence and Regime Change

3.1 Outcomes of the Revolutionary Process

The model yields a variety of possible equilibrium outcomes. A successful revolution may occur, a mass uprising may occur but fail to topple the regime, or no revolution may be attempted. The probability of each of these events depends on which of the equilibria in

Proposition 2 is played. In the equilibrium in which the population will never mobilize (i.e., plays s^∞), there is never an attempt at revolution. If, however, the population uses one of its two strategies involving a finite cutoff rule (i.e., s^L or s^H), a successful revolution will occur if two conditions are met.

First, a finite cutoff rule consistent with equilibrium must exist. As shown in Lemma 8 (and using the fact that in equilibrium $t = t^*$), such a rule only exists if $\theta \geq \mathring{\theta}(\eta)$.

Second, as shown in Equation 2, regime change succeeds if and only if

$$1 - \Phi\left(\frac{\hat{\theta}(\theta+\eta) - \theta}{\sigma_\epsilon}\right) \geq T$$

which can be rewritten

$$\theta \geq \hat{\theta}(\theta+\eta) - \Phi^{-1}(1-T)\sigma_\epsilon.$$

In the case where $\hat{\theta} = \hat{\theta}_L$, it is clear that the left-hand side of this inequality is increasing in θ and, from Lemma 9, that the right-hand side is decreasing in θ. These facts suggest a cutpoint analogous to that identified for a fixed cutoff rule in Equation 2, whereby there is victory only if θ is greater than $\theta_L^*(\eta)$ implicitly defined by

$$\theta_L^* = \hat{\theta}_L(\theta_L^* + \eta) - \Phi^{-1}(1-T)\sigma_\epsilon. \tag{7}$$

However, there may not be a θ_L^* that satisfies this equality. To see why, consider some $\theta > \hat{\theta}_L(\theta+\eta) - \Phi^{-1}(1-T)\sigma_\epsilon$. Now begin lowering θ, which lowers the left-hand side and raises the right-hand side of this inequality. Recall that $\hat{\theta}_L(\theta+\eta)$ only exists if $\theta \geq \mathring{\theta}(\eta)$. It is possible that prior to lowering θ enough to satisfy the equality in Equation 7, there will cease to be a finite cutoff rule consistent with equilibrium. If this occurs, then $\mathring{\theta}(\eta)$ is the lowest θ where victory could possibly be achieved (since it is the lowest θ for which there is positive participation). And, at $\mathring{\theta}(\eta + t - t^*)$ victory will be achieved, since θ had not been lowered enough to achieve equality, which means $\mathring{\theta}(\eta) > \hat{\theta}_L(\mathring{\theta}(\eta) + \eta) - \Phi^{-1}(1-T)\sigma_\epsilon$.

The argument above suggests the following result:

Lemma 12 *In the equilibrium where the population uses the strategy s^L, for any realization of η there is a unique, finite $\overline{\theta}_L(\eta)$ such that there will be victory if and only if $\theta \geq \overline{\theta}_L(\eta)$. It is given by*

$$\overline{\theta}_L(\eta) = \begin{cases} \theta_L^*(\eta) & \text{if } \theta \geq \mathring{\theta}(\eta) \\ \mathring{\theta}(\eta) & \text{else,} \end{cases}$$

where $\theta_L^*(\eta)$ and $\mathring{\theta}(\eta)$ are defined by Equation 7 and Lemma 8, respectively.

Moreover, we have the following two facts:

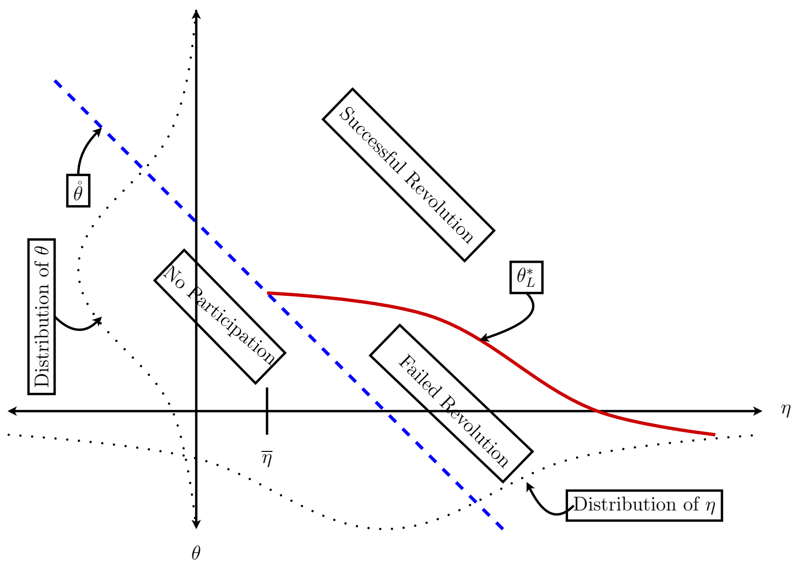

Figure 3: In the equilibrium in which the population plays s^L, there is successful regime change when the realization of (η, θ) lies to the northeast of the curve defined by $\mathring{\theta}$ (the dashed line) and θ^* (the solid curve). Increasing t shifts this curve to the southwest, thereby increasing the probability of successful regime change. The probability is calculated by taking the two-dimension integral of this curve with respect to the distribution of η and θ.

1. *There exists a* $\overline{\eta}$ *such that* $\overline{\theta}(\eta) = \mathring{\theta}(\eta)$ *if and only if* $\eta \leq \overline{\eta}$.

2. $\overline{\theta}(\eta)$ *is decreasing in* η.

Figure 3 illustrates the possible equilibrium outcomes when the population plays s^L. Successful revolution occurs if the realization of (η, θ) is to the northeast of the curve defined by $\mathring{\theta}$ (the dashed line) and θ^*_L (the solid curve). A failed revolution occurs if (η, θ) lies between $\mathring{\theta}$ and θ^*_L. And no revolution is attempted if (η, θ) lies to the soutwest of $\mathring{\theta}$. The probability of successful revolution is calculated by taking the two-dimension integral above the curve defined by $\mathring{\theta}$ and θ^*_L with respect to the distributions of η and θ. Importantly, increasing effort (t) relative to expectation (t^*) shifts the curve to the southwest, increasing mobilization and the probability of successful revolution. This is what gives the vanguard incentives to invest in violence—off the equilibrium path it manipulates the population into higher levels of participation.

Matters are somewhat more complicated when the population plays s^H. This is because it is no longer clear if total mobilization is increasing or decreasing in θ. On the one hand, a higher value of θ increases the probability of a finite cutoff rule consistent with equilibrium existing and increases the measure of people with a level of anti-government sentiment greater than any given cutoff rule. On the other hand, a higher value of θ increases the realized level of vanguard violence, which shifts the cutoff rule up, tending to decrease mobilization. Thus, unlike in the case of s^L, there may not be a cutpoint θ_H^* such that successful revolution occurs if $\theta \geq \theta_H^*$. However, even without being able to precisely characterize the probability of a successful regime change when the population plays s^H, it is possible to compare the probabilities of the various outcomes under each equilibrium.

Proposition 3 *The probability of successful revolution is higher and the probability of attempted but failed revolution is lower under the equilibrium in which the population uses the strategy s^L than under the equilibrium in which the population uses the cutoff rule s^H.*

3.2 Comparative Statics

The model yields several comparative statics for the equilibrium where the population plays the strategy s^L. In particular, the level of mobilization, and consequently the probability of successful regime change, is decreasing in the government's capacity to withstand an uprising (T) and to impose costs on those who organize against it (k). It is increasing in the extent to which the revolutionary organization excludes those who do not participate from the benefits associated with regime change (γ).

When the probability of or payoff to success increases (i.e., T decreases or γ increases) or the cost of participation decreases (i.e., k decreases) it becomes more attractive to participate. If the threshold for participation remained fixed, then there would be people not participating who could make positive payoffs from participating. At the lower threshold, equilibrium is sustained by making revolution relatively likely to succeed, thereby attracting relatively low types to participate. When revolution becomes more attractive, this equilibrium can accommodate even lower types, so the cutoff rule decreases.

I present these largely intuitive comparative statics primarily because they highlight the fact that structural characteristics of the society can affect the level of mobilization in equilibrium. This point will be important for later discussions.

Proposition 4 *In the equilibrium in which the population uses the strategy s^L, the number of people who mobilize, and consequently the probability of successful regime change, is decreasing in T, decreasing in k, and increasing in γ.*

The comparative statics are less clear cut when the population uses the strategy s^H. In that case, decreasing k or increasing γ has offsetting effects. On the one hand, either of those changes increases the probability of there being positive participation at all (i.e., of a finite cutoff rule consistent with equilibrium existing). On the other hand, conditional on a finite cutoff rule consistent with equilibrium existing, those changes decrease mobilization (since $\hat{\theta}_H$ increases). Decreasing T is even more complicated in this case. Doing so has both of the effects described above but also decreases the total level of mobilization needed for successful regime change.

