So You Say You Want a Revolution

A GAME THEORETIC EXPLANATION OF REVOLUTION IN REPRESSIVE REGIMES

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Existing models of revolutions tend to focus only on the behavior of the revolutionaries and do not account for government actions. This article presents a model that captures the decision making of a repressive government, career dissidents, and revolutionary participants. The model shows that (a) governments rarely offer concessions to protesters, (b) dissident activity is more likely to be successful in motivating large-scale protest under highly repressive conditions, and (c) Kurian’s hypothesis that regimes collapse suddenly with little warning is confirmed. The authors use the model to interpret the different outcomes that occurred during the successful Velvet Revolution in Czechoslovakia and the failed revolution in China during the Tiananmen Square democracy protests.

Why do some revolutions succeed while others fail? Czechoslovakia dismissed its communist regime in 1989, but dissident Chinese students were unable to motivate political change earlier that same year. What accounts for the difference in outcomes in these two cases? When does a revolutionary outcome follow a revolutionary situation? We address these issues from a rational choice perspective, modeling the interaction of three primary actors in any revolutionary situation: the government, dissidents, and the public.

1. We employ the definitions of revolutionary situations and outcomes that Tilly (1978) introduces. A revolutionary situation is characterized by multiple sovereignty, when a status quo government faces effective competition from another polity (Tilly 1978, 191). A revolutionary outcome requires that an oppressed group committed to social transformation catalyze a transfer of power from a status quo government to a new authority (Tilly 1978, 189).

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© 1999 Sage Publications, Inc.
Existing studies of revolution tend to consider only one of the above elements, generally focusing on the behavior of revolutionaries. Analyses that seek to offer a broader perspective do so at the expense of explaining micro-level behavior and use resource mobilization theories. All of these studies fall short, however, in explaining the outcome of rebellious action. When the conditions are ripe for social revolution, why do some rebellions succeed while others fail?

Kuran (1989, 1995) attempts to address this question with a threshold model that captures the social composition of protest dynamics, but Sandler (1992) correctly points out that the Kuran model does not account for interaction between the regime and protesters. Specifically, who is better informed, the regime or the opposition (Sandler 1992, 186)? Lohmann (1994) addresses some of these shortcomings by synthesizing an information cascade model with Kuran’s threshold model. However, this approach still does not incorporate regime action in determining the outcome of revolutionary situations.

We address these shortcomings by examining the conditions that lead a repressive government to offer accommodations to a revolutionary movement. Additionally, we want to capture some of the heterogeneity of protest groups. Thus, in our model, we present a bifurcated populace that is defined by a group of well-established dissidents and a secondary, largely unmoviblized, mass that encompasses the remaining population. This simplified model of group heterogeneity captures the dynamics of the tipping model that others have identified in earlier representations of revolutionary behavior (Sen 1967; Schelling 1971, [1921] 1985; Granovetter 1978; Kuran 1989, 1995; Karklins and Petersen 1993).

Our model allows us to make three substantive conclusions about revolutionary behavior. First, we find that it is dangerous for governments to offer concessions. Although it may help forestall revolution, it also signals weakness. Second, we find that dissident activity is much more likely to be effective in motivating rebellious action under highly repressive conditions when dissidents face grave sanctions, for the public is more likely to trust their leadership. Third, we confirm Kuran’s (1995) hypothesis that regimes collapse suddenly with little warning or protracted conflict. This is highlighted in the informational structure of this model. We consider the validity of these conclusions by briefly examining the protest movements in Czechoslovakia and China in 1989.

THE PLAYERS

Our model of revolution includes three actors: a repressive government (G), an organized group of dissidents (D), and the mass public (M), labeled in the game as the

2. For example, Gurr (1970) uses psychological motivations to explain protest behavior, and Karklins and Petersen (1993) employ an assurance game to explain individual revolutionary participation.

3. See, for example, Skocpol (1979) and Emizet and Hesli (1995). For further analysis of the history of the study of revolutions, we recommend Goldstone’s (1980) excellent review article.

4. DeNardo’s (1985) model of rebellion similarly allows for interaction between a regime and its protesters, but he does not account for the heterogeneity of protest movements. Empirical evidence, however, suggests that protesters possess different thresholds of participation (see Oliver and Marwell 1985; Chong 1991; Karklins and Petersen 1993; Petersen 1999).
mob. This formulation allows us to depict the government as something other than a static actor and capture some of the social heterogeneity found in protest movements. Other models may capture the heterogeneity of protesters at a finer level than we do; but, for the purposes of our model and computational tractability, the distinction that we make between the dissidents and the mob is sufficient.\(^5\)

We argue that dissidents are the most willing to protest; they have less to lose from official sanctions. They are already marginal citizens under the government regime and need not fear a loss of status. Thus, the dissidents, like the first players in a threshold model, do not need the assurance of company.

The mob, however, looks to the dissidents for information and leadership about the timing of protest participation. Without a dissident call for action, the mob will not take to the streets. However, it will not always heed the dissidents’ call. Even though the dissidents may believe a revolution is worthwhile, the mob may disagree.

The government is the third actor in our model. Some governments maintain power by exploiting reputations of strength that were earned in earlier time periods, even though they lack the power to suppress a rebellion. Other governments are strong and can withstand challenge. The dissidents’ and mob’s beliefs about the government’s ability to withstand a revolution play a vital role in determining whether a revolution occurs. A key aspect of our analysis is how dissidents and the mob assess whether their prospects of success make revolution worthwhile. It is to these informational considerations that we turn next.

**INFORMATION**

In any revolution, a shroud of uncertainty clouds decision making.\(^6\) What is the nature of this uncertainty? Who knows most accurately where the loyalties of the people lie? Who has the best assessment of the military’s power? Here, we consider two kinds of uncertainties that this creates: the strength of the regime and the dissonance of the mob.

One of the key factors affecting the mob’s decision to rebel is the probability of success. Against a weak regime, a rebellion is likely to succeed. However, a strong regime will most probably crush any rebellion and punish its participants. Given the limited amount of free press and other forms of information, the general public has little idea about whether the government can survive a major rebellion. Such information is costly and dangerous to obtain, and, as Kuran (1991, 1995) shows, efforts to collect this information will most likely yield inaccurate results. However, career dissidents spend much of their time and energy in competition with the government. Although the dissidents may possess limited information about the government’s strength, it is still superior to the mob’s information. Indeed, given the lack of challenges and the restricted flow of information, even the regime may have little information about its

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5. See, for example, Karklins and Petersen (1993) and Kuran (1995) for examples of models with greater levels of heterogeneity.

ability to survive. However, we assume that the government is best informed about its abilities, the mob has little or no information, and the dissidents’ information rests somewhere between the two extremes. Under a repressive regime, citizens are reluctant to express their true opinions for fear of punishment. In fact, citizens may purposely falsify their true preferences in response to official public opinion polls or in conversations with friends and neighbors (Kuran 1991, 1995). Thus, neither the government nor the dissidents knows the mob’s true sentiments. This makes it difficult for either side to assess with any certainty the mob’s relative support or dissatisfaction with either the government or the dissidents.

For the dissidents, this uncertainty over the mob’s dissatisfaction with the government is especially perilous. If they call for a demonstration and the mob is content, then the dissidents expose themselves to retaliation by the government. On the other hand, a dissatisfied mob is liable to respond to any call to rebel, and the government may regret not offering accommodations.

Our model combines threshold and informational aspects of existing models. The dissidents’ job is to convince the mob that a rebellion will succeed. The government’s job is to maintain office. To accomplish this, the government has two options: it can crush the rebellion with violence or offer accommodations. As the end of the cold war revealed, until dissidents expect to succeed, they hide. They bide their time until they can be more certain that their public efforts will catalyze substantive change. At the same time, governments do not tip their hand about their weakness. Hence, when governments are successfully challenged, they collapse rapidly rather than through a gradual series of compromises.

THE GAME

We turn now to a fuller explication of the game. In this section, we take the reader through the order of play and discuss the factors that affect each actor’s decision making. In the following section, we provide a more detailed explanation of the game’s equilibria.

