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How Rebellion Expands? From Periphery to Heartland*

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Abstract

While the theoretical literature maintains that strategic coordination is one of the keys to successful rebellion, anti-governmental campaigns are not necessarily synchronized across rebel groups in observed civil wars. To resolve this discrepancy, we develop a dynamic and spatial model of rebellion that illustrates patterns of contagious challenges against a government. As battles evolve, more rebels are inclined to "bandwagon," joining the ongoing war because the government is gradually revealed to be weak and because accumulated challenges shift the balance of power away from the government. Our theory also addresses why rebel movements often spread across the periphery and can eventually reach the heartland as if a siege shrinks. We delineate four geographic patterns of rebellion and then classify into them the Yugoslav Wars and other historical incidents.

Keywords: bandwagoning; geopolitics; expansion of rebellion.

JEL classifications: D74; F51.

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1 Introduction

When two political factions commonly confront an oppressive, and possibly despotic, sovereign, they naturally seek the possibility of pact or alliance to aggregate and leverage their power. Even when it is hardly possible for either faction solely to defeat the sovereign, the chances increase substantially if the two factions cooperatively synchronize their anti-sovereign campaigns. Weingast (1997) interprets such rebel strife as a coordination problem, whose solution necessitates a mechanism to limit the government and thus constitutes an integral component of the rule of law. As the theory applies to the masses, strategic coordination becomes even more critical for citizens, since power is much more sparsely distributed across the general populace than elites. Fearon (2011) generalized Weingast's two-player coordination game to many-player settings. He maintains that the very role of democracy is to render citizens the opportunity to coordinate their protests and create social consensus about when to replace the ruler, while criticizing other accounts of democracy for the lack of functional appeal (Przeworski 1991; Acemoglu and Robinson 2000, 2001; Boix 2003).¹ On very similar grounds, both Weingast and Fearon presume that anti-governmental strife can hardly thrive without strategic coordination across rebels or protesters. The Glorious Revolution, for instance, is an archetypal historical incident supportive of Weingast's theory in that the expulsion of James II owed heavily to the compromise between the relatively loyal Tories and the disobedient Whigs. In the international context, the American Revolution constitutes another incident of coordinated rebellion, where the thirteen colonies acted in unison to secede from the British regime. A close scrutiny on other rebel movements, however, suggests that strategic coordination is not necessarily a prerequisite for success in anti-governmental strife.

In the dismantling of former Yugoslavia during the past few decades, for instance, there was no formal alliance among separatist minorities to fight hegemonic Serbia. Although separatists of various ethnic groups defied the common threat from Belgrade, they did not synchronize their challenges (except for the simultaneous Slovene and Croatian declarations of independence in June 1991). Instead, the pattern of the Yugoslav wars unfolded as a series of ethno-specific challenges, which gradually

¹According to Fearon (2011), an electoral outcome with free speech functions as a public signal to arrange social consensus.

accumulated as the wars proceeded. Slovenia's inclination toward independence, as proclaimed by the 1990 referendum, initially spurred Croatia to exit the Federation.² Subsequently, galvanized by Slovenia's decisive victory in the Ten-Day War, Macedonia, Bosnia and Herzegovina, Montenegro, and finally Kosovo ensued with substantial time lags, resulting in the breakup of Yugoslavia as a sovereign state.³ With the exceptions of Macedonia and Montenegro, whose secessions incurred no or little casualties, these separatist movements resulted in a gradual escalation of wars between the hegemonic Serbs and several ethnic minorities.

A similar pattern of spreading challenges can be seen among inter-state wars, too. By 1811, Napoleonic France established her dominance on the European continent, and most parts of the continent once fell under her control. However, durable resistance in the Iberian peninsula inspired Russia to leave the France-led coalition by transgressing the Continental Blockade or an economic sanction on France's consistent rival Britain.⁴ Napoleon mobilized the Grande Armée to suppress Russia in 1812, but his failed invasion and futile retreat provoked further challenges from Prussia, Sweden, and Austria, leading to Napoleon's abdication in 1814.

These patterns of anti-hegemonic challenges share the same feature of multi-party war illustrated by Blainey (1988):

General wars began simply as wars between two nations. Other nations were later drawn in. A general war was thus a series of interlocked wars happening simultaneously. In the growth of a general war the entry of additional nations was often like the fisherman who intervened while the waterbirds fought, or waterbirds who pounced while the fisherman slept (p. 232).

In other words, a series of bilateral wars overlap and escalate into a multi-party war. Although Blainey's illustration does not focus on war between a hegemon and its multiple adversaries, it casts doubt on simultaneity in challenges stressed by Weingast's and Fearon's models. Mirroring Blainey's illustration, Haldi (2003: 159) insists

²Croatia seceded in part because the Federation without Slovenia would frame the Croats as a minority beneath the Serbs (Fearon 1998: 126).

³To be precise, Kosovo has declared independence twice since 1991. The first attempt was on October 1991, and the second on February 2008. In spite of these attempts, Kosovo's sovereignty has not yet been internationally recognized.

⁴Before Russia's transgression, Austria also exploited turmoil in the Iberian peninsula by invading Bavaria, but the plot ended in an utter failure.

that alliances cannot explain the widening of wars because most of alliances are formed during conflicts, not before them.