3.3 Structure versus Culture: The Problem of Root Causes

So called spark-and-tinder models argue that structural factors—regime capacity, international pressure, grievances, the economy, and so on—can make a society ripe for revolution. These structural factors constitute the tinder. Any spark, the argument goes, can set off the revolutionary fire. Advocates of such models point to the seemingly spontaneous nature of the revolutions in countries such as France and Russia as supporting evidence. (For a classic statement of this view, see Skocpol (1979).)

Yet, as DeNardo (1985), Geddes (1990), and others have pointed out, violent regime changes are rare events. The structural conditions often identified as the root causes of revolution occur far more often than do revolutions themselves. Indeed, this point has been made more generally about the emergence of terrorism and guerilla warfare (i.e., the vanguard). In general, those factors we think of as potential root causes of political violence and instability are far more common than the violence itself. (Krueger (2007), among others, makes this argument.)

The model, while not itself a structural account of regime change, casts some doubt on this empirical critique of structuralist explanations. The discussion in the preceding subsection highlighted several parameters of the model that can be interpreted as representing structural features of a society. As shown in Proposition 2, for many values of these parameters the model has multiple equilibria—some where revolution is more likely and some where it is less likely or impossible. The comparative statics in the previous subsection demonstrate that, given an equilibrium selection, structural factors influence mobilization and the likelihood of a successful revolution. Hence, these structural factors can be viewed as causes of revolution. Nonetheless, if two structurally identical societies play different equilibria, they have very different likelihoods of a successful revolution occurring, as shown in Proposition 3.

This argument suggests a quite general problem both for the empirical literature on the root causes of political violence and for policymaking. In a world characterized by multiple equilibria, much of the variation in the data may be due to whatever cultural or historic factors determine equilibrium selection, rather than those structural factors that we often think are of first-order importance for explaining political violence and instability. Thus, structural factors may matter (for a given equilibrium selection) but be difficult to detect empirically because we cannot observe which equilibrium a society is playing. Moreover, from the perspective of policymaking, this implies that, even though the data are not well explained by structural variation, it may be that, within a given society (playing its particular equilibrium), changing key structural factors would reduce political violence or the likelihood of violent regime change.

3.4 Vanguards and Selection Effects

Critics of purely structuralist explanations of regime change, such as DeNardo (1985), argue that a key problem with such accounts is their failure to consider the importance of revolutionary leaders who attempt to mobilize the masses. The emergence of such vanguards, it is argued, is the critical factor that differentiates "structurally ripe" societies that do or do not experience mass political violence.

The model, however, suggests that the fact that the level of vanguard activity is a predictor of a society having a high risk of revolution should not necessarily be interpreted as evidence that vanguards help cause revolutions. In particular, the model predicts that in equilibrium there will be selection effects—even controlling for all relevant structural factors, vanguards will be more active in societies that would have been more likely to have successful regime change even without a vanguard.

To see why, suppose there are three societies, A, B, and C that are structurally identical in all relevant respects (i.e., all parameter values and realizations of the random variables are the same). However, the population of A uses the strategy s^L, the population of B uses the strategy s^H, and the population of C uses the strategy s^∞. As shown in Lemma 9 and Proposition 2, an active revolutionary vanguard will emerge in societies A and B, but not in C. Moreover, as the next result demonstrates, the vanguard will engage in more violence in society A than in society B. The reason is that, as discussed earlier, the marginal benefit of violence is larger when society plays s^L rather than s^H.

Proposition 5 *The level of effort devoted to violence, and thus the expected level of violence, is higher in the equilibrium in which the population plays s^L at the revolution stage than in the equilibrium in which the population plays s^H at the revolution stage. That is, $t^*(s^L) > t^*(s^H)$.*

The arguments above show that, holding fixed structural factors, the vanguard is more active in societies that are more likely to have a successful revolution even without a vanguard. This is not true simply because the vanguard opportunistically seeks to claim credit for revolutions. Rather, for endogenous reasons, the marginal benefit of violence turns out to be largest when the population uses the equilibrium strategy that maximizes the likelihood of regime change and smallest when the population uses the equilibrium strategy that minimizes the likelihood of regime change. Moreover, this empirical relationship will be true even if the vanguard has no effect on mean beliefs (i.e., $\eta = 0$), simply because $\hat{\theta}_L < \hat{\theta}_H < \infty$. Hence, the fact that the presence of a particularly active revolutionary vanguard appears to empirically distinguish societies that do and do not experience violent regime change (all else equal) may not constitute evidence for the causal importance of vanguards.

3.5 The Efficacy of the Revolutionary Vanguard

The previous subsection points out that any correlation between the level of revolutionary vanguard activity and the probability of a successful revolution could be a pure selection effect. This naturally raises the question: Is the vanguard able to increase mobilization and make a successful revolution more likely?

When the population uses the strategy s^L, at least from an *ex post* perspective, the answer is unequivocally yes. A higher level of vanguard violence increases mobilization and the likelihood of successful revolution in two ways: it increases the probability of a finite cutoff rule consistent with equilibrium existing (see Lemma 8) and, conditional on one existing, it increases mobilization by decreasing the cutoff rule (see Lemma 6). These two effects are illustrated in the dotted line and curve in Figure 4. This figure shows what happens to the level of mobilization for a fixed θ, as η increases (thereby increasing the level of violence v). For low levels of violence, there is no finite cutoff rule consistent with equilibrium and mobilization is zero. When the level of violence becomes high enough, a finite cutoff rule consistent with equilibrium exists (leading to a discontinuous jump up in participation) and the level of mobilization then continues to increase as vanguard violence increases and $\hat{\theta}_L$ shifts down. Thus, the model is consistent with cases where successful vanguards seem to ignite mass uprisings against a government. Indeed, the model predicts that higher-than-expected levels of a violence by a vanguard will increase mobilization and the probability of regime change in those societies that are most prone to mobilizing for regime change (i.e., those where the population plays s^L).

When the population uses the strategy s^H, the answer, from an *ex post* perspective, is more equivocal. On the one hand, higher levels of vanguard violence again increase the probability of a finite cutoff rule consistent with equilibrium existing. On the other hand, conditional on a finite cutoff rule consistent with equilibrium existing, mobilization is decreasing in the level of vanguard violence since $\hat{\theta}_H$ is increasing in v (again, see Lemma 6). These facts are illustrated in the solid line and curve in Figure 4. Again, for low levels of violence there is no participation and, when violence becomes high enough to make a finite cutoff rule consistent with equilibrium exist, there is a discontinuous jump up in mobilization.

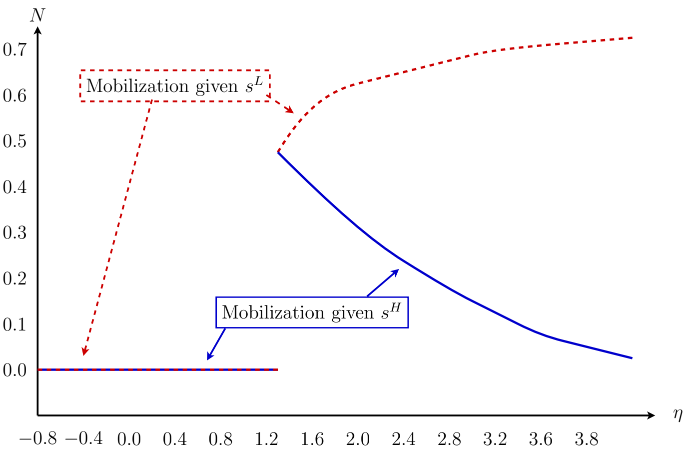

Figure 4: The equilibrium level of mobilization as a function of the level of violence (i.e., of changes in η for a fixed θ). The solid line and curve represent the case in which the population uses the strategy s^L. The dashed line and curve represent the case where the population uses the strategy s^H. The simulations assume $m = 1, \theta = 1, T = 0.3, \gamma = 0.5, \sigma_\epsilon^2 = \sigma_\eta^2 = \sigma_\theta^2 = 1$.

However, beyond that point, mobilization is decreasing in the level of vanguard violence.

This discussion above focuses on the *ex post* effects of higher levels of violence. To assess the expected efficacy of vanguards, taking an *ex ante* view is perhaps more appropriate. And from this perspective the vanguard is not efficacious, in the following sense. In equilibrium, the population correctly anticipates the level of effort the vanguard exerts. As a result, the population is able to filter out vanguard effort from the level of violence and extract an unbiased signal of the level of anti-government sentiment from the level of violence. That is, on the equilibrium path, $v - t^*$ is equal to $\theta + \eta$, which is a normally distributed random variable with mean equal to the true level of anti-government sentiment θ. As such, while the vanguard attempts to manipulate the population's beliefs, in expectation it does not actually succeed at doing so. The vanguard nonetheless exerts effort because, if it did not do so the population would likely observe lower-than-expected levels of violence and conclude that the level of anti-government sentiment is lower than it is in reality. However, if the vanguard could commit to low effort, the population would then update based on that commitment. As a result, the *ex ante* probability of a successful revolution would be unchanged.