THE ORDER OF PLAY

1. Nature determines the government’s type ($\theta$, the probability that the government can survive a revolution), and nature provides the dissidents with noisy information $n$ about the government’s type.
2. Given its type, the government may offer an accommodation $a$ to its citizens: $a \in [0,1]$.
3. The dissidents decide whether to mobilize or to accept the accommodation. Without mobilization, the game ends, and the accommodation is implemented.
4. If the dissidents choose to mobilize, then the mob decides whether to participate. If it does, then a revolution occurs. If the mob fails to respond to the dissidents’ call to arms, the game ends with the accommodation $a$ being accepted.
5. If revolution occurs, then the government survives with probability $\theta$ and is deposed with probability $1 - \theta$. If the government survives, then it disregards any accommodations that it offered and implements its most preferred policies.
The Government Learns Its Type

In the first move of the game, nature determines the government’s type ($\Theta$). The type represents the government’s probability of surviving a rebellion. The government is able to withstand an attempted revolution with probability $\Theta$ and will fall with probability $(1 - \Theta)$. The government’s type is private information. The dissidents interpret signals in an attempt to learn it.

The government’s strength, its ability to survive a revolution, varies. For simplicity, we assume that $\Theta$ is drawn from the uniform distribution: $\Theta \sim U[0,1]$. We assume that the government is the best informed of the three actors about its type, the dissidents possess noisy information about the government’s type, and the mob is virtually uninformed, knowing only the prior distribution from which it was drawn.

Information and Beliefs

The dissidents’ beliefs are based on two streams of information. First, they receive noisy information ($n$) from the government that reveals something about its type, but this information is unspecific and gleaned from observing the government’s day-to-day actions. To avoid remaining too abstract, suppose $n$ represents a series of coin flips in which the probability of heads equals the government’s type, the probability it can survive a rebellion, $\Theta$. Thus, by observing the ratio of heads to tails, the dissidents can estimate the likelihood that the government can withstand a revolution. If the dissidents observe only one coin flip, their assessment of the government’s type will tend to be inaccurate. By contrast, should the dissidents observe the ratio of heads to tails from 1,000 coin tosses, they will have a far more accurate estimation of the government’s type. The number of coin flips can be thought of as parameterizing the accuracy of the dissidents’ information.

This noisy information stream is augmented by the government’s willingness to offer accommodations to the public. We represent this signal as $a$, a measure of the level of accommodation that the government offers. This variable, $a$, ranges between zero and one, with zero representing no accommodation and one being an offer of significant concessions. As an example, we might think of this signal as a set of new media restrictions or perhaps an offer of open elections.

The Dissidents Act

The third move of the game calls for the dissidents ($D$) to act upon the information that they have learned about the government. They can either choose to maintain the status quo (i.e., remain in hiding) or issue a call for mobilization, hoping that the mob will follow. If the dissidents choose not to mobilize, the game ends and the government remains in power. If the government has already made an offer of accommodation, then this accommodation is instituted and changes the status quo, thus affecting the actors’ payoffs. We assume that the game will always end at this point if the dissidents do not call for mobilization.
The Mob Chooses Sides

Following a call for mobilization by the dissidents, the mob \((M)\) is confronted with a choice. It needs to decide whether to take to the streets. The mob listens to the dissidents' signal and evaluates it along with its own information about the government's strength. The mob will participate in a revolution only if it trusts the dissidents and believes that a revolution will yield a positive outcome. Should the mob choose not to mobilize, the game ends, and the government remains in power. If the mob follows the dissidents' lead and foments a revolution, the government will survive or fall depending on the magnitude of its type.

PAYOFFS

This model has four possible outcomes. Figure 1 diagrams the order of play and each outcome. Below, we discuss the variables that affect payoffs at each of these outcomes. The notation is summarized in Table 1. Following the discussion, we identify how payoffs are calculated at each outcome.

Variables

*Violence* \((v)\). Each of the actors must be conscious of the dangers of violence. Violence has costs domestically and internationally. The mob and the dissidents are most likely to suffer the brunt of physical harm from a conflict with an organized militia. However, the government, too, must be chary of provoking violence. Granting government forces unfettered permission to quash public protests may result in international outcry and official sanctions.

*Accommodation* \((a)\). Accommodations are costly to the government and a benefit for the dissidents and the mob. When the government makes an accommodation to the public, it is an act of concession that in some fashion improves the public's lot at the expense of the government. For example, an offer of accommodation that encompasses free elections would open the future possibility that the government might be thrown from office through the ballot box. Thus, accommodation \(a\) is a negative payoff for the government and a positive payoff for both the dissidents and the mob.

*The cost of exposure* \((k)\). When the dissidents call for mobilization, they expose themselves to risk. If they foment a successful revolution, they stand to enjoy rewards. However, if the mob does not heed the dissidents' call or the revolution fails, then the dissidents expose themselves to punishment. To reflect these eventualities, calling for mobilization carries a negative utility of \(-k\) for the dissidents.

*The revolutionaries' reward* \((x_d)\) and \((x_a)\). The revolutionaries enjoy benefits from toppling the repressive regime. For the dissidents, this reward might be in the form of
positions in the new government as occurred in Czechoslovakia when Civic Forum dominated in open elections. The mob’s benefit will be the less tangible expectation of a more benevolent government.

*Holding office* ($\Psi$). The government enjoys its position of power and reaps a reward $\Psi$ from maintaining office. This reward can be whittled away through an offer of accommodation or by using violence to try and crush a revolution.
TABLE 1  
Summary of Notation

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
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<tbody>
<tr>
<td>$\nu$</td>
<td>cost associated with the use of violence</td>
</tr>
<tr>
<td>$a$</td>
<td>compromise offered by government</td>
</tr>
<tr>
<td>$x_M$</td>
<td>the mob’s anticipated reward for removing the current regime</td>
</tr>
<tr>
<td>$x_D$</td>
<td>the dissidents’ anticipated reward for toppling the regime</td>
</tr>
<tr>
<td>$\Psi$</td>
<td>government’s reward for holding power</td>
</tr>
<tr>
<td>$\theta$</td>
<td>government’s strength (type); probability of surviving a revolution</td>
</tr>
<tr>
<td>$n$</td>
<td>noisy signal containing information about the government type</td>
</tr>
<tr>
<td>$k$</td>
<td>the cost of exposure</td>
</tr>
<tr>
<td>$\gamma_a$</td>
<td>probability of the mob rebelling given compromise $a$</td>
</tr>
<tr>
<td>$\beta_{es}$</td>
<td>probability of dissidents mobilizing</td>
</tr>
</tbody>
</table>

**Outcome One: The Dissidents Do Not Mobilize**

If the dissidents fail to mobilize, the game ends and the government maintains its office. If the government offers an accommodation $a$, then the accommodation will be implemented, although the government remains in office. The government’s payoff is $U_G = \Psi - a$. The mob will not take to the streets without assurance from the dissidents that rebellious action is prudent. Thus, no revolution will occur. Both the dissidents and the mob enjoy whatever benefits derive from a government accommodation: $U_D = a$ and $U_M = a$.

**Outcome Two: The Mob Fails to Mobilize**

When the mob is not comfortable with the dissidents’ call for action, no revolution occurs and the government maintains office. In this case, the government earns its reward for maintaining office ($U_G = \Psi - a$), the dissidents suffer the cost of exposure ($U_D = a - k$), and the mob accepts whatever accommodation the government may have offered ($U_M = a$).

**Outcome Three: Revolution and the Government Survives**

The government’s type determines the probability that it survives. With probability $\theta$, the government withstands the concerted challenge from the dissidents and the mob. However, to do so, it must use repressive techniques and suffer the cost of violence ($U_G = \Psi - \nu$). This violence is, of course, costly to the mob as well ($U_M = -\nu$). The dissidents must confront the added danger of being targets for retaliatory sanctions following the suppression of the revolt ($U_D = -\nu - k$).

**Outcome Four: Revolution and the Government Falls**

With probability $(1 - \theta)$, the government is overthrown by the challengers. In this case, the government does not enjoy any office-holding benefits and must bear the
responsibility for having employed violence \((U_c = -\nu)\). The mob enjoys its rewards for toppling the government, which offset the violence it suffered earlier \((U_M = \nu_m - \nu)\). However, we assume that in most cases, the outgoing government will not go down without a fight and will focus the brute of its retaliatory action on the dissidents. So, despite the fact that the government falls, the dissidents suffer the cost of exposure \(k\) during early phases of the successful revolution \((U_D = \nu_D - \nu - k)\).