To delineate this sequential pattern of war between a government (a hegemonic state in the international context) and several rebel groups (vassal states), we develop a dynamic model, which incorporates into the standard coordination game the following three features: (i) two social groups (players) are uncertain about the government's strength; (ii) battle outcomes are unpredictable due to the "fog of war" (Clausewitz [1832] 1976); (iii) these groups are heterogeneous in terms of resolve and strength. Built upon these features, our theory holds that rebel challenges may not simultaneously arise because either group opportunistically chooses the side it belongs to, contingent upon the tide of battles between the government and the precedent rebel group. Namely, either group may remain to acquiesce the government until the reports from battle fields convincingly indicate that the government is so weak that the challenge is worthwhile.⁵ We formally theorize this decision-making process by the Bayesian method, based on the model's three features mentioned above.

From another point of view, for a rebellion to break out without strategic coordination such as alliance, there must be an "instigator" (or a leading political unit) who has the resolve and strength to solely challenge the government even without other parties' guaranteed military support. Our theory maintains that the instigator can inspire other discontent parties by demonstrating the government's weakness through his own insurgent campaigns and also by shifting the balance of power in rebels' favor.⁶ As the instigator's battles evolve, others may "bandwagon," joining the ongoing rebellion, depending on the instigator's military performance. This endogenous and gradual formation of a social agreement to demolish the status quo is overlooked in existing models, which commonly treat the social consensus as exogenously assumed.⁷

On the contrary, if there is no instigator or a party with outstanding resolve and strength, then those discontent with the status quo may seek prewar alliance. Due to

⁵Technically, an opportunistic party's decision to join an ongoing rebellion depends mainly on the following two factors: (a) the chance to defeat the government jointly with the precedent rebel group; (b) the risk of being defeated by the government. As the precedent rebel group resists the government's suppression, the government is gradually revealed as weak, so that factor (a) dominates (b) in some time period, spurring the opportunistic party toward war.

⁶In our theory, no particular rebel group is exogenously appointed to be an instigator, but he endogenously emerges in equilibrium.

⁷For instance, Weingast points out a charismatic leader's role in creating social coordination such as an elite pact or inter-ethnic coalition, but he remains silent on the issue of how a leader can bring about the coordination.

the lack of an instigator, no battle takes place before the formation of alliance, and neither is the government's strength revealed. Alliance thus conditions that all its participants are willing to collectively fight the government even when not knowing the government's strength, though none of the participants is strong enough to initiate fighting alone. Our theory therefore implies that *rebel groups are likely to coordinate their challenges if they are homogeneous in terms of resolve and strength* and that *such a coordination is less likely if they are heterogeneous*. The former implication is consistent with Weingast's (1997) and Fearon's (2011) theories, both of which assume homogeneity among rebel groups.

We further deliver geopolitical implications. Because it is more difficult for a government to suppress rebels far away than nearby (DeRouen and Sobek 2004; Fearon 2004), an instigator plausibly nests in a remote area or beyond geographic safeguards.⁸ The general direction of rebellion spreading among multiple rebel groups is therefore inward. Namely, in light of three or more rebel groups, *a rebellion initiates at a geographic fringe and then spreads across peripheral areas. Once the government is besieged by rebels in the periphery, those in the rimland may join the fighting. As the war further escalates, this siege gradually shrinks and can finally reach the heartland*. This pattern of geographic diffusion can be confirmed in the Yugoslav Wars, the Napoleonic Wars, the American Civil War, and the Boshin War (Section 5). Depending on the possibility of alliance, one of the following four patterns of rebellion expansion may emerge: (i) *a snowballing rebellion*, which gradually escalates as more challengers are drawn in (Napoleonic Wars); (ii) *a catalytic rebellion*, where a sole instigator provokes a galvanizing event to inspire all others' simultaneous challenges (Boshin War); (iii) *a partially coalitional rebellion*, which is initiated by a subset of *ex post* rebels (American Civil War, Yugoslav Wars); (iv) *a fully coalitional rebellion*, for which all the rebels act in unison (American Revolution, Glorious Revolution).

The rest of this article proceeds as follows. Section 2 reviews the literature. Section 3 presents and solves the dynamic and spatial model of rebellion. Section 4 illustrates four patterns of rebellion expansion and addresses when each of them is likely to emerge. Section 5 connects our theory to historical incidents. Section 6 concludes.

⁸Using the Napoleonic Wars as examples, Clausewitz ([1832] 1976: 527) illuminates this diminishing property of force. Boulding (1962: 58) also introduces a similar concept in his words "loss of strength gradient."

2 Literature Review

There are plenty of theoretical studies on why war begins (Fearon 1995; Powell 1999) and how it ends (Wagner 2000; Filson and Werner 2002; Slantchev 2003; Powell 2004; Fearon 2007) in dyadic environments, but few theoretical investigations have been devoted to *how war expands*, perhaps due to the difficulty of modeling multilateral wars (Jackson and Moreli 2011).⁹ We tackle this issue by focusing on a particular form of war—war between a hegemon (government) and its challengers (rebels).¹⁰ Formal modelling of this form of war is particularly relevant to civil-war studies because one of the unique features of civil war is that while a government is hierarchically organized and can act as a single decision-making body, rebels are often decentralized and occasionally too disorganized to adopt collective tactics.

There are at least two major approaches to formally theorizing multiple-party rebellion. One is to treat it as a collective action problem (Olson 1965: 105-110), which holds that citizens lack the incentive to join rebellion although they could depose a tyrant if they acted collectively. The other is to treat it as a coordination problem (Weingast 1995, 1997, 2005; Fearon 2011), according to which social groups or citizens are willing to participate in rebellion only when others also participate (except for the mixed-strategy equilibrium). Neither theory can explain why rebellions (or wars against a hegemon in the international context) often evolve only gradually. The theory of collective action fails because of individuals' unwillingness to sacrifice their private interests for collective ends. The theory of social coordination also fails because according to it, a rebellion breaks out only when rebels mount challenges simultaneously, not sequentially. In our theory, on the other hand, after someone provokes a rebellion, the incentive for others to join the fight against the government is nourished as battles continue since lengthy fighting implies the government's inability to promptly suppress the rebels. Put another way, our theory describes the transition of the model's payoff structure from the collective-action type to the social-coordination one by Bayesian learning.¹¹

⁹Reiter (2003) surveys the bargaining theories of war.