While, within the current model, the vanguard would like to commit to devoting minimal effort toward violence, it would be an over-interpretation to conclude that vanguards should never emerge. As will be discussed below, the informational mechanism studied here constitutes only one role for vanguards in organizing violence. The vanguard may be more efficacious, even from an *ex ante* perspective, at other tasks, such as providing selective incentives, provoking the government, or drawing international attention. Nor should one conclude that the informational mechanism is necessarily unimportant to the vanguard simply because it is not efficacious in expectation. Once one of these other mechanisms motivates a vanguard to form, the population will make inferences about the level of support for anti-government activity from the level of violence. Thus, while the informational mechanism may not be sufficient to motivate a vanguard to emerge, it will provide the sort of incentives for effort directed at violence discussed in this model, once the vanguard decides to engage in violence at all.

3.6 Vanguards and the Level of Revolutionary Extremism

The model generates two cutoff equilibria with positive probability of successful regime change. In the first, the revolutionary vanguard is quite active and the population uses the lower cutoff strategy (s^L). In the second, the revolutionary vanguard is less active and the population uses the higher cutoff strategy (s^H).

In the first equilibrium, more people mobilize in expectation, because they are using the lower cutoff rule. As a result, successful revolution is more likely. Further, the average level of anti-government sentiment among those who participate in revolution is lower in the first equilibrium, since the lower cutoff rule induces people with lower signals to participate.

This argument suggests some empirical implications regarding different types of outcomes in revolutions that occur with more or less active revolutionary vanguards (though, importantly, vanguard activity does not cause these relationships).These implications are summarized in the following result.

Proposition 6 *Holding fixed parameter values, revolutions that begin with a more active vanguard (i.e., $t^*(s^L)$) have:*

1. *higher expected levels of mobilization,*
2. *higher probabilities of success, and*
3. *lower average levels of anti-government sentiment among the participants,*

as compared to revolutions where the vanguard engages in a lower level of effort (i.e., $t^*(s^H)$).

3.7 Other Mechanisms for Organizing Revolution

I have highlighted one previously unexplored micro-foundation for a credible revolutionary threat. In particular, how a revolutionary vanguard might use violence to coordinate and mobilize a population against a government by communicating information about the level of anti-government sentiment in society. This mechanism is by no means the only one considered in the literature.

There is, of course, an enormous literature on mass violence and revolution. (See Goldstone (2001) for a recent survey.) Reviewing that literature is beyond the scope of this paper. Rather, I focus here on the applied theory literature most closely related to my work.

Recent formal models have explored other pathways through which violence by a revolutionary vanguard can foment revolution. Ginkel and Smith (1999) argue that a revolutionary vanguard that has private information regarding the strength of the government can, under certain conditions, engage in costly violence that will signal to the population that the government is likely to be weak and, therefore, susceptible to revolution. Baliga and Sjostrom (2009) study how violence by terrorists (modeled as cheap-talk communication) with private information about the preferences of one party in a dispute can cause a cycle of violence by goading that party into increased aggressiveness. Bueno de Mesquita and Dickson (2007) and Siqueira and Sandler (2007) consider how violence by an extremist group can be used to provoke a government to engage in repression and thereby spark a more widespread violent backlash. And, of course, a variety of scholars have discussed the role of revolutionary entrepreneurs in solving the collective action problem by establishing organizations that provide selective incentives (Tullock 1971, 1974; Popkin 1979; Lichbach 1995) or create incentives for high levels of commitment (Berman 2003; Berman and Laitin Forthcoming).

Other papers discuss information and information manipulation by players other than vanguards in revolutionary settings. Building on a global games model of regime change, Edmond (2007, 2008) explores how governments may attempt to manipulate information about government capacity to convince citizens not to participate in revolution. Lohmann (1994) studies how sudden revolution can occur as a result of information cascades. Fearon (2006) models a situation in which citizens attempting to create a credible revolutionary threat face a coordination problem (due to the need to impose punishments in a repeated game) and uncertainty about each other's preferences. He argues that regularly timed elections can coordinate the revolutionary threat (if elections are not held or their results are ignored, rebel) and simultaneously provide an aggregate signal of the level of public dissatisfaction with the government. Elections in that model and the revolutionary vanguard in this model, thus, play related roles.

4 Conclusion

I study how a vanguard may use violence to coordinate and mobilize members of a mass public by convincing them that anti-government sentiment is high. The model is consistent with the idea that violence by vanguards can sometimes spark successful revolution. Higher than expected realizations of violence lead to increased mobilization in those societies most prone to violent regime change. However, the model also suggests that the micro-foundations of revolution in general, and the role of vanguards in particular, are complicated and subtle.

The model has multiple equilibria, some where successful regime change is relatively likely and some where it is relatively unlikely or even impossible. Within an equilibrium, structural factors affect the likelihood of revolution. Nonetheless, if two identical societies play different equilibria, they have very different likelihoods of experiencing revolution. This finding implies that it may be difficult to empirically identify root causes of political violence or instability. Moreover, it suggests that the standard empirical critique of structural accounts—that many more societies possess the putative structural causes of revolution than actually experience revolution—may have weaker logical foundations than the current literature acknowledges.

The characterization of the multiple equilibria also establishes the presence of selection effects. Revolutionary vanguards engage in a high level of violence in societies that are already particularly prone to regime change, a lower level of violence in societies less prone to regime change, and minimal violence in societies where regime change is impossible. Thus, even though vanguard violence is *ex ante* ineffective, a society with a more active vanguard will be more likely to have a successful revolution (all else equal) than a society with a less active vanguard. These selection effects further complicate attempts to empirically establish the root causes of revolution and political violence.

Appendix: Proofs of Numbered Results

Proof of Lemma 1. Suppose players play a strategy profile with $a_i = 0$ for all θ_i. The probability of victory is 0. If an individual were to consider deviating to participation, the probability of victory would still be zero, since all individuals are measure 0. Thus, the payoff to the deviation is $-k$, while the payoff to not participating is $0 > -k$. ■

Proof of Lemma 2. The argument in the text demonstrates that, given a $v-t^*$, a necessary condition for a cutoff rule $\hat{\theta}(v-t^*)$ being part of an equilibrium is $G(\hat{\theta}(v-t^*), v-t^*) = k$. Thus, if $\max_x G(x, v-t^*) < k$ the strategy must assign the choice $a_i = 0$. Further the second equilibrium selection criterion requires that if the strategy uses a finite cutoff rule for any $v-t^*$ satisfying $\max_x G(x, v-t^*) \geq k$, then it must use a finite cutoff rule for all such $v-t^*$. Hence, if s has positive probability of positive participation, it must choose a finite cutoff rule whenever feasible.

The argument above shows that the only candidates for equilibrium finite cutoff rules are those satisfying $G(\hat{\theta}(v-t^*), v-t^*) = k$. The definition of equilibrium further requires that the cutoff rule be continuous in $v-t^*$ except at the $v-t^*$ satisfying $\max_x G(x, v-t^*) = k$. All that remains, then, is to show sufficiency of $G(\hat{\theta}(v-t^*), v-t^*) = k$.

For sufficiency, consider a profile in the revolution stage where all players employ such a cutoff rule. Fix a $v-t^*$ such that a finite cutoff rule consistent with equilibrium exists and consider a player with type $\theta_i < \hat{\theta}(v-t^*)$. Such a player will participate if $[1-\Phi(f(\hat{\theta}(v-t^*)), v-t^*)]\gamma\theta_i - k \geq 0$. Now, notice that

$$\begin{aligned}
[1-\Phi(f(\hat{\theta}(v-t^*), v-t^*))]\gamma\theta_i - k &< [1-\Phi(f(\hat{\theta}(v-t^*), v-t^*))]\gamma\hat{\theta}(v-t^*) - k \\
&= G(\hat{\theta}(v-t^*), v-t^*) - k \\
&= 0.
\end{aligned}$$

Thus, there is no profitable deviation to participating. Now consider a person with type $\theta_i > \hat{\theta}(v-t^*)$. Such a person will participate if $[1-\Phi(f(\hat{\theta}(v-t^*), v-t^*))]\gamma\theta_i - k \geq 0$. Now, notice that

$$\begin{aligned}
[1-\Phi(f(\hat{\theta}(v-t^*), v-t^*)]\gamma\theta_i - k &> [1-\Phi(f(\hat{\theta}(v-t^*), v-t^*))]\gamma\hat{\theta}(v-t^*) - k \\
&= G(\hat{\theta}(v-t^*), v-t^*) - k \\
&= 0.
\end{aligned}$$

Thus, there is no profitable deviation to not participating.