RESULTS

The properties of perfect Bayesian equilibria, our solution concept, are formally characterized in the appendix. In the main text, we concentrate on certain equilibrium properties and describe their substantive implications.

We present the analysis of the model in four stages. First, we analyze the mob’s decision to join the rebellion. Second, we examine when the dissidents mobilize. Third, given the behavior of the factions, we characterize the regime’s decision to offer accommodations. Fourth, we discuss the implications of this behavior for government continuity and sudden collapse.

UNDER WHICH CONDITIONS WILL THE MOB TAKE TO THE STREETS?

A revolution requires two conditions to be satisfied. First, the mob must think that a revolution is worthwhile, and second, the dissidents need to coordinate protest. The second aspect, coordination, has been explored in the threshold literature. Without some group to catalyze the revolution, it is impossible for the mob to rebel. In our model, the dissidents fill this role. To this extent, our model captures the thresholds of participation for heterogeneous groups. Yet, the dissidents also fulfill another role. Dissidents act as information providers and help convince the mob of the desirability of revolution.

To start the analysis, we consider the mob’s decision calculus. If the revolution succeeds, then the mob receives a payoff of \(x_m - \nu\); if the revolution fails, the mob pays the cost of violence, \(-\nu\). The government survives a revolution with probability \(\theta\). Therefore, if the mob rebels, its expected payoff is \(U_m(\text{rebel}) = (1 - \theta)(x_m - \nu) + \theta(-\nu) = (1 - \theta)x_m - \nu\). Alternatively, if the mob refuses to follow the dissidents, or the dissidents never mobilize, then no rebellion occurs, and the government implements its accommodations. Hence, the mob’s expected payoff in the absence of revolution is \(U_m(\text{no rebellion}) = a\).

If presented with the opportunity to revolt, the mob only does so if \((1 - \theta)x_m - \nu \geq a\). Rearranging this equation yields \(x_m \geq \frac{\nu + a}{1 - \theta}\). Not surprisingly, it is those types who desire change most (high values of \(x_m\)) who are the more likely to rebel. If the government is extremely strong, \(\theta = 1\), then the mob, regardless of how much it desires change, would never want to revolt. Yet, if the government is weak, \(\theta = 0\), and provided that \(x_m \geq \nu + a\), then the mob wants to rebel. However, \(\theta\), the probability that the govern-
ment can survive a revolution, is unknown to the mob. Not knowing whether a revolution will succeed, the mob is uncertain whether to revolt. Although never certain, given its beliefs about the government, the mob can calculate the average reward from revolution. On average, the mob rebels if \( x_m \geq \frac{\gamma \cdot a}{1 - E[\theta | a]} \), the term \( E[\theta | a] \) replacing the term \( \theta \) found in earlier expressions. \( E[\theta | a] \) is simply the expected value of \( \theta \) given the compromise \( a \) that the government offers. Later we discuss how government accommodations affect these beliefs.

This equation implies that if the mob thinks that on average the government is strong—that is, \( E[\theta | a] \) is large—then the mob must strongly desire change before it rebels. Conversely, if \( E[\theta | a] \) is small, many types of mobs readily rebel, for they expect the government to be weak. As we shall subsequently show, both the government’s and the dissidents’ actions affect whether a revolution occurs, in part because these actions determine whether the mob thinks a revolution will succeed. We let \( \gamma_a \) represent the probability that the mob revolts in the event that the dissidents mobilize and the regime offers compromise \( a \): \( \gamma_a = \Pr(x_m \geq \frac{\gamma \cdot a}{1 - E[\theta | a]}) \), which, given the uniform distribution of \( x_m \), equals max \((0,1 - \frac{\gamma \cdot a}{1 - E[\theta | a]})\).

**UNDER WHICH CONDITIONS WILL THE DISSIDENTS MOBILIZE?**

For the dissidents, mobilization is problematic. Without their organization, a revolution will never occur, but starting a protest enables the government to identify them. They mobilize when they believe both that the mob will follow and they can overthrow the government. The dissidents use the information of the noisy signal \( n \) and the government’s accommodations \( a \) in assessing the probability of success.

Formally, the dissidents’ expected payoff from mobilizing is \( E[U_p(Mobilize|\theta)] = \gamma_a((1 - \theta)(x_D - n - k) + \theta(-n - k)) + (1 - \gamma_a)(a - k) \). The first term, \( \gamma_a((1 - \theta)(x_D - n - k) + \theta(-n - k)) \), represents the payoff if the mob responds by revolting. If a revolution occurs, then the government survives with probability \( \theta \), and the dissidents’ payoff is \((n + k)\). If the revolution succeeds with probability \((1 - \theta)\), then the dissidents’ payoff is \((x_D - n - k)\). The second term \((1 - \gamma_a)(a - k)\) represents starting a protest but receiving no support. Under these conditions, any government accommodation is implemented, but the dissidents risk punishment for protesting. The dissidents’ payoff in this case is \((a - k)\).

If the dissidents accept the regime’s offer \( a \), their expected payoff is \( E[U_p(\sim Mobilize|\theta, a)] = a \). Therefore, the dissidents mobilize if \( x_D \geq \frac{\gamma \cdot a}{\gamma_a(1 - \theta)} \). However, the dissidents are uncertain of the government’s true type. Thus, replacing \( \theta \) with \( D \)’s expectation, the dissidents mobilize if \( x_D \geq \frac{\gamma \cdot a}{\gamma_a(1 - E[\theta | a, a])} \). Rearranging this equation yields

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7. Formally, if \( \mu(\theta | a) \), a probability density function, represents the mob’s beliefs about the regime’s type, then \( E[\theta | a] = \int_0^1 \theta \mu(\theta | a) d\theta \). Note that these beliefs also depend on whether the dissidents mobilize. However, because the mob cannot rebel without the coordination of the dissidents, we drop this dependency from the notation.
$E[\theta|n, a] \leq \frac{\gamma_s \alpha_s \gamma_f - \alpha_f \alpha_s - k}{\gamma_s}$. Therefore, the weaker the dissidents believe the government to be, the more likely they are to mobilize. However, the dissidents may not always protest when they believe the government is weak. They only risk protest when they expect the mob to follow. Note that if the mob is unlikely to revolt ($\gamma_f$ close to zero), then the dissidents remain passive against a hopeless government ($\theta = 0$).

Given that the dissidents are uncertain about the mob’s support, they must generate an expectation as to the likelihood that the mob will follow their lead. We represent this belief as $\beta_{a,n}$, the probability that the dissidents mobilize after an offer of $a$ and signal $n$ from the government. The dissidents mobilize only if they believe that the mob will support them and there is a strong probability that public rebellion will lead to the government’s collapse. Otherwise, the dissidents expose themselves to retaliatory sanctions from the government and a payoff of $-k$.

**Information and Coordination**

As stated earlier, two conditions are needed for a revolution to occur. First, the coordination problem needs to be solved. Second, the mob must want to rebel. An important component of this latter factor is that the mob must be convinced that a revolution is likely to succeed.

When the dissidents protest, they help inform the mob about the relative strength of the government. The dissidents mobilize if $E[\theta|n, a] \leq \frac{\gamma_s \alpha_s \gamma_f - \alpha_f \alpha_s - k}{\gamma_s}$. Hence, upon seeing the mobilization, the mob should infer that on average the government’s type is below $\frac{\gamma_s \alpha_s \gamma_f - \alpha_f \alpha_s - k}{\gamma_s}$.

However, this call for mobilization is a blunt instrument; it gives only a weak indication about on which side of $\frac{\gamma_s \alpha_s \gamma_f - \alpha_f \alpha_s - k}{\gamma_s}$ the government’s type lies. It is also a costly instrument to use. When the dissidents protest, they identify themselves to the government, which targets them for punishment.