¹⁰In this sense, contagion in civil war examined in this article is internal—all rebels challenge the same sovereign—and should be distinguished from external contagion where rebel movements spread across states (Lake and Rothchild 1998).

¹¹In contrast, Weingast (1995, 1997, 2005) reconciles the two theories by side payments: a sovereign may appease one of her subjects by transferring payoff in order to fractionalize and weaken the rebels. Drawbacks of Weingast's model are summarized in the online Appendix A (available upon request).

3 Model of Rebellion

We provide a dynamic and spatial model of rebellion, illustrating a situation where two political units individually choose (not) to fight their common adversary. The model can apply to at least three political contexts: (i) a separatist war in which ethnic minority groups challenge their host state in order to secede from the status quo regime;¹² (ii) a revolution in which political parties or economic classes rise in revolt against the sovereign; (iii) an inter-state war in which vassal states take up arms against the suzerain state to seek greater autonomy.

3.1 The Model's Structure

In the model, there are two social groups ($i \in \{\alpha, \beta\}$) that are discontented with the status quo maintained by the government. In the first period $t = 1$, each of the two groups decides to "fight" or "acquiesce" to the government. Also, in subsequent periods $t = 2, 3, \dots$, any group that has not yet fought the government decides whether to fight or not. If group i chooses to fight, inflicting a lump-sum cost c_i , the battle results in one of i 's "win," "holdout," and "loss" in that period, depending on the government's (later-specified) military strength G relative to the rebels'. If i "wins" ("loses"), the war ends with i 's one-shot gain w_i (loss l_i). If i "holds out" in a battle, the war continues to the next period. The payoff from "acquiesce" is normalized to be zero.

Once a group starts fighting, it cannot withdraw its army, and the battle evolves until the group "wins" or "loses" the war (Figure 1).¹³ In other words, a group's decision is when to fight or permanently acquiesce. On the other hand, the government is assumed not to make any strategic decision; i.e., the government is committed to suppressing rebellion to preserve its sovereignty.¹⁴ The game continues until every group's battle ends decisively with a "win" or "loss."

¹²Ethnic groups decide to secede or not quite strategically (Walter 2006a).

¹³Our model does not allow the possibility of negotiated settlement between the government and the rebels because the government risks its legitimacy if it openly negotiates with the rebels (Licklider 1995).

¹⁴Walter (2006b; 2009) explains a government's resolve to suppress rebellion by its reputational concerns: if the government settles a deal with a separatist group, other ethnic minorities would become skeptical of the government's resolve and capabilities, and thus their separatist movements would escalate. In a similar context, Alt et al. (1988) conducted a theoretical investigation on a hegemon's strategic decision to build its reputation. Our model, by contrast, assumes away the government's counter-insurgency problem and focuses on rebels' strategic interdependency.

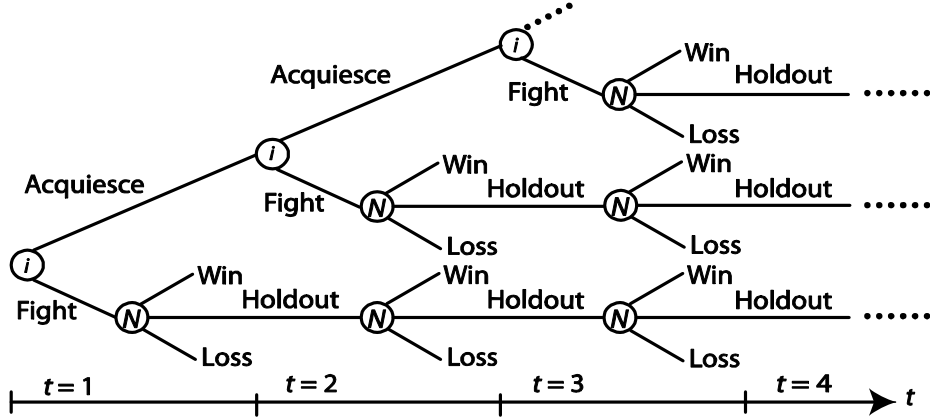


Figure 1: Group i 's decisions and paths.

3.2 Spread of Information

The model captures the uncertainty of the government's strength. The two groups do not know the government's true strength g , which is binary: low or high ($g \in \{g^L, g^H\}$ with $g^L < g^H$), but they know the prior probability distribution $\Pr(g)$.

Each group i is given a parameter r_i , which denotes i 's strength or robustness. On the ground that rebels nesting in remote areas or beyond geographic safeguards are naturally difficult for the government to repress ("diminishing force of the attack" Clausewitz [1832] 1976: 527; "loss of strength gradient" Boulding 1962: 58), r_i is possibly associated with i 's such safeguards. Based on this presumption, we seek the model's geographic implications toward the end of the article.

A battle outcome depends on the government's relative military strength:

$$G \equiv g - \sum_{i \in \{\alpha, \beta\}} I_i r_i \text{ for } g \in \{g^L, g^H\},$$

where I_i is an indicator which is zero if group i acquiesces or has fought but lost the war (i.e., $I_i = 0$ for i 's "acquiesce" or "loss"), while it is one if i is fighting the government or has won the war ($I_i = 1$ for i 's "win" or "holdout"). This means that as more groups challenge the government, the balance of power shifts away from the government, but it shifts back if a rebel group is defeated.