By construction, a person of type $\theta_i = \hat{\theta}(v-t^*)$ is indifferent. ■

Proof of Lemma 3. Since $k > 0$, at any $\hat{\theta}$ that satisfies Equation 3, $G(\hat{\theta}, v-t^*)$ must be positive. Since $1-\Phi(f(x, v-t^*)) > 0$ for all x, this means that for $G(\hat{\theta}, v-t^*) = (1-f(\hat{\theta}, v-t^*))\hat{\theta}$ to be positive, $\hat{\theta}$ must be positive. ■

Proof of Lemma 4.

The first point follows directly from differentiating and rearranging.

Next I prove the second point. From the first point, $G(x, v-t^*)$ is increasing in x if and only if $\frac{1-\Phi(f(x,v-t^*))}{x\phi(f(x,v-t^*))}$ is greater than the finite positive constant α. Further, $f(x, v-t^*)$ is clearly increasing in x. Now, notice that since the normal density is log-concave, $\frac{1-\Phi(f(x,v-t^*))}{\phi(f(x,v-t^*))}$ is decreasing monotonically in x, which implies that $\frac{1-\Phi(f(x,v-t^*))}{x\phi(f(x,v-t^*))}$ is decreasing monotonically in x, for $x > 0$. Thus, to prove that $G(x, v-t^*) = (1-\Phi(f(x, v-t^*)))x$ is single peaked in x for $x > 0$, it is sufficient to show that there exists an x sufficiently small that $\frac{1-\Phi(f(x,v-t^*))}{x\phi(f(x,v-t^*))} > \alpha$ and an x sufficiently large that $\frac{1-\Phi(f(x,v-t^*))}{x\phi(f(x,v-t^*))} < \alpha$. If this is true, the fact that $G(x, v-t^*)$ is continuous and its slope is monotonically decreasing will imply single peakedness.

I start by showing that $\lim_{x\to 0} \frac{1-\Phi(f(x,v-t^*))}{x\phi(f(x,v-t^*))} = \infty$. To see this, note that the limit of the numerator as x goes to 0 is some positive finite number and the limit of the denominator is zero. Thus, for $x > 0$ sufficiently small, $G(x, v - t^*)$ is increasing.

Next I show that there is a sufficiently large x that $G(x, v-t^*)$ is decreasing. To see this, first note that $G(1, v - t^*)$ is strictly positive. Next the following chain of inequalities shows that $\lim_{x\to\infty} \frac{1-\Phi(f(x,v-t^*))}{x\phi(f(x,v-t^*))} = 0$:

$$\begin{aligned}
\lim_{x\to\infty} \frac{1-\Phi(f(x,v-t^*))}{x\phi(f(x,v-t^*))} &= \lim_{x\to\infty} \frac{-\phi(f(x,v-t^*))f_1(x,v-t^*)}{\phi(f(x,v-t^*)) + x\phi'(f(x,v-t^*))f_1(x,v-t^*)} \\
&= \lim_{x\to\infty} \frac{-\phi(f(x,v-t^*))f_1(x,v-t^*)}{\phi(f(x,v-t^*)) - xf(x,v-t^*)\phi(f(x,v-t^*))f_1(x,v-t^*)} \\
&= \lim_{x\to\infty} \frac{f_1(x,v-t^*)}{xf(x,v-t^*)f_1(x,v-t^*) - 1} \\
&= 0,
\end{aligned}$$

where $f_1(x, v-t^*) = \alpha$ is the partial derivative of f with respect to its first argument (x). The first equality is due to l'Hopital's rule, the second equality uses the fact that $\phi'(x) = -x\phi(x)$, the third equality is algebra, and the fourth equality follows from the fact that $f(x, v - t^*)$ is increasing in x and $f_1(x, v - t^*) = \alpha$ is constant in x. These equalities show that at least somewhere between $x = 1$ and the limit as x goes to infinity, $G(x, v - t^*)$ is decreasing. And the fact that the derivative of $G(x, v - t^*)$ is monotonically decreasing for positive x implies that whenever $(G(x, v - t^*)$ first slopes down, it slopes down forever after, establishing that there is a single peak for positive x.

Next I prove the third enumerated point. We can write $f(x, v - t^*) = \alpha x - \beta$. Now we can state the following chain of equalities:

$$\begin{aligned}
\lim_{x\to\infty}(1-\Phi(f(x,v-t^*)))x &= \lim_{x\to\infty}\frac{(1-\Phi(f(x,v-t^*)))}{\frac{1}{x}} \\
&= \lim_{x\to\infty}\phi(f(x,v-t^*))f_1(x,v-t^*)x^2 \\
&= \lim_{x\to\infty}\frac{f_1(x,v-t^*)x^2 e^{\frac{-f(x,v-t^*)^2}{2}}}{\sqrt{2\pi}} \\
&= \lim_{x\to\infty}\frac{f_1(x,v-t^*)x^2}{e^{\frac{f(x,v-t^*)^2}{2}}\sqrt{2\pi}} \\
&= \lim_{x\to\infty}\frac{f_1(x,v-t^*)2x}{f(x,v-t^*)f_1(x,v-t^*)e^{\frac{f(x,v-t^*)^2}{2}}\sqrt{2\pi}} \\
&= \lim_{x\to\infty}\frac{\alpha 2x}{(\alpha x-\beta)\alpha e^{\frac{(\alpha x-\beta)^2}{2}}\sqrt{2\pi}} \\
&= \lim_{x\to\infty}\frac{\alpha 2}{\alpha^2 e^{\frac{(\alpha x-\beta)^2}{2}}\sqrt{2\pi}+(\alpha x-\beta)^2\alpha^2 e^{\frac{(\alpha x-\beta)^2}{2}}\sqrt{2\pi}} \\
&= 0,
\end{aligned}$$

where, in order, the equalities follow from (1) simple rearrangement, (2) l'Hospital's rule, (3) the definition of the PDF of the standard normal, (4) the fact that $e^{-x} = 1/e^x$, (5) l'Hospital's rule, (6) the definition $f(x, v-t^*) = \alpha x - \beta$, (7) l'Hospital's rule, and (8) the observation that the numerator is a positive constant in x and the denominator goes to infinity.

The fourth point is immediate. ■

Proof of Lemma 5. I make use of the following Claim.

Claim 1 *For any $x > 0$, $G(x, v-t^*)$ is increasing in $v-t^*$.*

The value of x^* is clearly always positive, since $1-\Phi(f(x, v-t^*))$ is strictly positive.

Now, given the claim, fix an $x^*(v-t^*)$. Consider some new $\overline{v-t^*} > v-t^*$. It is clear from the claim that $G(x^*(v-t^*), \overline{v-t^*}) > G(x^*(v-t^*), v-t^*)$. Thus, by the definition of a maximum, it must be that $G(x^*(\overline{v-t^*}), \overline{v-t^*}) > G(x^*(v-t^*), v-t^*)$.

All the remains is to prove the claim.

Proof of Claim. Differentiating G, we have $\frac{\partial G(x,v-t^*)}{\partial(v-t^*)} = \phi(f(x, v-t^*))\frac{\psi\gamma x}{\sigma_2} > 0$. ■ ■

Proof of Proposition 1. Lemma 1 shows s^∞ is consistent with cutoff equilibrium.

From Lemma 2 we have that a strategy that includes a finite cutoff rule is consistent with cutoff equilibrium if and only if the cutoff rule satisfies Condition 3 and the strategy takes the form

$$s(\theta_i, v-t^*) = \begin{cases} 1 & \text{if } \max_x G(x, v-t^*) \geq k \text{ and } \theta_i \geq \hat{\theta}(v-t^*) \\ 0 & \text{else.} \end{cases}$$

Since s^H and s^L take this form and, by definition, $\hat{\theta}_L$ and $\hat{\theta}_H$ satisfy Condition 3, both s^H and s^L are strategies consistent with cutoff equilibrium. All that remains is to show that there are no other such strategies.