The dissidents typically have much better information about the regime than simply whether $E[\theta|a,n]$ lies on one side of $\frac{\gamma_s \alpha_s \gamma_f - \alpha_f \alpha_s - k}{\gamma_s}$ or the other. Yet, it is hard for the dissidents to communicate this information to the mob. This is true for two reasons. First, as discussed above, authoritarian systems restrict the flow of information. Second, the mob should not completely believe them.

Suppose the dissidents tell the mob that the government is weak. The mob knows that the dissidents have a stronger desire to overthrow the government than it does. The conditions under which the mob would rebel are more restrictive than the set of conditions under which the dissidents would rebel. Thus, the likelihood that the mob will participate in a revolution is a function of the dissidents’ credibility. If the dissidents’ messages to the mob are not credible, then it is unlikely that the mob will open itself to the risk of confronting the government.

The easier it is for the dissidents to mobilize (in terms of the model, this means low values of $k$), the less likely that their call for mobilization convinces the mob that the government is weak. However, when the risks of mobilizing are low (small $k$), dissi-
dents are more likely to protest even when the likelihood that the mob will respond is low. When the government is capable of identifying and punishing protesters, the dissidents are more reluctant to mobilize. Yet, paradoxically, under these circumstances mobilization provides a stronger signal that the government is weak and unable to resist a rebellion. Hence, we expect to see the following pattern: when the risks of punishment are low, despite the high frequency of protests, the mob is unlikely to rebel. Yet, as the risks of punishment \((k)\) increase, protests become rarer, but the mob is more likely to join such protests, and any resulting revolutions are more likely to be successful.

**THE DILEMMA OF COMPROMISE**

Offering accommodations signals weakness, for a strong government that can survive a rebellion has little incentive to compromise. In contrast, weak governments compromise if compromise helps avert revolution. Thus, upon seeing an accommodation, the citizens realize that their government is weak.

Governments that fear they will not survive a revolution have an incentive to preempt violence by accommodating the people’s wishes. If the mob knew the government’s type, then this is what would happen. Yet, when there is little information, offering an accommodation is a mixed blessing. Offering an accommodation may reduce the mob’s dissonance with the government, but it tells the mob that the government no longer fully controls the reigns of power.

Suppose the government is contemplating offering a compromise \(a\) or no compromise \(a_0 = 0\). The expected payoff from offering \(a\) is

\[ U_G(a|\theta, n) = \beta_{a,n} \gamma_a \theta(\Psi - v) + (1 - \theta)(-v) + \beta_{a,n}(1 - \gamma_a)(\Psi - a) + (1 - \beta_{a,n})(\Psi - a) = \Psi - a + \beta_{a,n} \gamma_a \theta \Psi - v - \Psi + a. \]

There is a corresponding payoff \(U_G(a_0|\theta, n)\) if the government offers \(a_0\).

The difference between the two payoffs is

\[ U_G(a|\theta, n) - U_G(a_0|\theta, n) = \left( \Psi - a + \beta_{a,n} \gamma_a \theta \Psi - v - \Psi + a \right) - \left( \Psi - a_0 + \beta_{a_0,n} \gamma_{a_0} (\Psi \Psi - v - \Psi + a) \right), \]

which simplifies to

\[ \left( \beta_{a,n} \gamma_a - \beta_{a_0,n} \gamma_{a_0} \right) ((\theta - 1)\Psi - v) + a(\beta_{a_0,n} \gamma_{a_0} - 1). \]

If type \(\theta\) ever offers the compromise \(a\), then it must be utility maximizing to do so; that is, \(U_G(a|\theta, n) - U_G(a_0|\theta, n) \geq 0\). Because the second term, \(a(\beta_{a_0,n} \gamma_{a_0} - 1)\), and the latter part of the first term, \(((\theta - 1)\Psi - v)\), are both negative, then for the entire expression to be positive, \(\left( \beta_{a,n} \gamma_a - \beta_{a_0,n} \gamma_{a_0} \right)\) must be negative. Thus, if any type ever offers the compromise \(a\), it must reduce the probability of rebellion.

The expression

\[ U_G(a|\theta, n) - U_G(a_0|\theta, n) = \left( \beta_{a,n} \gamma_a - \beta_{a_0,n} \gamma_{a_0} \right) ((\theta - 1)\Psi - v) + a(\beta_{a_0,n} \gamma_{a_0} - 1) \]

also yields another result: weaker types have larger incentives to offer compromises than higher types. To see why, note that because \(\left( \beta_{a,n} \gamma_a - \beta_{a_0,n} \gamma_{a_0} \right) < 0\), \(U_G(a|\theta, n) - U_G(a_0|\theta, n)\) is decreasing in type \(\left( \frac{dU_G(a|\theta, n) - U_G(a_0|\theta, n)}{a} \right) < 0\). Thus, if type \(\theta'\) prefers to offer the accommodation \(a\) rather than \(a_0\), then so do all types \(\theta < \theta'\).

These results lead to two substantive conclusions. First, if an accommodation is offered, then it reduces the probability of rebellion. Second, weak governments have
the greater incentive to offer accommodations. This combination of conclusions indicates that making concessions is a tricky business. Concessions may reduce the probability of rebellion, but they signal weakness. Rebellion is likely to occur when the mob is unhappy and when it believes that it can topple the government. An accommodation affects both of these factors, but in opposite directions. The accommodation makes the government more palatable to the mob. Yet, because weak types make the offer, the mob infers that a revolution is likely to succeed.

To illustrate the effect more concretely, consider the mob’s propensity to rebel: $\gamma_a = \Pr(x_m \geq \frac{a+\epsilon}{1-x[\Theta]} \mid a^\star)$. If the accommodation is large, then the numerator gets large, making it harder to satisfy the condition required for revolution. However, the signal of weakness means that the term $E[\Theta \mid a]$ falls, which increases the denominator, making it easier to satisfy the condition. By contrast, if the government offers no compromise, then both the numerator and the denominator are large. Whether the large term over the large term or the small term over the small term is larger depends on the precise conditions. In some cases, accommodation reduces the likelihood of revolution, in which case compromises can occur. In contrary situations, accommodations make revolution more likely, and governments never compromise.

What does this imply empirically? First, accommodation will be rarer than we would naively expect. Second, when accommodations occur, they reduce the probability of revolution but weaken the government with respect to further bargaining, since the government’s opponents now know that it is weak.

**GOVERNMENT CONTINUITY AND SUDDEN COLLAPSE**

Kuran (1995) provides a compelling explanation for the Soviet Bloc’s lengthy persistence and sudden collapse. He argues that the public’s practice of preference falsification throughout the Soviet Union and Eastern Europe was essential in maintaining the communist system and responsible for its rapid downfall. Our model confirms this hypothesis.

First, consider the persistence of repressive regimes. Why do repressive regimes last as long as they do in the face of massive public discontent? The simple answer to this question is information uncertainty, where preference falsification is an integral element. As we have shown above, the depth of information affects revolutionary outcomes in our model. The government is uncertain about the discontent of the people. The dissidents do not know whether the mob will follow their call for mobilization and cannot know with certainty the strength of the government. The mob is not sure that it can trust the dissidents and is wary of challenging the government. Often beliefs persist, unchanged for many years. In effect, the system can become informationally frozen.

Little new information is ever generated unless actors take direct action. For example, the dissidents will never know if the mob will revolt unless they mobilize. Similarly, the regime’s strength is never tested unless rebellion occurs. Yet, there are great risks and costs in finding out this information. Revolution is a fishing expedition. Citi-
zens do not revolt until the prospects of success are high. In many cases, the information they need to make that assessment is obtained only by actually rebelling. If the citizens initially believe that the government is strong enough to resist, then they never challenge the government. As a result, there are few opportunities to learn whether their beliefs about the government are correct, and the status quo supports the government’s maintenance.