Each of the two groups is assumed to be weaker than the government.

Assumption 1 For $i \in \{\alpha, \beta\}$, $r_i < g^L$.

Given the relative strength G , "nature" determines group i 's battle outcomes in period t ($h_{i|t} \in \{win, hold, loss\}$) with the following restrictions: (i) neither group can solely defeat a strong government; (ii) rebels are more likely to win (both a per-period battle and the entire war) if they are stronger; (iii) a war is more likely to be prolonged if military capabilities between warring parties are closer. The power balances perfectly when $G = 0$.

Assumption 2 For $i \in \{\alpha, \beta\}$, (i) $\Pr(win|G_i^L) > 0$ and $\Pr(win|G_i^H) = 0$, where G_i^L (G_i^H) denotes the government's relative strength if i is fighting the government with strength g^L (g^H). (ii) Both $\Pr(win|G)$ and $\frac{\Pr(win|G)}{\Pr(win \cup loss|G)}$ decrease with G until they reach zero.¹⁵ (iii) $\Pr(hold|G)$ decreases with $|G|$.

When both groups are simultaneously fighting the government, they are assumed to operate the same campaign; namely, the two groups' battle outcomes are identical probabilistic events ($h_{\alpha|t} = h_{\beta|t}$).

Once either group initiates war, the other group infers the government's true strength g from a series of reports from battle fields. For instance, if α holds out the first battle (denoted as $hold_{\alpha|1}$), β updates its belief as to the government's low strength by Bayes' rule:

$$\begin{aligned} \Pr(g^L|hold_{\alpha|1}) &= \frac{\Pr(g^L) \Pr(hold|G_\alpha^L)}{\Pr(g^L) \Pr(hold|G_\alpha^L) + \Pr(g^H) \Pr(hold|G_\alpha^H)} \\ &= \frac{1}{1 + \frac{\Pr(g^H) \Pr(hold|G_\alpha^H)}{\Pr(g^L) \Pr(hold|G_\alpha^L)}}. \end{aligned}$$

More generally, β 's belief based on α 's battles until period T can be shown as:

$$\Pr(g^L|h_{\alpha|T}) = \frac{1}{1 + \frac{\Pr(g^H)}{\Pr(g^L)} \left(\frac{\Pr(hold|G_\alpha^H)}{\Pr(hold|G_\alpha^L)} \right)^{T-1} \frac{\Pr(h_{\alpha|T}|G_\alpha^H)}{\Pr(h_{\alpha|T}|G_\alpha^L)}}, \quad (1)$$

where α 's history is $(hold_{\alpha|1}, hold_{\alpha|2}, \dots, h_{\alpha|T})$.

Lemma 1 For $i \in \{\alpha, \beta\}$, (i) $\Pr(g^L|win_{i|T}) = 1$ for any $T \geq 1$, and (ii) $\Pr(g^L|hold_{i|T})$ increases with T .

¹⁵An implicit premise in (ii) is that $\Pr(hold|G) > 0$ regardless of G .

Proof. By Assumptions 1 and 2, $\frac{\Pr(\text{win}|G_i^H)}{\Pr(\text{win}|G_i^L)} = 0$ and $\frac{\Pr(\text{hold}|G_i^H)}{\Pr(\text{hold}|G_i^L)} < 1$ in Equation (1).

■

The interpretation of Lemma 1 is straightforward: (i) a rebel group's "win" reveals the government to be weak; (ii) an indecisive battle implies that the government does not possess the sufficient military capability to promptly police the rebel group. As the rebel group persists, the other group further lowers its estimate of the government's strength. This transition of the estimate can influence a potential rebel group's prospect of war and thus its decision to fight the government.

3.3 Mutual Influence Between Rebel Groups

In the current two-player setting, the following two patterns of rebellion can be considered. In one, two groups rebel in sequence.

Definition 1 *A rebellion is uncoordinated if it is initiated by group α and later joined by group β , depending on α 's battle outcomes.*

In the other, two groups rebel in unison.

Definition 2 *A rebellion is coordinated if it is provoked simultaneously by α and β .*

Below we focus on uncoordinated rebellion, for which the initial rebel group is denoted as α and the other as β . (The issue regarding the pattern and sequence of challenges will be tackled in Section 3.5.)

To analyze the players' incentives, we derive their expected payoffs from fighting. When α decides to challenge the government or not, it counts on β 's possible reinforcement. Anticipating β 's reinforcement after T -round battles, α rationally initiates rebellion in the first period if its expected payoff in Definition 1 is positive:

$$V_{\alpha|1}^I(T) \equiv \sum_{g \in \{g^L, g^H\}} \Pr(g) \left(\sum_{t=1}^T \Pr(\text{hold}|G_\alpha)^{t-1} \pi_\alpha(G_\alpha) + \Pr(\text{hold}|G_\alpha)^T \Pi_\alpha(G_{\alpha,\beta}) \right) - c_\alpha, \quad (2)$$

¹⁶ $G_{\alpha,\beta}$ denotes the government's relative strength when it simultaneously fights α and β .

where $\pi_i(G)$ for $i \in \{\alpha, \beta\}$ is i 's per-period payoff given G , and $\Pi_i(G)$ i 's continuation payoff:

$$\begin{aligned}\pi_i(G) &\equiv \Pr(\text{win}|G) w_i - \Pr(\text{loss}|G) l_i \\ \Pi_i(G) &\equiv \sum_{t=1}^{\infty} \Pr(\text{hold}|G)^{t-1} \pi_i(G).\end{aligned}$$

Equation (2) shows that $V_{\alpha|1}^I(T)$ consists of per-period payoffs before β 's reinforcement, which occurs in period $T + 1$, and payoffs in and after $T + 1$, indicating that α 's decision to fight hinges critically on the timing of β 's participation ($T + 1$), the likelihood of α 's survival until β 's participation ($\Pr(\text{hold}|G_\alpha)^T$), and the significance of β 's military support ($r_\beta = G_{\alpha,\beta} - G_\alpha$).