To see that there are no other cutoff rules consistent with cutoff equilibrium, it suffices to show that for any $v-t^*$ such that $G(x^*(v-t^*), v-t^*) \geq k$, if $G(x, v-t^*) = k$, then $x = \hat{\theta}_L(v-t^*)$ or $x = \hat{\theta}_H(v-t^*)$. To see this, recall from Lemma 4 that $G(0, v-t^*) = 0$ and the limit of $G(x, v-t^*)$ as x goes to infinity is also 0. Since G is continuous and single peaked in its first argument, with peak at $G(x^*(v-t^*), v-t^*)$, it follows that, for $x \in (0, \infty)$, $G(x, v-t^*)$ takes all values in $(0, G(x^*(v-t^*), v-t^*))$ exactly twice. Since $G(x^*(v-t^*), v-t^*) > k$, this implies that $G(x, v-t^*)$ takes the value k exactly twice for $x \in (0, \infty)$, at $\hat{\theta}_L(v-t^*)$ and $\hat{\theta}_H(v-t^*)$. ■

Proof of Lemma 6. By Lemma 4, $G(x, v-t^*)$ is single peaked in its first argument. The combination of single peakedness and the fact that $G(\hat{\theta}, v-t^*) = k$ at all equilibria with finite $\hat{\theta}$, implies that $\hat{\theta}_L(v-t^*)$ and $\hat{\theta}_H(v-t^*)$ are on opposite sides of $x^*(v-t^*)$. Since $x^*(v-t^*)$ is the maximum and G is single peaked, G is increasing (resp. decreasing) in its first argument to the left (resp. right) of $x^*(v-t^*)$. ■

Proof of Lemma 7. If the population plays the equilibrium with no participation, then the payoff to any level of violence is simply $-c(t)$ and the optimal choice is $t^* = 0$. ■

Proof of Lemma 8. From Proposition 1, an equilibrium finite cutoff rule exists iff

$$G(x^*(v-t^*), v-t^*) \geq k.$$

From Lemma 5, $G(x^*(v-t^*), v-t^*)$ is monotonically increasing in v.

From the definition of G it is immediate that $\lim_{v \to -\infty} G(x^*(v-t^*), v-t^*) = 0$. Since $v = \theta + \eta + t$, and θ and η have full support on the real line, v has full support on the real line. Thus, for sufficiently small realizations of $\eta + \theta$ a finite cutoff rule consistent with equilibrium does not exist. Moreover, since $G(x^*(v-t^*), v-t^*)$ is monotonically increasing and continuous in v, and since by Assumption 1 there exists some v such that $G(x^*(v-t^*), v-t^*) \geq k$, then there is some v where the inequality holds with equality and for any larger v it continues to hold strictly which establishes that a $\mathring{\theta}(\eta + t - t^*)$ exists.

To see that $\mathring{\theta}(\eta + t - t^*)$ is decreasing in η and t, notice that θ, η, and t are substitutes in v and do not enter G anywhere else. ■

Proof of Lemma 9.

Implicitly differentiating Equation 3, we have that

$$\frac{\partial \hat{\theta}(v-t^*)}{\partial (v-t^*)} = \frac{-\phi(\alpha\hat{\theta} - \beta)\frac{\psi}{\sigma_2}\gamma\hat{\theta}^2}{G_1(\hat{\theta}_L(v-t^*), v-t^*)}.$$

The numerator is clearly negative. By Lemma 6 the denominator is positive if $\hat{\theta} = \hat{\theta}_L$ and negative if $\hat{\theta} = \hat{\theta}_H$. ■

Proof of Lemma 10.

There cannot be a corner solution, since c satisfies the Inada conditions. If there is an interior pure strategy best response, it must satisfy the first-order conditions. The first-order condition in the statement of the Lemma is found by setting the derivative of Equation 5 with respect to t equal to zero and imposing consistency of beliefs with actions (i.e., $t = t^*$).

To see that, if a pure strategy best response exists it must be unique, notice the following. The left-hand side of the first-order condition is a finite constant. Since, c is strictly convex, the right-hand side is strictly increasing. Hence, the equation has at most one solution. And it has at least one since $c'(\cdot)$ satisfies the Inada conditions. Given this, there is only one candidate for a pure strategy best response, the one satisfying the first-order condition in the statement of the Lemma. ■

Proof of Lemma 11. Lemma 10 shows that, given a selection of $\hat{\theta}$, any pure strategy best response must be the t^* that satisfies Equation 6. Now it remains to be shown that there is an open set of cost functions such that t^* is in fact a best response by the vanguard. To do so, it suffices to establish the concavity of the objective at t^*. This will imply that t^* is a local maximum. Then the fact that there are no other critical values of the objective (as established in the proof of Lemma 10) will imply that t^* is a global maximizer.

I make use of the following facts. Implicitly differentiating Equation 4 shows that

$$\frac{\partial \mathring{\theta}}{\partial t} = \frac{G_1\frac{\partial x^*}{\partial t} + G_2}{G_1\frac{\partial x^*}{\partial t} + G_2} = -1.$$

Implicitly differentiating Equation 3 shows that $\frac{\partial\hat{\theta}}{\partial\theta} = \frac{\partial\hat{\theta}}{\partial t}$.

The second order condition, evaluated at t^*, requires the following:

$$-\int_{-\infty}^{\infty}\Bigg[\phi\left(\tfrac{\hat{\theta}(\mathring{\theta}(\tilde{\eta})+\tilde{\eta})-\mathring{\theta}(\tilde{\eta})}{\sigma_\epsilon}\right)\tfrac{1}{\sigma_\epsilon}\phi\left(\tfrac{\tilde{\theta}-m}{\sigma_\theta}\right)\left(1+\tfrac{\partial\hat{\theta}(\tilde{\theta}+\tilde{\eta})}{\partial t}\right)+\left(1-\Phi\left(\tfrac{\hat{\theta}(\mathring{\theta}(\tilde{\eta})+\tilde{\eta})-\mathring{\theta}(\tilde{\eta})}{\sigma_\epsilon}\right)\right)\tfrac{\sigma_\epsilon}{\sigma_\theta}\phi'\left(\tfrac{\mathring{\theta}(\tilde{\eta})-m}{\sigma_\theta}\right)+$$
$$\int_{\mathring{\theta}(\tilde{\eta})}^{\infty}\left(\phi'\left(\tfrac{\hat{\theta}(\tilde{\theta}+\tilde{\eta})-\tilde{\theta}}{\sigma_\epsilon}\right)\left(\tfrac{\partial\hat{\theta}(\tilde{\theta}+\tilde{\eta})}{\partial t}\right)^2\tfrac{1}{\sigma_\epsilon}+\phi\left(\tfrac{\hat{\theta}(\tilde{\theta}+\tilde{\eta})-\tilde{\theta}}{\sigma_\epsilon}\right)\tfrac{\partial^2\hat{\theta}(\tilde{\theta}+\tilde{\eta})}{\partial t^2}\right)\phi\left(\tfrac{\tilde{\theta}-m}{\sigma_\theta}\right)d\tilde{\theta}\Bigg]\phi\left(\tfrac{\tilde{\eta}}{\sigma_\eta}\right)d\tilde{\eta} \leq \sigma_\theta\sigma_\epsilon\sigma_\eta c''(t^*)$$

The left-hand side of this inequality is finite and constant in t^*. Label its value K. Now suppose $c''' \geq 0$. Then, as long as $c''(\underline{t}) \geq \frac{K}{\sigma_\theta\sigma_\eta}$, the inequality is satisfied at $t^* > \underline{t}$. Thus, all that remains to show that there is an open set of cost functions satisfying $c' > 0$, $c'' \geq 0$, $c''' \geq 0$, and $c''(\underline{t}) \geq \frac{K}{\sigma_\theta\sigma_\eta}$ for any finite constant $\frac{K}{\sigma_\theta\sigma_\eta}$.

To see that this is the case, consider the family of cost functions $c(x,\rho) = \rho(x-\underline{t})^2$ for any $x \geq \underline{t}$. Clearly $c'(x) = 2\rho(x-\underline{t}) > 0$, $c''(x) = 2\rho > 0$, and $c'''(x) = 0 \geq 0$. Finally, for any $\rho \geq \frac{K}{2\sigma_\theta\sigma_\eta}$ we have that $c''(\underline{t}) \geq \frac{K}{\sigma_\theta\sigma_\eta}$. ■

Proof of Lemma 12. The proof of the characterization of $\overline{\theta}(\eta)$ follows from the argument in the text. I now proceed to the two enumerated points.

1. $\overline{\theta}(\eta) = \mathring{\theta}(\eta)$ if and only if

$$x^*(\mathring{\theta}(\eta)+\eta) - \Phi^{-1}(1-T)\sigma_\epsilon \geq \mathring{\theta}(\eta).$$

   From Lemma 8, $\mathring{\theta}(\eta)$ is decreasing in η. This implies that the right hand side of the above inequality is decreasing in η. Now consider the left-hand side.

$$\frac{\partial x^*(\mathring{\theta}(\eta)+\eta)}{\partial\eta} = \frac{\partial x^*(\mathring{\theta}(\eta)+\eta)}{\partial v}\left(\frac{\partial\mathring{\theta}}{\partial\eta}+1\right).$$

   Now differentiating Equation 4, we have

$$\frac{\partial\mathring{\theta}}{\partial\eta} = -\frac{G_1\frac{\partial x^*}{\partial v}+G_2}{G_1\frac{\partial x^*}{\partial v}+G_2} = -1.$$

   Substituting back in yields $\frac{\partial x^*(\mathring{\theta}(\eta)+\eta)}{\partial\eta} = 0$, so the left-hand side of the inequality is constant. Thus, the inequality holds for η sufficiently large. Label the minimal η as $\overline{\eta}$, given by:

$$x^*(\mathring{\theta}(\overline{\eta})+\overline{\eta}) - \Phi^{-1}(1-T)\sigma_\epsilon = \mathring{\theta}(\overline{\eta}).$$

2. From above, we have that if $\overline{\theta} = \mathring{\theta}$ then it is decreasing ($\frac{\partial\mathring{\theta}}{\partial\eta} = -1$.) Suppose instead

that $\overline{\theta} = \theta^*$. Implicitly differentiating Equation 7 yields:

$$\frac{\partial \theta_L^*}{\partial \eta} = \frac{\frac{\partial \hat{\theta}_L}{\partial \eta}}{1 - \frac{\partial \hat{\theta}_L}{\partial \theta}}.$$

It is immediate from Equation 3 that $\frac{\partial \hat{\theta}_L}{\partial \eta} = \frac{\partial \hat{\theta}_L}{\partial \theta}$. And an argument identical to that in the proof of Lemma 6 shows that both of these derivatives are negative. Taken together this implies that the numerator in the displayed equation above is negative and the denominator is positive.