Accommodations signal weakness. In the absence of a direct threat, the government has no incentive to publicize its weakness, preferring instead to let the status quo reign. Indeed, as the analysis shows, even when faced with a direct revolutionary threat, governments are reluctant to compromise for fear of revealing weakness. Under such circumstances, the rapidity of regime disintegration is perhaps not surprising. Governments do not yield compromises that are in line with their underlying strength. Should an exogenous shock jolt expectations back in line with reality, governments are left in untenable situations. Overtures of concession signal that the government is ripe for overthrow, so compromise might only hasten the government’s demise. In the next section, we argue that this was indeed the case with the Velvet Revolution, in which Czechoslovak dissidents and ordinary citizens looked to referent events in Poland and Hungary as signals of communism in decline. Exogenous events throw new information into the system. When this information suggests that revolutionary success is likely, weak governments facing open rebellion are liable to sudden collapse. With the informational uncertainties conquered, revolutionary participation cascades, and the mob rapidly overthrows the government. Efforts to cling to power by offering concessions often only accelerate the collapse because they signal that the government can no longer maintain its position with repressive methods.

EMPIRICAL APPLICATIONS

A thorough empirical test of our model is beyond the scope of this article, but it is appropriate here to consider the model as a heuristic for examining revolutions. Above, we have highlighted the role that information plays in affecting action and determining outcomes. Substantively, Czechoslovakia’s Velvet Revolution and the Tiananmen Square democracy movement in China represent two informational extremes, and we use these two cases to examine how information affects revolutionary behavior in practice.

Our model predicts that dissident activity and mob response should differ in these two cases. The Czechoslovak government was less capable of sanctioning dissidents in the months leading up to the Velvet Revolution. Therefore, we should expect to see many small, ineffectual protests. It was later, when the government began to get nervous, that the dissidents faced their harshest sanctions. The result was that the protests exploded in size and ferocity, and the government collapsed. In China, where the sanctions for dissident activity were strong from the beginning, the protests grew far more quickly, although the government was too well entrenched to fall from power.
THE VELVET REVOLUTION

The revolutionary context that was present in Eastern Europe in 1989 was a key informational element to the events that occurred in Czechoslovakia. Solidarity had moved Poland toward competitive elections, and in Hungary the communist regime stepped down in a negotiated transition of power. Foreign intervention of the type that was seen in 1956 in Hungary or in 1968 in Czechoslovakia seemed far less likely in 1989. Therefore, the Czechoslovak government was on its own in confronting its opponents.

At this time, the Czechoslovak government was mired in crisis that was evident to all observers. Economic malaise provided generally docile citizens with a reason for discontent, and the ever-burgeoning number of dissident organizations provided a safe outlet for anger. The inability of Czech leaders to deal with these crises was a signal to dissidents that the communist leaders’ stranglehold on power was slipping. For the first time since the 1968 Prague Spring, the communist regime allowed protest organizations to meet with little disruption. This was a signal that the government was conceding a plurality of opinion, and dissidents and the general public took this as license to take their message to the streets. Public demonstrations increased from mid-1988 despite threats of official sanctions (Wheaton and Kavan 1992, 25).

The government’s reluctance to punish dissident activity made it both less dangerous and less necessary to participate in protest activities. Our model predicts that when sanctions are minimal, we should expect to see many small and ineffectual protests where the sense of urgency associated with massive demonstrations is absent. This was initially the case in Czechoslovakia. Over time, demonstrations grew larger in the face of more severe government opposition.

The first major public demonstration took place on August 21, 1988, in memory of the foreign intervention during the Prague Spring. More than 10,000 people took to the streets and marched through the city chanting slogans and issuing demands. Toward the end of the march, after the demonstration had dwindled to less than 1,000, police forcibly dispersed the remaining crowd. The government had weathered an initial act of rebellion, but the outcome came at a cost. First, the communist government resorted to violence, an act that was noted in the world press; second, it did not employ force until the crowd had diminished. Security forces that were present exhibited a reluctance to attack the demonstrators, thus signaling that the government was losing support from its police.

The government took preemptive action in an attempt to forestall the next planned demonstration in October, publishing stern warnings in the press and placing prominent dissidents under house arrest before the protest was to begin. People participated regardless. This time the police acted more quickly, but their action was not enough to deter further revolt. Demonstrations also occurred in December and in January 1989.

During the January 1989 protests, police action was more intense and Vaclav Havel was arrested. These actions were costly for the government. International scrutiny increased, and the Czechoslovak people were undeterred by the government action.

Opponents protested Havel’s arrest with a massive letter-writing campaign and petitions that thousands, including public figures, signed.

During these protests, the Czechoslovak government was issuing mixed signals. On one hand, it was stepping up repressive pressure on public demonstrations, but at the same time it allowed new opposition groups to form. Thus, violence was intermixed with signals of accommodation. In some cases, the government even appeared to heed some of the calls for reform. The result was that dissidents and the public alike began to believe that their efforts were bearing fruit.

Events came to a head in November 1989. Over the course of the year, the traditional network of dissident leaders had been augmented, and new leadership cadres had formed. Most important, students had become strongly organized and prepared a march for November 17 in which more than 50,000 students in Prague participated. The police response was especially brutal; one student was killed and more than 500 were injured. Again, however, police seemed reluctant to confront the demonstrators until late in the protest, and the regime violence seemed to focus resolve rather than quash it.

The disorganized police response to the November 17 march provoked anger more than fear. On November 18, Civic Forum, an umbrella organization of dissident groups, was formed. Civic Forum used its network of organizations to shepherd a nationwide strike on November 27 in which more than 900 factories closed for a 2-hour period and millions participated. This nationwide protest, coupled with week-long demonstrations in Prague, proved to be the end for the Czechoslovak communist regime. Two days later, the clause of the constitution that granted the Communist Party the “leading role” in state affairs was removed, and the transition to democracy was officially under way.

The communist regime’s final capitulation occurred more than a year after initial public protests began but took little more than a week after protest events intensified following the November 17 student demonstration. The year that preceded the November events was especially important from an information standpoint. At no point in this time period did the government exhibit the resolve to crush dissent as it had during the Prague Spring. Instead, its acts of repression seemed inefficient and its efforts to co-opt certain protests appeared as concessions to the opposition. By the time that Civic Forum called for the general strike, the dissidents and the public were essentially fully informed about the government’s ability to crush protest; they were powerless, and the communist government fell.

Within the context of our model, we can make several informed speculations about the factors that affected the outcome of Czechoslovakia’s revolutionary process. Although we can never know the Czechoslovak government’s type with certainty, the evidence is consistent with that of a government that believed it was unlikely to survive a revolution. First, it offered compromises, allowing opposition groups to organize. Second, when challenged, it was unable to survive civic unrest. Our model suggests

9. Hanzel (1991) reports that the nationwide strike was coordinated with the Czechoslovak government. He states that Havel and representatives of Civic Forum met with communist officials to discuss the timing of the strike. Thus, the dissident leadership was well informed about the type of response it could expect from the government during the strike.
that it is precisely the types that think they are unable to survive that choose to accommodate opposition demands. The Czechoslovak regime attempted to appease the population by allowing low-level reforms. However, while reducing dissent, appeasement revealed the precarious situation of the government. With the compromises failing to satiate the citizens, and the citizens realizing the government’s weakness, collapse was inevitable.

Our model indicates that the costs and risks associated with protest affect the frequency and the impact of demonstrations. When the penalty for demonstrating is low, dissidents readily take to the streets even if they suspect that the citizens will not follow. Yet, precisely because of the ease of protest, the general citizenry are not immediately convinced. Indeed, in comparison to the Chinese case, the protest movement in Czechoslovakia took a year to gather steam. This pattern of protest is consistent with the model’s predictions: when the punishment for protest is low, there are many small demonstrations, but they are ineffectual with respect to rallying the people.

TIANANMEN SQUARE

The Tiananmen Square democracy protests in China during the spring of 1989 yielded a markedly different outcome than Czechoslovakia’s Velvet Revolution. We argue here, within the context of our model, that this difference is due in large part to the greater level of uncertainty that was present in China during the time of the student demonstrations. In Czechoslovakia, undercurrents of dissatisfaction had burbled for some time before the revolution assumed full force, but in China events developed perhaps too rapidly and outpaced the conditions necessary for change to occur. There was no external signal that suggested that the government might be losing its grip on power, and the Chinese political system was better situated to control the flow of information. Furthermore, the government did not make overtures of concessions to the demonstrating students.