On the other hand, if β rebels in period $T + 1$, β 's expected payoffs conditional on α 's T -period battle outcomes $h_{\alpha|T} \in \{\text{win}_{\alpha|T}, \text{hold}_{\alpha|T}, \text{loss}_{\alpha|T}\}$ are:

$$\begin{aligned}V_{\beta|T+1}^I(\text{win}_{\alpha|T}) &\equiv \Pi_\beta(G_{\alpha,\beta}^L) - c_\beta \\ V_{\beta|T+1}^I(\text{hold}_{\alpha|T}) &\equiv \sum_{g \in \{g^L, g^H\}} \Pr(g|\text{hold}_{\alpha|T}) \Pi_\beta(G_{\alpha,\beta}) - c_\beta \\ V_{\beta|T+1}^I(\text{loss}_{\alpha|T}) &\equiv \sum_{g \in \{g^L, g^H\}} \Pr(g|\text{loss}_{\alpha|T}) \Pi_\beta(G_\beta) - c_\beta,\end{aligned}$$

where the government is fully revealed as weak when α "wins" (Assumption 2-(i)), and it is more likely for β to defeat the government when α "holds out" than when it "loses" ($G_{\alpha,\beta} < G_\beta$). Based on its latest estimate of the government's strength, β deliberately decides to fight or not.

If β 's rational decision is independent of α 's battle outcomes or the government's relative strength, an additional report on α 's battles does not contribute to β 's better decision-making, so that it makes no sense for β to learn from α 's fighting. For the government's relative strength to influence β 's decision, we reasonably impose the following restrictions on preferences:

Assumption 3 (i) Jointly with α , β is willing to fight if the government is weak but unwilling if it is strong; i.e., $\Pi_\beta(G_{\alpha,\beta}^H) < c_\beta < \Pi_\beta(G_{\alpha,\beta}^L)$. (ii) Without α 's assistance, β is unwilling to fight even the weak government; i.e., $\Pi_\beta(G_\beta^L) < c_\beta$.

By Assumption 3-(i), α 's victory provokes β toward the rebellion, and β 's rational decision during α 's fighting is conditional on the latest estimate of the government's

strength. (Without this assumption, β might "fight" or "acquiesce," regardless of α 's battle outcomes.) By (ii), α 's defeat dampens β 's willingness to challenge the government.

3.4 Timing of Bandwagoning

To solve the model by backward induction, we first derive lagged challenger β 's timing to join initial challenger α 's rebellion and then find the condition for the rebellion's outbreak.

While α 's rational decision can be derived immediately from the comparison of payoffs between "fight" in the first period and "acquiesce" permanently, β 's decision analysis is not so straightforward. In fact, what β chooses is not just whether to fight or acquiesce in a period but also when to rebel if it does so. Positiveness of the expected payoff from fighting ($V_{\beta|T+1}^I(hold_{\alpha|T})$) does not necessarily rationalize β 's decision to fight because β can be better informed of the government's strength by postponing the decision as long as α is holding out. Therefore, β must assess the relative merit and demerit of fighting today and waiting to make a better decision tomorrow.

If α 's battles do not convey enough information about the government's strength, β would not postpone its fighting for the informational advantage. We rule out such an uninteresting case by imposing the following restriction on the prior distribution of g :

Assumption 4 *The prior probability that the government is strong is so large that at least one period of acquiescing is worthwhile to β or that*

$$\Pr(g^L) \Pr(loss|G_{\alpha}^L) (\Pi_{\beta}(G_{\alpha,\beta}^L) - c_{\beta}) < \Pr(g^H) \Pr(loss|G_{\alpha}^H) (c_{\beta} - \Pi_{\beta}(G_{\alpha,\beta}^H)). \quad (3)$$

Without Assumption 4, β would immediately fight, implying that the two challenges would occur simultaneously in the first period. The assumption also suggests that the effects of acquiescing in a period are twofold: if α is solely defeated by the government, β can avoid the risk of erroneously challenging the strong government by abandoning fighting (expressed in the right-hand side of Inequality (3)); however, α 's defeat also deprives β of the chance to subvert the weak government jointly with α

(in the left-hand side). The comparison between these gain and loss from acquiescing determines the optimal timing of β 's bandwagoning.

Lemma 2 *Suppose group α initiates a rebellion. (i) Once α "wins," β immediately challenges the government. (ii) If α "loses," β acquiesces forever. (iii) As long as α "holds out," β acquiesces until period T_β and then joins α 's rebellion, where T_β is the smallest T which violates Inequality (3) with $\Pr(g^L|hold_{\alpha|T})$ and $\Pr(g^H|hold_{\alpha|T})$ instead of $\Pr(g^L)$ and $\Pr(g^H)$, respectively.*

Proof. Assumption 3 trivially rationalizes β 's decisions in (i) and (ii). The proof of (iii) appears in the Appendix. ■

As α 's battle continues, β 's estimate of the government's strength gradually declines (Lemma 1), so that β becomes less likely to erroneously challenge the strong government, while more likely to waste the opportunity to defeat the weak government jointly with α . In other words, as β acquiesces longer, the gain from acquiescing gradually disappears, while the loss becomes more substantial. Thus, lengthy battles between the government and α induce β to attack the government before α is fully disarmed. In period T_β , β finds it no longer worthwhile to postpone fighting, and β then joins α 's rebellion.¹⁷

This simple analysis might explain why rebel movements spread sequentially and contagiously, not simultaneously. Once group α provokes rebellion, group β starts speculating on the government's true strength. As β waits longer, it will become more informed of the strength. Once β realizes that the government is sufficiently likely to be weak, it will participate in the rebellion. For β to take up arms, a certain length of time might be needed. Our theory explains this lagged participation in rebel movements by initial challenger α 's durability in battles and the time for informational spreading.