■

Proof of Proposition 2. Follows from Proposition 1, Lemma 7, and Lemma 10. ■

Proof of Proposition 3. On the equilibrium path the probability of revolution being attempted is

$$\int_{-\infty}^{\infty} \int_{\mathring{\theta}(\tilde{\eta})}^{\infty} \frac{1}{\sigma_\theta} \phi\left(\frac{\tilde{\theta} - m}{\sigma_\theta}\right) \frac{1}{\sigma_\eta} \phi\left(\frac{\tilde{\eta}}{\sigma_\eta}\right) d\tilde{\theta}\, d\tilde{\eta},$$

regardless of whether the population uses the strategy s^L or s^H. Thus, it suffices to show that the probability of a successful revolution is higher under s^L.

Lemma 12 shows that the probability of successful revolution, given that the population uses s^L, is:

$$\int_{-\infty}^{\overline{\eta}(0)} \int_{\mathring{\theta}(\tilde{\eta})}^{\infty} \frac{1}{\sigma_\theta} \phi\left(\frac{\tilde{\theta} - m}{\sigma_\theta}\right) \frac{1}{\sigma_\eta} \phi\left(\frac{\tilde{\eta}}{\sigma_\eta}\right) d\tilde{\theta}\, d\tilde{\eta} + \int_{\overline{\eta}(0)}^{\infty} \int_{\theta_L^*(\tilde{\eta})}^{\infty} \frac{1}{\sigma_\theta} \phi\left(\frac{\tilde{\theta} - m}{\sigma_\theta}\right) \frac{1}{\sigma_\eta} \phi\left(\frac{\tilde{\eta}}{\sigma_\eta}\right) d\tilde{\theta}\, d\tilde{\eta}.$$

To prove that the probability under s^H is lower, it suffices to show that (i) there are no (θ, η) pairs where victory is achieved under s^H and not under s^L and that there are an open set of (θ, η) pairs where victory is achieved under s^L but not s^H.

The proof of the first point is by contradiction. Suppose there was a pair (θ, η) such that victory was achieved under s^H but not s^L. This implies that

$$1 - \Phi\left(\frac{\hat{\theta}_H(\theta + \eta) - \theta}{\sigma_\epsilon}\right) \geq T > 1 - \Phi\left(\frac{\hat{\theta}_L(\theta + \eta) - \theta}{\sigma_\epsilon}\right),$$

which implies that

$$\Phi\left(\frac{\hat{\theta}_L(\theta + \eta) - \theta}{\sigma_\epsilon}\right) > \Phi\left(\frac{\hat{\theta}_H(\theta + \eta) - \theta}{\sigma_\epsilon}\right).$$

Since Φ is strictly increasing, this implies that $\hat{\theta}_L(\theta+\eta) > \hat{\theta}_H(\theta+\eta)$, a contradiction.

Now turn to the second point. Consider any pair $(\eta, \theta^*(\eta))$ with $\eta > \overline{\eta}(0)$. Here, by the definition of $\theta_L^*(\eta)$, we have

$$1-\Phi\left(\frac{\hat{\theta}_L(\theta_L^*(\eta)+\eta)-\theta_L^*(\eta)}{\sigma_\epsilon}\right)=T.$$

By definition, $\hat{\theta}_H(\theta_L^*(\eta)+\eta) > \hat{\theta}_L(\theta_L^*(\eta)+\eta)$. Since Φ is an increasing function, this implies that

$$1-\Phi\left(\frac{\hat{\theta}_H(\theta_L^*(\eta)+\eta)-\theta_L^*(\eta)}{\sigma_\epsilon}\right)<T,$$

so victory is not achieved. Notice, further, that since Φ is continuous and $\hat{\theta}_H$ is almost always continuous when it exists, this inequality also holds for some open set of θ's that are strictly greater than $\theta_L^*(\eta)$. Further, this argument holds for every $\eta > \overline{\eta}(0)$. Thus, it holds for an open set of (θ, η) pairs. ■

Proof of Proposition 4. I make use of the following lemmata.

Lemma 13 *$\hat{\theta}_L(\theta+\eta)$ is increasing in T, increasing in k, and decreasing in γ.*

Proof. Implicitly differentiating Equation3 we have:

$$\frac{\partial\hat{\theta}_L}{\partial T}=\frac{\phi(\alpha\hat{\theta}_L-\beta)\gamma\hat{\theta}_L\frac{\sigma_\epsilon}{\sigma_2}(\Phi^{-1})'(1-T)}{G_1(\hat{\theta}_L, v-t^*)}>0,$$

where the inequality follows from the facts that the numerator is clearly positive and the denominator is positive by Lemma 6.

$$\frac{\partial\hat{\theta}_L}{\partial k}=\frac{1}{G_1(\hat{\theta}_L, v-t^*)}>0,$$

where the inequality again follows from the fact that the denominator is positive by Lemma 6.

$$\frac{\partial\hat{\theta}_L}{\partial \gamma}=\frac{-(1-\Phi(\alpha\hat{\theta}_L-\beta))\hat{\theta}_L}{G_1(\hat{\theta}_L, v-t^*)}<0,$$

where the inequality follows from the fact that the numerator is clearly negative and the denominator is positive by Lemma 6. ■

Lemma 14 *$\mathring{\theta}(\eta)$ is increasing in T, increasing in k, and decreasing in γ*

Proof. Implicitly differentiating Equation 4 and using the fact that, since $x^*(\mathring{\theta}+\eta)$ is a maximizer of G with respect to x, we have $G_1(x^*(\mathring{\theta}+\eta), v-t^*)=0$, yields:

$$\frac{\partial \mathring{\theta}}{\partial T} = \frac{\phi(\alpha x^*(\mathring{\theta}+\eta)-\beta)\frac{\sigma_\epsilon}{\sigma_2}(\phi^{-1})'(1-T)\gamma x^*(\mathring{\theta}+\eta)}{\phi(\alpha x^*(\mathring{\theta}+\eta)-\beta)\frac{\psi}{\sigma_2}\gamma x^*(\mathring{\theta}+\eta)} > 0,$$

where the inequality follows from the fact that $x^* > 0$ and $(\Phi^{-1})'$ is positive since Φ is strictly increasing.

$$\frac{\partial \mathring{\theta}}{\partial k} = \frac{1}{\phi(\alpha x^*(\mathring{\theta}+\eta)-\beta)\frac{\psi}{\sigma_2}\gamma x^*(\mathring{\theta}+\eta)} > 0.$$

$$\frac{\partial \mathring{\theta}}{\partial \gamma} = -\frac{(1-\Phi(\alpha x^*(\mathring{\theta}+\eta)-\beta))x^*(\mathring{\theta}+\eta)}{\phi(\alpha x^*(\mathring{\theta}+\eta)-\beta)\frac{\psi}{\sigma_2}\gamma x^*(\mathring{\theta}+\eta)} < 0.$$

■

The number (measure) of people who mobilize is

$$N = \int_{-\infty}^{\infty}\int_{\mathring{\theta}(\tilde{\eta})}^{\infty}\left(1-\Phi\left(\frac{\hat{\theta}_L(\tilde{\theta}+\tilde{\eta})-\tilde{\theta}}{\sigma_\epsilon}\right)\right)\frac{1}{\sigma_\theta}\phi\left(\frac{\tilde{\theta}-m}{\sigma_\theta}\right)\frac{1}{\sigma_\eta}\phi\left(\frac{\tilde{\eta}}{\sigma_\eta}\right)d\,\tilde{\theta}d\,\tilde{\eta}.$$