The 1989 democracy movement in China had no external referent, and internal discontent was still at a nascent stage. In early 1989, some informal student organizations formed to discuss political issues. On February 23, 1989, this became more formalized with the founding of Amnesty 89, an organization concerned with the condition of political prisoners (Calhoun 1994, 30). A month later, this led to an open letter to the government calling for political democratization, freedom of speech and press, the release of political prisoners, and increased funding for education and research.

When student dissidents began to plan events in commemoration of the May 4, 1919, student protests, the government became concerned and started interfering with the planning for the commemorative event (Calhoun 1994, 34). In Czechoslovakia, as stated above, the communist regime did nothing to stem the tide of developing dissident groups through 1988, even going so far as to adopt some of their proposals. In China, however, student plans to demonstrate in commemoration of the 1919 student
protest, even though the 1919 event was hailed by the Communist Party for starting China’s path to national liberation, were met with immediate concern.

Thus, the Chinese government demonstrated its opposition to dissident activity from the earliest stages. At no point did the communist authorities indicate that the government was losing its will to suppress opinions that criticized the party. Events came to a head on April 15, 1989, when China’s former general secretary Hu Yaobang died.

Hu had become a hero of Chinese students for two reasons. First, during his tenure in office, he had attempted to liberalize policies in an effort to construct a “socialist democracy” (Mu and Thompson 1989, 12-14). Second, he had been the head of the Communist Party during the last major student protests in 1986 and 1987 and was credited with restraining government action to suppress the movement (Calhoun 1994, 35). Among Beijing’s student population, he was regarded as a liberal presence who was more favorably disposed toward openness and Western ideas than the rest of the politburo. When he died, students in Beijing mourned his death with posters declaring that the “wrong man died.”

Hu’s death provided a spark to growing student unrest. In keeping with Kuran’s predictions, an exogenous shock—Hu’s death—sparked protest. However, Hu’s death could not provide dissident student leaders with new information about the government’s type; they had no way of judging whether the government was less capable of withstanding challenge. Instead, they had a powerful symbol that they could use as a rallying point for participants. Thus, student organizers in groups such as the Autonomous Students Association of Beijing Universities took advantage of Hu’s death to press their demands for democracy.

Public protests began to gather steam on April 18 when more than 6,000 students gathered to mourn Hu’s death in Beijing. Over the next couple of days, student protests spread to other cities throughout the country. Calhoun (1994, 37) writes that the nature of this particular set of student protests posed a particular challenge for Chinese leaders, for “it was awkward [for them] to challenge mourning for a deceased head of the Communist Party.” Chinese authorities hoped to quell the protests by quickly staging a memorial service for Hu on April 22 in Tiananmen Square. To protect against student disruptions, they planned to close the square and issued a warning in the People’s Daily on April 21.11 Despite these actions, more than 100,000 students gathered in the square the day before the memorial service and remained overnight in defiance of the authorities.

Class boycotts ensued following the event, and the government began to take sterner measures to return the country to normal. Deng Xiaoping convened a politburo meeting in which it was decided that the government would crack down on students using whatever means were necessary. The government publicized this decision in a strongly worded editorial in the People’s Daily on April 26 that warned that “illegal demonstrations and parades are forbidden, as is the establishment of contacts in factories, villages and schools. Those who are engaged in beating, smashing, looting and burning will be punished according to law. The students’ right to study must be pro-

11. The text of this warning can be found in Calhoun (1994, 42).
tected."\textsuperscript{12} Despite these clearly worded warnings, more than 500,000 students marched to Tiananmen Square the day after the editorial was published.

These large protests in defiance of official warnings were not spontaneous events. Calhoun (1994) makes it clear that there was a well-defined although heterogeneous leadership cadre within the student protest movement.\textsuperscript{13} This leadership network allowed for news to be passed between student groups throughout the country. Recognizable leaders within this network served a coordinating function within the student movement and issued clear calls for mobilization to demonstration participants, calls that were heeded in large numbers.

A few weeks after the April 27 demonstrations, despite continued government efforts to curtail protests, more than 1 million students gathered in Tiananmen Square on May 18. The day before, more than 1 million Beijing residents demonstrated, including many who occupied government positions, in support of the students. On May 28, the students in the square voted to remain until the National People’s Congress convened on June 20. They did not achieve their goal. On June 3, tens of thousands of soldiers entered the square and permanently broke up the demonstrations.

Given this pattern of protest and government efforts to quash the demonstrations, there are two questions that we need to address within the context of the model that we present here. First, why did people continue to protest in the wake of stern government warnings? Second, why did this revolution fail?

Above, we report that when the cost of exposure is high for the dissidents, the mob is more likely to trust their signal and heed the call for mobilization. This is the situation that existed in China during the spring of 1989. The government had warned student dissidents against provoking conflict, but students continued to do so nonetheless. The dissident action in the face of official sanctions lent credibility to their mobilization calls. Hundreds of thousands of nondissidents turned out to support the student leaders, and the protests swept across the nation. Run-of-the-mill participants invested trust in the student leaders, heeding their call for mobilization and assuming that the student leadership had greater knowledge about the government’s type than they, themselves, possessed.

Yet, the massive demonstrations and protests did not provoke a revolutionary outcome. In comparison to the case of Czechoslovakia’s Velvet Revolution, there is one stark difference. In Czechoslovakia, dissidents made assessments about the government’s type based on its domestic performance and communism’s recent troubles throughout Eastern Europe. Thus, the Czechoslovak dissidents’ estimation of the government’s type was informed by events that directly affected the government’s ability to withstand challenge. This was not the case in China.

Calhoun (1994, 175) perhaps sums it up best when he discusses the many levels of uncertainty that existed during the student demonstrations. He highlights the fact that neither side was certain of what the other would do, and that contact between the students and the government was minimal at best. This differs distinctly from the Czechoslovak dissidents’ estimation of the government’s type was informed by events that directly affected the government’s ability to withstand challenge. This was not the case in China.

12. Translation provided in Mu and Thompson (1989, 155-57).
13. For a discussion of leadership organization in the Chinese student protest movement, see Calhoun (1994, 173-80).
slovak case in which representatives from Civic Forum met with government officials to plan the timing of the nationwide strike and, thus, were well informed about the types of government reaction they could expect (Hanzel 1991). China's communist regime, however, was more effective than Czechoslovakia's in restricting the flow of information about the depth of its power and willingness to employ it, and it was difficult for the dissident leadership to update its beliefs about the government's efficacy.

Perhaps the dissidents' most important piece of information came from the demonstration of support for the student protesters that occurred on May 17 when more than 1 million Beijing residents—many of them lower level government officials—rallied behind the students. However, this show of support came late in the game when the dissidents still had poor information about the government's type. The display of support for the students reflected some government defections but still did not allow the dissidents to develop an accurate assessment of the government's type—merely that it was weaker than it had been originally. The government, however, was not so weak that it had an incentive to offer concessions to the protesters. Instead, it possessed the wherewithal to end the student protests with force. Both the dynamics of the protest and the failure of the dissidents to achieve a revolutionary outcome are consistent with the findings of our model.

CONCLUSION

In this article, we have attempted to add to the study of revolutions by developing a model of revolutionary behavior that incorporates a dynamic interaction between integral actors. Where earlier models have focused strictly on revolutionary action and individual participation, we have developed a model that also captures government decision making. In the process, we have been forced to make several simplifying assumptions that strips the revolutionary process to a parsimonious core, but this still allows us to draw some substantive conclusions that appear reasonable in light of empirical evidence.

Our model confirms Kuran's hypothesis that repressive regimes will hold on to power until the bitter end, collapsing suddenly rather than withering away through a gradual loss of legitimacy. Czechoslovakia's Velvet Revolution is an example of this phenomenon. However, whereas Kuran focuses solely on societal preferences, we include government action as a determinant on revolutionary outcomes. We believe that this is a more accurate representation of revolutionary processes.

At the heart of this process is the role that dissidents play in affecting revolutionary protest. These first actors are also important in Kuran's analysis, but Kuran does not consider how these actors affect those that follow them or how the government affects their actions. We demonstrate how government sanctioning affects the efficacy of dissident action and influences the outcomes of revolutions.