From a technical standpoint, uncertainties both of the government's strength and of battle outcomes are necessary for the time lag in fighting between the rebel groups. If it were almost certain that the government is weak, rebels would have no reason to postpone fighting and challenge the government simultaneously, as in Weingast's (1997) model. In fact, Weingast's model is equivalent to ours with deterministic battle outcomes (i.e., no "fog of war"): $\Pr(win|G_{\alpha,\beta}) = 1$; $\Pr(loss|G_i) = 1$ for $i \in \{\alpha, \beta\}$.

¹⁷The dynamic of β 's incentives is illustrated in a numerical example in Section 3.6.

3.5 Outbreak of Rebellion

When rebels conspire against a government, they may strategically coordinate their challenges by forming a coalition to ensure success. However, due to lack of communication channels caused by factors such as long-lasting hatred, mutual distrust, disparity in value systems, or geographic hindrance, strategic coordination is not always an option among rebels.

The proposition below suggests that a rebellion can break out even in light of such communicational obstacles if there exists an "instigator," or leading rebel α , which is so strong and resolved that it can provoke the other group β toward rebellion.

Proposition 1 *Even without strategic coordination, a rebellion can break out as initiated solely by group α if and only if it is so strong and resolved that $V_{\alpha|1}^I(T_\beta) \geq 0$, where T_β is of Lemma 2.*¹⁸

Proof. The proof is straightforward and thus is omitted. ■

We next incorporate into our model the process toward strategic coordination specified as follows. Before the rebellion's onset, each group is given the option to propose a collective campaign to the other. If a proposal is placed by a group and accepted by the other, they mount a collective rebellion in the first period. Otherwise, they make their decisions to fight or not individually.

The following proposition shows that rebels do not necessarily synchronize their challenges even if such coordination is an option.

Proposition 2 *With the means to coordinate their challenges, the two groups fight the government simultaneously if and only if no group is so strong and resolved to solely initiate a rebellion in the sense that $V_{\alpha|1}^I(T_\beta) \not\geq 0$, where T_β is of Lemma 2, but both of them are resolved enough that $\min \{V_\alpha^{II}, V_\beta^{II}\} \geq 0$, where V_i^{II} for $i \in \{\alpha, \beta\}$ is i 's expected payoff from joint, simultaneous fighting (Definition 2):*

$$V_i^{II} \equiv \sum_{g \in \{g^L, g^H\}} \Pr(g) \Pi_i(G_{\alpha, \beta}) - c_i.$$
¹⁹

¹⁸The outbreak of uncoordinated rebellion hinges on strong military (large r_α) and unyielding resolve, which consists of obsession for victory (large w_α), fearlessness of defeat (small l_α), and little cost of fighting (small c_α). Among these factors, only a strong military can influence β toward fighting. Even when α proclaims rebellion, β is unlikely to be drawn in if α is not strong enough to durably resist the government's suppression (or if $\Pr(\text{hold} | G_\alpha)^T$ is not so large).

¹⁹The two groups would also simultaneously challenge if neither group has the incentive to acquiesce or if Assumption 4 fails.

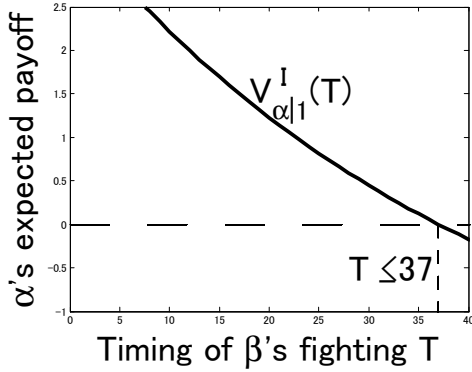
Proof. If $V_{\alpha|1}^I(T_\beta) \geq 0$, β would delay fighting or $T_\beta \geq 1$ (Assumption 4), so it must be that $V_{\alpha|1}^I(T_\beta) \not\geq 0$. For simultaneous "fight" to be at least as good as permanent "acquiesce," it must also be that $\min \{V_\alpha^{II}, V_\beta^{II}\} \geq 0$. These conditions are sufficient as well as necessary. ■

For a rebellion to be coordinated, all participants must possess the willingness to fight simultaneously even at a sizable risk that the government is strong. A coordinated rebellion also requires that there is no group outstanding in terms of resolve and strength because if there is, the other group might be better off by delaying its challenge. In this regard, rebel movements might not be so conventionally synchronized as previously considered. To say the least, the means of coordination does not guarantee its adoption. On the contrary, an uncoordinated rebellion requires an instigator who is willing to initiate fighting even without the other group's committed reinforcement. Propositions 1 and 2 thus imply that *a coordinated rebellion is more likely to break out if rebel groups are homogeneous in terms of resolve and strength and that an uncoordinated rebellion is more likely if they are heterogeneous.*