Differentiating we have

$$\begin{aligned}\frac{\partial N}{\partial T} &= \int_{-\infty}^{\infty}\int_{\mathring{\theta}(\tilde{\eta})}^{\infty} -\phi\left(\frac{\hat{\theta}_L(\tilde{\theta}+\tilde{\eta})-\tilde{\theta}}{\sigma_\epsilon}\right)\frac{\partial\hat{\theta}_L(\tilde{\theta}+\tilde{\eta})}{\partial T}\frac{1}{\sigma_\epsilon}\frac{1}{\sigma_\theta}\phi\left(\frac{\tilde{\theta}-m}{\sigma_\theta}\right)\frac{1}{\sigma_\eta}\phi\left(\frac{\tilde{\eta}}{\sigma_\eta}\right)d\,\tilde{\theta}d\,\tilde{\eta}\\ &\quad - \int_{\mathring{\theta}(\tilde{\eta})}^{\infty}\left(1-\Phi\left(\frac{\hat{\theta}_L(\mathring{\theta}(\tilde{\eta})+\tilde{\eta})-\mathring{\theta}(\tilde{\eta})}{\sigma_\epsilon}\right)\right)\frac{1}{\sigma_\theta}\phi\left(\frac{\mathring{\theta}(\tilde{\eta})-m}{\sigma_\theta}\right)\frac{\partial\mathring{\theta}(\tilde{\eta})}{\partial T}\frac{1}{\sigma_\eta}\phi\left(\frac{\tilde{\eta}}{\sigma_\eta}\right)d\,\tilde{\eta} < 0\end{aligned}$$

where the inequality follows from the fact that $\frac{\partial\hat{\theta}_L(\tilde{\theta}+\tilde{\eta})}{\partial T} > 0$ and $\frac{\partial\mathring{\theta}(\tilde{\eta})}{\partial T} > 0$ from Lemmata 13 and 14, respectively. Thus, as T increases, mobilization decreases and the number of people needed for victory increases, so the probability of victory also decreases.

$$\begin{aligned}\frac{\partial N}{\partial k} &= \int_{-\infty}^{\infty}\int_{\mathring{\theta}(\tilde{\eta})}^{\infty} -\phi\left(\frac{\hat{\theta}_L(\tilde{\theta}+\tilde{\eta})-\tilde{\theta}}{\sigma_\epsilon}\right)\frac{\partial\hat{\theta}_L(\tilde{\theta}+\tilde{\eta})}{\partial k}\frac{1}{\sigma_\epsilon}\frac{1}{\sigma_\theta}\phi\left(\frac{\tilde{\theta}-m}{\sigma_\theta}\right)\frac{1}{\sigma_\eta}\phi\left(\frac{\tilde{\eta}}{\sigma_\eta}\right)d\,\tilde{\theta}d\,\tilde{\eta}\\ &\quad - \int_{\mathring{\theta}(\tilde{\eta})}^{\infty}\left(1-\Phi\left(\frac{\hat{\theta}_L(\mathring{\theta}(\tilde{\eta})+\tilde{\eta})-\mathring{\theta}(\tilde{\eta})}{\sigma_\epsilon}\right)\right)\frac{1}{\sigma_\theta}\phi\left(\frac{\mathring{\theta}(\tilde{\eta})-m}{\sigma_\theta}\right)\frac{\partial\mathring{\theta}(\tilde{\eta})}{\partial k}\frac{1}{\sigma_\eta}\phi\left(\frac{\tilde{\eta}}{\sigma_\eta}\right)d\,\tilde{\eta} < 0\end{aligned}$$

where the inequality follows from the fact that $\frac{\partial \hat{\theta}_L(\tilde{\theta}+\tilde{\eta})}{\partial k} > 0$ and $\frac{\partial \mathring{\theta}(\tilde{\eta})}{\partial k} > 0$ from Lemmata 13 and 14, respectively. Thus, as k increases, mobilization decreases and T stays constant, so the probability of victory also decreases.

$$\frac{\partial N}{\partial \gamma} = \int_{-\infty}^{\infty} \int_{\mathring{\theta}(\tilde{\eta})}^{\infty} -\phi\left(\frac{\hat{\theta}_L(\tilde{\theta}+\tilde{\eta})-\tilde{\theta}}{\sigma_\epsilon}\right) \frac{\partial \hat{\theta}_L(\tilde{\theta}+\tilde{\eta})}{\partial \gamma} \frac{1}{\sigma_\epsilon} \frac{1}{\sigma_\theta} \phi\left(\frac{\tilde{\theta}-m}{\sigma_\theta}\right) \frac{1}{\sigma_\eta} \phi\left(\frac{\tilde{\eta}}{\sigma_\eta}\right) d\,\tilde{\theta} d\,\tilde{\eta}$$
$$- \int_{\mathring{\theta}(\tilde{\eta})}^{\infty} \left(1-\Phi\left(\frac{\hat{\theta}_L(\mathring{\theta}(\tilde{\eta})+\tilde{\eta})-\mathring{\theta}(\tilde{\eta})}{\sigma_\epsilon}\right)\right) \frac{1}{\sigma_\theta} \phi\left(\frac{\mathring{\theta}(\tilde{\eta})-m}{\sigma_\theta}\right) \frac{\partial \mathring{\theta}(\tilde{\eta})}{\partial \gamma} \frac{1}{\sigma_\eta} \phi\left(\frac{\tilde{\eta}}{\sigma_\eta}\right) d\,\tilde{\eta} > 0$$

where the inequality follows from the fact that $\frac{\partial \hat{\theta}_L(\tilde{\theta}+\tilde{\eta})}{\partial \gamma} < 0$ and $\frac{\partial \mathring{\theta}(\tilde{\eta})}{\partial \gamma} < 0$ from Lemmata 13 and 14, respectively. Thus, as γ increases, mobilization increases and T stays constant, so the probability of victory also increases. ■

Proof of Proposition 5. The choice of effort by the vanguard is given by equation 6. Since, as shown in the proof of Lemma 12, $\frac{\partial \mathring{\theta}}{\partial t} = -1$, the left hand side of that equation can be rewritten:

$$\int_{-\infty}^{\infty} \left(1-\Phi\left(\frac{\hat{\theta}(\mathring{\theta}(\tilde{\eta})+\tilde{\eta})-\tilde{\theta}}{\sigma_\epsilon}\right)\right) \frac{1}{\sigma_\theta} \phi\left(\frac{\mathring{\theta}(\tilde{\eta})-m}{\sigma_\theta}\right) \frac{1}{\sigma_\eta} \phi\left(\frac{\tilde{\eta}}{\sigma_\eta}\right) d\tilde{\eta}$$
$$- \int_{-\infty}^{\infty} \int_{\mathring{\theta}(\tilde{\eta})}^{\infty} \phi\left(\frac{\hat{\theta}(\tilde{\theta}+\tilde{\eta})-\tilde{\theta}}{\sigma_\epsilon}\right) \frac{\partial \hat{\theta}(\tilde{\theta}+\tilde{\eta})}{\partial t} \frac{1}{\sigma_\theta} \phi\left(\frac{\tilde{\theta}-m}{\sigma_\theta}\right) \frac{1}{\sigma_\eta} \phi\left(\frac{\tilde{\eta}}{\sigma_\eta}\right) d\tilde{\theta}\, d\tilde{\eta}$$

Since $\hat{\theta}_H > \hat{\theta}_L$, the first term is smaller under s^H for any η. Moreover, as shown in Lemma 6, $\frac{\partial \hat{\theta}}{\partial t}$ is positive for $\hat{\theta}_H$ and negative for $\hat{\theta}_L$ implying that under s^H the second term is negative and under s^L the second term is positive. Thus, the entire left-hand side of Equation 6 is smaller under s^H than under s^L. Since the left-hand side of Equation 6 is constant in t and the right hand side is increasing, the fact that the left-hand side is small under s^H than under s^L implies that $t^*(s^H) < t^*(s^L)$. ■

Proof of Proposition 6.

1. The expected level of mobilization in the two equilibria are

$$\int_{-\infty}^{\infty} \int_{\mathring{\theta}(\tilde{\eta})}^{\infty} \left(1-\Phi\left(\frac{\hat{\theta}_L(\tilde{\theta}+\tilde{\eta})-\tilde{\theta}}{\sigma_\epsilon}\right)\right) \frac{1}{\sigma_\theta} \phi\left(\frac{\tilde{\theta}-m}{\sigma_\theta}\right) \frac{1}{\sigma_\eta} \phi\left(\frac{\tilde{\eta}}{\sigma_\eta}\right) d\,\tilde{\theta} d\,\tilde{\eta}$$

and

$$\int_{-\infty}^{\infty}\int_{\mathring{\theta}(\tilde{\eta})}^{\infty}\left(1-\Phi\left(\frac{\hat{\theta}_H(\tilde{\theta}+\tilde{\eta})-\tilde{\theta}}{\sigma_\epsilon}\right)\right)\frac{1}{\sigma_\theta}\phi\left(\frac{\tilde{\theta}-m}{\sigma_\theta}\right)\frac{1}{\sigma_\eta}\phi\left(\frac{\tilde{\eta}}{\sigma_\eta}\right)d\,\tilde{\theta}d\,\tilde{\eta},$$

respectively. It is obvious from the fact that $\hat{\theta}_H > \hat{\theta}_L$, that the latter is smaller than the former.