Finally, we provide rigorous confirmation of a sensible intuition that governments are loathe to offer concessions to protesters. It is a signal of weakness, but under some conditions it may help to lower the probability of revolution. By itself, this is not an
earth-shattering conclusion, but it helps to confirm the accuracy of our model. We would be surprised if this were not a finding.

This study is but a first pass at developing a representative dynamic model of revolutionary behavior. This model needs to be incorporated with structural approaches to provide a more complete picture of revolutionary context, and the model needs more thorough empirical testing. This is a standard challenge for game theoretic applications in comparative politics and a worthy goal to pursue.

APPENDIX

To characterize perfect Bayesian equilibria, we need to ensure that all beliefs are consistent with Bayes’s rule and that for all players, all types are utility maximizing given the strategies of the other players and their beliefs. Before starting, we formalize notation. The mob’s strategy $\sigma_m(x_m, a) = \sigma_m(x_m, \text{Mobilization})$ is the probability that a type $x_m$ will rebel following the dissidents’ mobilization given the offer $a$. The dissidents’ strategy $\sigma_D(a, n)$ is the probability that the dissidents mobilize given they see the signal $n$ and the compromise $a$. The government’s strategy $\sigma_g(a, 0, n)$ is the probability that a government of type $0$, having observed the noisy signal $n$, offers accommodation $a$.

The mob’s preference for a new government, its type, is private information, but it is common knowledge that this type is drawn from the standard uniform distribution $x_m \sim U[0, 1]$. The ability of the regime to survive a revolution (its type, $\theta$) is private information. Although its precise value is unknown, everyone has common priors. Let $\mu(\theta)$ represent these prior beliefs that we assume are uniformly distributed over the unit interval: $\mu(0) = 1$ for $0 \leq \theta \leq 1$. Where there is any possibility of ambiguity, we subscript $\mu$ to indicate whose beliefs are being considered.

We start by characterizing how the various signal and actions affect beliefs.

BELIEFS

Noisy Signaling

The government’s type $\theta$ is unknown to other players. However, the distribution from which this type is drawn, the uniform distribution over the unit interval, is common knowledge. The general citizenry know nothing more than this about the regime’s type. The dissidents, however, learn more about the type of government by observing noisy information. We let $N$ represent the set of all possible signals and $n$ the signal that dissidents actually see. The probability that the dissidents see a particular signal depends on the type of the regime. Let $p(n|\theta)$ represent the

(continued)

14. A straightforward generalization is to assume that the dissidents’ type $x_D$ is private information but drawn from a known distribution $G(x)$. In this case, a strategy is a mapping from type, signal, and accommodation into a probability of mobilization: $\sigma_D(x_D, n, a)$.

15. We assume that the government and the dissidents observe the noisy signal. Hence, $G$ conditions its strategy on this information. Altering this assumption, to assume that the message is unobserved by the regime, changes the mathematics but it does not fundamentally alter the substantive results.
probability that the dissidents observe signal \( n \) given the regime’s type \( \theta \). Hence, given the signal \( n \), the dissidents update their beliefs by Bayes’s rule:

\[
\mu(\theta|n) = \frac{\mu(\theta)p(n|\theta)}{\int_{\theta} \mu(\theta)p(n|\theta) \, d\theta}
\]

As a simple example, suppose the signal is a series of \( t \) Bernoulli trials with \( s \) successes, where the probability of success in each trial is independent and takes the value \( \theta \). Given regime type \( \theta \), the probability of seeing \( s \) successes from \( t \) trials is \( p(n|\theta) = p(s, t|\theta) = \binom{t}{s} \theta^s (1-\theta)^{t-s} \), the binomial distribution. Given their prior beliefs (\( \mu(\theta) = 1 \) for \( 0 \leq \theta \leq 1 \)), and having observed the signal \( n \), the dissidents update their beliefs about the government: \( \mu(\theta|n) = \frac{\mu(\theta)p(n|\theta)}{\sum_{\theta} \mu(\theta)p(n|\theta)} \).

Hence, the dissidents’ posterior beliefs are beta distributed \( \mu(\theta|ln) = \mu(\theta|lt,s) = \text{Be}(\theta|1 + s, 1 + (t - s)) \).

Compromises as Signals

Compromises by the government also act as signals. Let \( \sigma (a|\theta,n) \) represent the probability that a government of type \( \theta \) offers the accommodation \( a \). The citizens update their beliefs using Bayes’s rule: if the dissidents observe accommodation \( a' \), then

\[
\mu_D(\theta, a'|n) = \frac{\sigma (a'|\theta,n) \mu(\theta|n)}{\int_{\theta} \sigma (a'|\theta,n) \mu(\theta|n) \, d\theta}
\]

The calculation is similar for the mob, except that it has not observed the signal \( n \),

\[
\mu_M(\theta, a') = \frac{\int_{\theta} \sigma (a'|\theta,n) \mu(\theta) \, d\theta}{\int_{\theta} \sigma (a'|\theta,n) \mu(\theta) \, d\theta}
\]

The integral with respect to the signal is to calculate the marginal density of \( \theta \) given the offer \( a \). Because \( M \) does not see \( n \), the mob cannot condition its beliefs upon it.

Mobilization as a Signal

Both the noisy signal \( n \) and the accommodation \( a \) affect the dissidents’ decision to mobilize. Hence, this decision contains information about both. The mob’s beliefs upon observing mobilization \( (M) \) following the compromise \( a \) are \( \mu_m(\theta|a,M) = \mu_m(\theta|a,M) = \mu_m(\theta|a) \). They are calculated by repeatedly applying Bayes’s rule. We illustrate several steps in the calculation. For convenience of exposition, we use the term \( \Pr() \) loosely. When talking about a continuously distributed random variable, we mean the probability density.

\[
\mu_m(\theta|a,M) = \Pr(\theta|a,M) = \frac{\Pr(M|\theta,a) \Pr(\theta|a)}{\Pr(M|\theta,a)}
\]

We consider each term sequentially. \( \Pr(M|\theta,a) \), the probability that the dissidents mobilize given type \( \theta \) and compromise \( a \), is calculated by integrating with respect to all the possible noisy signals:

16. If a random variable \( \theta \) is beta distributed with parameters \( \alpha \) and \( \beta \), then the density of \( \theta = f(\theta|\alpha,\beta) = c\beta^{-1}(1-\beta)^{-1}, 0 < \beta < 1 \), where \( c = \Gamma(\alpha + \beta) / \Gamma(\alpha) \Gamma(\beta) \). The uniform distribution is simply a special case of the beta distribution with parameters \( \alpha = 1 \) and \( \beta = 1 \). Given this conjugate analysis, the results could easily be applied to any priors with beta distribution.
APPENDIX Continued

\[ \Pr(M|a,n) = \int_{n \in N} \Pr(M|a,n) \Pr(n|\theta) d\theta = \int_{n \in N} \sigma_D(a,n) \rho(n|\theta) d\theta. \]

This term contains information about type from two sources: the accommodation and the dissidents’ decision that was made in light of both the noisy signal and the accommodation. It is through this term that the mob learns about the regime from the dissidents’ decision.