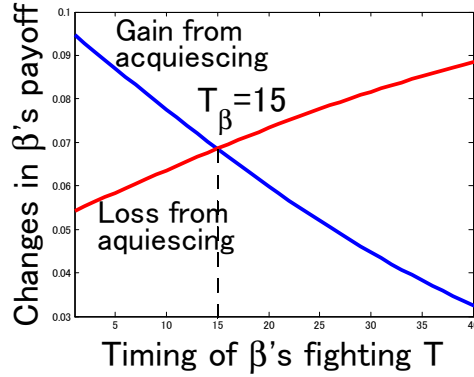
From geographic point of view, the model also suggests that an instigator is likely to nest in areas free from the government's influence or beyond geographic or climatic safeguards on the presumption that rebels in these areas are difficult for the government to police promptly (plausibly with a larger r_α). While the instigator holds out, rebels in areas closer to the government are incited to be drawn in. Thus *an uncoordinated rebellion may spread from geographic fringes to the center of the state.* As explored in Section 5, this pattern of contagion can be observed commonly in Yugoslav Wars, Boshin War, American Civil War, Napoleonic Wars.

If there is no instigator α such that $V_{\alpha|1}^I(T_\beta) \geq 0$, a rebellion can take place only in a coordinated manner in equilibrium. If there is only one instigator, a rebellion takes place even without strategic coordination, and the sequence of fighting is uniquely determined in equilibrium.²⁰ If both groups are resolved and strong enough to serve as an instigator, multiple equilibria emerge. In this situation, either group can initiate fighting. However, given that rebels with dispersed power naturally face difficulties with overthrowing a government, the multiplicity, rather than scarcity, of instigators would not be of importance.

²⁰Trivially, the strategy profile by which both groups acquiesce permanently forms a perfect Bayesian equilibrium on the ground that neither believes the other ever rebels. We rule out such an equilibrium by imposing the sequential rationality on lagged challengers off the equilibrium paths.



(a) α 's incentive to fight



(b) β 's incentive to fight

Figure 2: Strategic interdependency between the two groups.

3.6 Numerical Example

The strategic interdependency between the two groups is illustrated in Figure 2, where α is stronger and more resolved than β : $w_\alpha = 12$; $l_\alpha = 3$; $c_\alpha = 1$; $r_\alpha = 7$; $w_\beta = 8$; $l_\beta = 3$; $c_\beta = 1$; $r_\beta = 3$; $g^L = 8$; $g^H = 12$; $\Pr(g^L) = \Pr(g^H) = \frac{1}{2}$; $\Pr(\text{hold}|G) = \frac{99}{100} \exp\left(-\frac{|G|}{100}\right)$; $\Pr(\text{win}|G \in [0, 5)) = \Pr(\text{loss}|G \in (-5, 0)) = \frac{1}{200} \exp\left(-\frac{|G|}{2}\right)$. It can be seen in (a) that α would not rebel if β 's reinforcement is too late ($T > 37$). In (b), as α 's battle evolves (or as T rises), β 's gain from acquiescing falls while the loss rises. Right after the 15th round of α 's battle when the government is revealed likely enough to be weak, β will join α 's rebellion, that happens with probability 0.593. An uncoordinated rebellion becomes impossible when $c_\alpha = 3$, with which the coordinated rebellion takes place.

4 Four Patterns of Rebel Expansion

In this section, the model is extended to incorporate three discontent groups ($i \in \{\alpha, \beta, \gamma\}$).

4.1 Definitions

Whereas observed rebellions often involve more than three groups, this three-player setting suffices to portray the following four general patterns of rebellion. (Without loss of generality, we label rebel groups from the first α to the last γ in Greek

alphabetical sequence.)

Definition 3 *A rebellion is snowballing if it is initiated solely by α and then joined by β and even later by γ .*

Definition 4 *A rebellion is catalytic if it is provoked by α and then amplified simultaneously by β and γ .*

Definition 5 *A rebellion is partially coalitional if it is waged jointly by α and β and later entered by γ .*

Definition 6 *A rebellion is fully coalitional if all three groups fight simultaneously.*

In scenarios involving more than three groups, even more complicated patterns may emerge, but they still fall into some combination of these four patterns.

4.2 Analysis

Below we investigate the players' incentives and informally delineate the condition for each pattern of rebellion to emerge.²¹

As in the two-player game, analysis of the initial rebel α 's incentive is straightforward: α is willing to challenge the government if it expects β and γ 's reinforcements likely and reliable enough. Also as in the two-player game, the last rebel γ chooses to bandwagon when its predecessor(s) α (and β) reveal the government to be sufficiently weak. On the other hand, β 's decisionmaking is more complicated—when β decides the timing of fighting, it takes into account the following two conflicting factors: the possibility of α 's defeat and the timing of γ 's participation. If β fights earlier, α is more likely to survive, but β must endure longer until γ 's reinforcement. In contrast, if β delays fighting, it can anticipate γ 's reinforcement soon, but α is more likely to be defeated alone. By comparing these relative merits and demerits, β determines the timing of fighting.

Depending on the distribution of power across the government and the rebels ($g, r_\alpha, r_\beta, r_\gamma$) as well as on the rebels' resolve (w_i, l_i, c_i for $i \in \{\alpha, \beta, \gamma\}$), one of the following four patterns of rebellion may emerge:

²¹The formal analysis of this three-player model is lengthy and technically tedious. We thus leave it in the online Appendix B (available upon request).