2. Probability of success is monotonic in expected mobilization, so this point follows directly from the previous point.

3. Assuming an equilibrium finite cutoff rule exists, a member of the population mobilizes if $\epsilon_i \geq \hat{\theta} - \theta$. Thus, for a fixed θ and η where $\hat{\theta}$ exists, the average level of extremism among participants is $\int_{\hat{\theta}(\theta+\eta)-\theta}^{\infty}(\theta+\tilde{\epsilon})\frac{1}{\sigma_\epsilon}\phi\left(\frac{\tilde{\epsilon}}{\sigma_\epsilon}\right)d\epsilon$.

   A finite cutoff rule consistent with equilibrium only exists if $\theta \geq \mathring{\theta}(\eta)$. So integrating this expected extremism over all (θ, η) pairs where a finite cutoff rule consistent with equilibrium exists, we get that the expected extremism among participants in the equilibrium in which the vanguard plays $t^*(s^L)$ is given by:

$$\int_{-\infty}^{\infty}\int_{\mathring{\theta}(\tilde{\eta})}^{\infty}\int_{\hat{\theta}_L(\tilde{\theta}+\tilde{\eta})-\tilde{\theta}}^{\infty}(\tilde{\theta}+\tilde{\epsilon})\frac{1}{\sigma_\epsilon}\phi\left(\frac{\tilde{\epsilon}}{\sigma_\epsilon}\right)\frac{1}{\sigma_\theta}\phi\left(\frac{\tilde{\theta}}{\sigma_\theta}\right)\frac{1}{\sigma_\eta}\phi\left(\frac{\tilde{\eta}}{\sigma_\eta}\right)d\tilde{\epsilon}\,d\tilde{\theta}\,d\tilde{\eta},$$

   and in the equilibrium in which the vanguard plays $t^*(s^H)$ is given by:

$$\int_{-\infty}^{\infty}\int_{\mathring{\theta}(\tilde{\eta})}^{\infty}\int_{\hat{\theta}_H(\tilde{\theta}+\tilde{\eta})-\tilde{\theta}}^{\infty}(\tilde{\theta}+\tilde{\epsilon})\frac{1}{\sigma_\epsilon}\phi\left(\frac{\tilde{\epsilon}}{\sigma_\epsilon}\right)\frac{1}{\sigma_\theta}\phi\left(\frac{\tilde{\theta}}{\sigma_\theta}\right)\frac{1}{\sigma_\eta}\phi\left(\frac{\tilde{\eta}}{\sigma_\eta}\right)d\tilde{\epsilon}\,d\tilde{\theta}\,d\tilde{\eta}.$$

   The fact that the former is smaller than the latter follows directly from the fact that $\hat{\theta}_H > \hat{\theta}_L$, so the expectation of ϵ on $\hat{\theta}_H$ to infinity is larger than on $\hat{\theta}_L$ to infinity.

■

References

Acemoglu, Daron and James A. Robinson. 2001. "A Theory of Political Transitions." *American Economic Review* 91(4):938–963.

Acemoglu, Daron and James A. Robinson. 2006. *Economic Origins of Dictatorship and Democracy*. Cambridge, UK: Cambridge University Press.

Angeletos, George-Marios, Christian Hellwig and Alessandro Pavan. 2006. "Signaling in a Global Game: Coordination and Policy Traps." *Journal of Political Economy* 114(3):452–484.

Angeletos, George-Marios, Christian Hellwig and Alessandro Pavan. 2007. "Dynamic Global Games of Regime Change: Learning, Multiplicity, and the Timing of Attacks." *Econometrica* 75(3):711–756.

Baliga, Sandeep and Tomas Sjostrom. 2009. "Decoding Terror." Kellogg typescript.

Berman, Eli. 2003. "Hamas, Taliban, and the Jewish Underground: An Economists View of Radical Religious Militias." UC San Diego typescript.

Berman, Eli and David D. Laitin. Forthcoming. "Religion, Terrorism and Public Goods: Testing the Club Model." *Journal of Public Economics* .

Bueno de Mesquita, Bruce and Alastair Smith. 2008. "Political Survival and Endogenous Institutional Change." *Comparative Political Studies* . Forthcoming.

Bueno de Mesquita, Bruce, Alastair Smith, Randolph M. Siverson and James D. Morrow. 2003. *The Logic of Political Survival.* Cambridge: MIT Press.

Bueno de Mesquita, Ethan. 2009. "Uniqueness and Multiplicity in Games of Regime Change: A Note." University of Chicago typescript.

Bueno de Mesquita, Ethan and Eric Dickson. 2007. "The Propaganda of the Deed: Terrorism, Counterterrorism, and Moblization." *American Journal of Political Science* 51(2):364–381.

Chwe, Michael. 1998. "Culture, Circles, and Commercials: Publicity, Common Knowledge, and Social Coordination." *Rationality and Society* 10:47–75.

Chwe, Michael. 2001. *Rational Ritual: Culture, Coordination, and Common Knowledge.* Princeton: Princeton University Press.

DeGroot, Morris H. 1970. *Optimal Statistical Decisions.* McGraw-Hill.

DeNardo, James. 1985. *Power in Numbers: The Political Strategy of Protest and Rebellion.* Princeton: Princeton University Press.

Edmond, Chris. 2007. "Information Manipulation, Coordination and Regime Change." NYU typescript.

Edmond, Chris. 2008. "Information Revolutions and the Overthrow of Autocratic Regimes." NYU typescript.

Fearon, James D. 2006. "Self-Enforcing Democracy." Stanford typescript.

Geddes, Barbara. 1990. "How the Cases You Choose Affect the Answers You Get: Selection Bias in Comparative Politics." *Political Analysis* 2(1):131–150.

Gillespie, Richard. 1995. Political Violence in Argentina: Guerrillas, Terrorists, and *Carapintadas*. In *Terrorism in Context*, ed. Martha Crenshaw. University Park: Pennsylvania State University Press pp. 211–248.

Ginkel, John and Alastair Smith. 1999. "So You Say You Want a Revolution: A Game Theoretic Explanation of Revolution in Repressive Regimes." *Journal of Conflict Resolution* 43(3):291–316.

Goldstone, Jack A. 2001. "Toward a Fourth Generation of Revolutionary Theory." *Annual Review of Political Science* 4(June):139–187.

Holmström, Bengt. 1999. "Managerial Incentive Problems: A Dynamic Perspective." *Review of Economic Studies* 66(1):169–182.

Kalyvas, Stathis N. 1999. "Wanton and Senseless? The Logic of Massacres in Algeria." *Rationality and Society* 11(3):243–285.

Kalyvas, Stathis N. 2007. "How Free is 'Free Riding' in Civil Wars? Violence, Insurgency, and the Collective Action Problem." *World Politics* 59(2):1043–1068.

Krueger, Alan B. 2007. *What Makes a Terrorist: Economics and the Roots of Terrorism.* Princeton: Princeton University Press.

Kurrild-Klitgaard, Peter. 1997. *Rational Choice, Collective Action, and the Paradox of Rebellion.* Copenhagen: Institute of Political Science, University of Copenhagen.

Lichbach, Mark Irving. 1995. *The Rebel's Dilemma.* Ann Arbor: University of Michigan Press.

Lohmann, Susanne. 1994. "The Dynamics of information Cascades: The Monday Demonstrations in Leipzig, East German, 1989–1991." *World Politics* 47(1):42–101.

Morris, Stephen and Hyun Song Shin. 1998. "Unique Equilibrium in a Model of Self-Fulfilling Currency Attacks." *American Economic Review* 88(3):587–597.

Myerson, Roger B. 2007. "Leadership, Trust, and Power: Dynamic Moral Hazard in High Office." University of Chicago typescript.

Popkin, Samuel L. 1979. *The Rational Peasant: The Political Economy of Rural Society in Vietnam*. Berkelely: University of California Press.

Popkin, Samuel L. 1988. Political Entrepreneurs and Peasant Movements in Vietnam. In *Revolution and Rationality*, ed. Michael Taylor. Cambride, U.K.: Cambridge University Press pp. 9–62.

Schelling, Thomas C. 1960. *The Strategy of Conflict*. Cambridge, MA: Harvard University Press.

Siqueira, Kevin and Todd Sandler. 2007. "Terrorist Backlash, Terrorism Mitigation, and Policy Delegation." *Journal of Public Economics* 91(9):1800–1815.

Skocpol, Theda. 1979. *States and Social Revolutions: A Comparative Analysis of France, Russia, and China*. New York: Cambridge University Press.

Tullock, Gordon. 1971. "The Paradox of Revolution." *Public Choice* 11(Fall):89–100.

Tullock, Gordon. 1974. *The Social Dilemma: The Economics of War and Revolution*. Blacksburg: Center for the Study of Public Choice.