The second term \( \Pr(\theta|a) \) is the probability that the regime’s type is \( \theta \) given that it offers \( a \): \( \Pr(\theta|a) = \mu_m(\theta; a) \), which was calculated above. The final term, the denominator \( \Pr(M|a) \), is the probability that the dissidents mobilize following the accommodation \( a \).

\[ \Pr(M|a) = \int_{n \in N} \Pr(M|a,n) \Pr(n|a) d\theta = \int_{n \in N} \sigma_D(a,n) \Pr(n|a) d\theta, \]

where \( \Pr(n|a) = \frac{\Pr(a|n) \Pr(n)}{\Pr(a)} = \frac{\int_{\theta} \rho(n|\theta) \mu(\theta; a) d\theta}{\Pr(a)} \). Expanding the term \( \Pr(a|n) \),

\[ \Pr(a|n) = \int_{\theta} \Pr(a|\theta,n) \mu(\theta; n) d\theta = \int_{\theta} \sigma_c(a|\theta,n) \mu(\theta; n) d\theta \]
\[ \Pr(n) = \int_{\theta} \Pr(n|\theta) \Pr(\theta) d\theta = \int_{\theta} \rho(n|\theta) \mu(\theta) d\theta \]
\[ \Pr(a) = \int_{a \in A} \Pr(a|n) \Pr(n) d\theta = \int_{a \in A} \Pr(a|n) \mu(\theta; n) \Pr(n) d\theta d\theta. \]

Hence,

\[ \Pr(n|a) = \frac{\Pr(a|n) \Pr(n)}{\Pr(a)} = \frac{\int_{\theta} \sigma_c(a|\theta,n) \mu(\theta|n) d\theta \int_{\theta} \rho(n|\theta) \mu(\theta) d\theta}{\int_{n \in N} \left[ \int_{\theta} \sigma_c(a|\theta,n) \mu(\theta|n) d\theta \int_{\theta} \rho(n|\theta) \mu(\theta) d\theta \right] d\theta}. \]

Despite being messy, conceptually \( \mu_m(\theta|a) = \mu_m(\theta|a,M) \) is determined by three terms. The first, \( \Pr(M|\theta,a) \), reflects the information that the dissidents learned from both their available sources, the noisy signal and the accommodation. The second term, \( \Pr(\theta|a) \), reflects what the mob can learn, independent of the dissidents, from the accommodation made. The denominator is simply a normalizing factor to ensure that the probabilities add up to one.

We now examine what constitutes best responses for each player.

The Mob’s Decision to Rebel

If a revolution occurs, then the mob’s expected payoff is

\[ E[U_M(rebell|a)] = E[\theta(-\nu) + (1-\theta)(x_m - \nu)] = \int_{\theta} (x_m - \nu - \theta x_m) \mu(\theta|a) d\theta = x_m(1 - E[\theta|a]) - \nu. \]

If no revolution occurs, then the government’s compromise is implemented:

\[ U_M(-rebella) = a. \]
Hence, $M$ rebels only if $x_m \geq \frac{\gamma_a + \delta_a}{1 - E[\theta | a]}$, where $E[\theta | a]$ is $M$'s expectation about $\theta$ given the compromise $a$ and the dissidents' mobilization.

Probability of rebellion given mobilization and the compromise $a$, $\gamma_a$ is the probability that $x_m \geq \frac{\gamma_a + \delta_a}{1 - E[\theta | a]}$. Given that $x_m$ is uniformly distributed on the unit interval, $\gamma_a = \max \left\{1 - \frac{\gamma_a + \delta_a}{1 - E[\theta | a]}, 0\right\}$.

**Dissidents’ Decision to Mobilize**

Given the noisy signal $n$ and the accommodation $a$, if the dissidents mobilize, their expected payoff is

$$E[U_M(mobilize|n,a)] = \int_0^n (\gamma_a (x_D (1 - \theta) - \nu) + (1 - \gamma_a) (a - k) u(\theta, n, a)) d\theta = (x_D (1 - E[\theta | n, a]) - \nu - a) \gamma_a - k + a.$$  

If the dissidents do not mobilize, then they receive a payoff of $U_D(-mobilize, n, a) = a$.

Therefore, the dissidents mobilize if $x_D \geq \frac{\gamma_a + \delta_a + k}{\gamma_a (1 - E[\theta | n, a])}$ or, expressed alternatively, if $E[\theta | n, a] \leq \frac{\gamma_a + \delta_a - \nu}{\gamma_a (1 - E[\theta | n, a])}$. Thus,

$$\sigma_D(a, n) = \begin{cases} 0 & \text{if } x_D < \frac{\gamma_a + \delta_a + k}{\gamma_a (1 - E[\theta | n, a])} \\ \{0, 1\} & \text{if } x_D = \frac{\gamma_a + \delta_a + k}{\gamma_a (1 - E[\theta | n, a])} \\ 1 & \text{if } x_D > \frac{\gamma_a + \delta_a + k}{\gamma_a (1 - E[\theta | n, a])} \end{cases}$$

Let $\beta_{a,n}$ represent the probability that $D$ mobilizes given accommodation $a$ and signal $n$. This leads directly to the following result.

**Lemma 1.** If $\gamma_a = 0$, then $\beta_{a,n} = 0$.

**Government’s Decision**

Each type of regime picks its optimal level of compromise $a$. First, we show that value of revolution is always less than the value of any accommodation that is offered in equilibrium. The regime’s payoff if rebellion occurs is $(\theta \Psi - \nu)$, and the payoff if the accommodation prevents a rebellion is $(\Psi - a)$. Note that the government could always offer $a = 0$. Even if this always resulted in rebellion, the worst possible outcome from the government’s perspective, the government’s payoff would be $(\theta \Psi - \nu)$. The government would never offer a compromise that makes it worse off; that is, $(\Psi - a) \geq (\theta \Psi - \nu)$, which implies that $a \leq \Psi (1 - \theta) + \nu$.

Given that the dissidents see the signal $n$, if a government of type $\theta$ offers accommodation $a$, then the regime’s expected payoff is
APPENDIX Continued

\[ U_G(a, \theta, n) = \beta_{a_n, \gamma_a}(\theta(\Psi - \nu) + (1 - \theta)(-\nu)) + \beta_{a_n}(1 - \gamma_a)(\Psi - a) + (1 - \beta_{a_n})(\Psi - a) = \Psi - a + \beta_{a_n, \gamma_a}(\theta(\Psi - \nu) - \Psi + a). \]

Suppose the government contemplates two different offers \( a \) or \( a_0 \):

\[ U_G(a, \theta, n) - U_G(a_0, \theta, n) = (\Psi - a + \beta_{a_n, \gamma_a}(\theta(\Psi - \nu) - \Psi + a)) - (\Psi - a_0 + \beta_{a_n, \gamma_a}(\theta(\Psi - \nu) - \Psi + a_0)). \]

Now suppose that some type \( \theta \) plays \( a > a_0 = 0 \). Therefore, \( U_G(a, \theta) - U_G(a_0, \theta) \geq 0 \), which implies that \( (\beta_{a_n, \gamma_a} - \beta_{a_0, \gamma_a})(\theta - 1)(\Psi - \nu) + a(\beta_{a_n, \gamma_a} - 1) \geq 0 \).

The second term is nonpositive \( (\beta_{a_n, \gamma_a} - \beta_{a_0, \gamma_a} - 1) \leq 0 \). Therefore, to satisfy the constraint, the first term must be nonnegative. Because \( (\theta - 1)(\Psi - \nu) < 0 \), this implies that \( (\beta_{a_n, \gamma_a} - \beta_{a_0, \gamma_a}) \) is strictly negative. Thus, a type \( \theta \) will not offer an accommodation unless it reduces the probability of revolution. 17

**Lemma 2.** If a regime of type \( \theta \) offers an accommodation \( a > 0 \), then this accommodation strictly reduces the probability of revolution: \( \beta_{a_n, \gamma_a} - \beta_{a_0, \gamma_a} \).

Next, we consider how \( U_G(a, \theta, n) - U_G(a_0, \theta, n) \) varies with respect to changes in types by differentiating with respect to \( \theta \):

\[ \frac{d}{d\theta}(U_G(a, \theta, n) - U_G(a_0, \theta, n)) = \left( \beta_{a_n, \gamma_a} - \beta_{a_0, \gamma_a} \right) < 0 \].

This yields the following lemma.

**Lemma 3.** For any \( n \in \mathcal{N} \), higher types (larger \( \theta \)) offer smaller accommodations.

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**REFERENCES**


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17. We generate analogous results if we assume the government does not observe the signal \( n \). Under these conditions, we need to integrate with respect to \( n \). Thus, \( U_G(a, \theta) - U_G(a, \theta) \geq 0 \) reduces to

\[ \int_{\text{all } n} p(n|\theta)[(\beta_{a_n, \gamma_a} - \beta_{a_0, \gamma_a})] dn + a \int_{\text{all } n} p(n|\theta)(\beta_{a_n, \gamma_a} - 1) dn \geq 0. \]

Again, this implies that \( \int_{\text{all } n} p(n|\theta)[(\beta_{a_n, \gamma_a} - \beta_{a_0, \gamma_a})] dn \) is negative, which gives the same results.