- A snowballing of rebel movements is most likely when the three groups are heterogeneous in terms of strength and resolve; the first group (α) is outstanding to lead the rebellion; the second (β) also overpowers the third (γ). Put more concretely, in period one, while α is willing to fight, the two others are not; also in some later period, while β is, γ is not. The rebellion then escalates in sequence, generating a snowball effect.
- A catalytic rebellion may take place if one group (α) is outstanding in strength, while the two others (β and γ) share similar propensities for fighting. When α provokes the rebellion, β and γ are unwilling to take up arms even jointly with others. However, as the rebellion evolves, they update their evaluation of the government's strength, convincing themselves that the challenge is worthwhile if the other also rebels. The coordination dilemma then afflicts them. After a certain length of α 's battles, β and γ 's joint challenges in any period can be in equilibrium. In light of such multiple equilibria, the instigator α would be eager to generate Schelling's (1960) focal point—a catalyst—in order to assist β and γ in coordinating their challenges. For instance, the instigator would bring about a galvanizing event such as establishing its legitimacy or garnering international recognition in order to implicate a larger population into the rebellion.
- A partial coalition is sought by a pair of groups (α and β) that are unwilling to solely challenge the government but willing to jointly do so. Depending on α and β 's success in their campaigns, the last group (γ) may also rebel.
- A full coalition is most likely the power is distributed equally across the three (α , β and γ) in the sense that no sole group or pairwise coalition is willing to fight, but all three prefer collective challenges to permanent subordination.

These predictions are consistent with the theoretical literature in their claim that strategic coordination is required for the outbreak of a rebellion across homogeneous groups, but we deliver an additional claim that even without strategic coordination, a rebellion can break out if there is an instigator who is resolved enough to mount a challenge and is strong enough to convince others to join the rebellion.

4.3 Geographic Implications

The discussions above indicate that power distribution across rebel groups can influence the pattern of rebellion: (i) a stronger and more resolved group tends to fight earlier; (ii) groups with similar strength and bellicosity tend to fight together. In addition, by interpreting r_i as the extent to which i is protected by geography (Section 3.2), we can elicit inferences on how geographic factors matter for the rebel pattern. Put concretely, since a rebel farther away from the government is harder to repress (with a larger r_i), it can be inferred: (i') a group farther away from the government tends to fight earlier; (ii') groups in similar geographic relations to the government tend to fight together.

To deduce these inferences, a rebellion is likely to break out in a geographic fringe; it then spreads across remote areas where the government's influence is limited; if the rebellion in remote areas accomplishes certain success, it further expands to areas closer and even closer to the government. In geopolitical language (Mackinder 1942; Spykman 1944), *ceteris paribus, a rebellion tends to expand from the periphery through the rimland to the heartland as if a siege surrounding the government gradually shrinks.*²² A corollary to this implication is that geography also matters for groups' political stances to the government: those in the periphery tend to be disobedient and even hostile; those in the rimland opportunistic; those in or near the heartland obedient or loyal.²³ A caveat is that geography is not the sole factor in determining patterns of rebel diffusion. As discussed later, a variety of other factors can plausibly influence the patterns of rebellion. Nonetheless, this geographic pattern can largely be confirmed by historical incidents as outlined in Section 5.

4.4 Numerical Example

The next numerical example confirms our intuition that the power distribution across the rebel groups is a key determinant of the sequence of rebel movements.

If rebel α of the numerical example in Section 3.6 is split into two groups α and β ($r_\alpha = 4$ and $r_\beta = 3$), with the last rebel relabeled as γ , a snowballing rebellion emerges. In the new equilibrium, where $T_\beta = 10$ and $T_\gamma = 15$, β fights with probability

²²This also explains why a government often fights for terrain with little economic value (Walter 2009). It must build a reputation of its resolve to deter additional challengers later on.

²³In a related context, the distance to the state's capital influences the scope of civil war, and vice versa (Buhaug and Gates (2002)).

0.509, and γ fights with probability 0.428. If β becomes less bellicose such that $w_\beta = 8$, β and γ share the identical preference, so that they fight simultaneously, constituting a catalytic rebellion.

5 Historical Incidents

To materialize our theory, we relate it to the following five historical incidents: Napoleonic Wars (as snowballing challenges), Boshin War (catalytic rebellion); Yugoslav Wars and American Civil War (partial coalition); American Revolution (full coalition).

5.1 Napoleonic Wars: Snowballing Challenges

Our theory is applicable not only to rebellions, but also to anti-hegemonic inter-state wars such as the Napoleonic Wars.

The abrogation of the Treaty of Amiens in 1803 is considered as the Wars' onset. Since then, Britain had been consistently hostile to France. While the British navy won the Battle of Trafalgar in 1805, her army was not capable of solely counteracting France on the European continent. Britain exercised her diplomatic means to contain France in coordination with several continental powers, but France expanded her influence on the continent by repulsing her challengers. France became hegemonic in the continent, whereas Britain kept her naval supremacy (Ellis 2003: 78). To undermine Britain's interventions on the continent, Napoleon decreed the Continental Blockade in 1806, but pro-British Portugal objected in 1807 as did counter-revolutionary Sweden in 1808 (Dufraisse 1991: 103-104). France forcibly brought them into the Blockade, but the Spanish citizens rose in revolt, later supported by Britain, to overthrow the Napoleonic monarchy (Lentz 2005: 91).

Observing France troubled with the Iberian resistance, Russia also seceded from the Blockade and became secretly allied with Britain in 1810. To inflict a punitive charge, France invaded Russia in 1812. However, as the general frost approached, Napoleon was forced to abandon his strategic objectives and retreated from Russia in the winter of 1812 when Russia counterattacked and devastated the French army (Ellis 2003: 120). Once the power balance shifted away from France, those once allied with France shrewdly bandwagoned. Napoleon's military and strategic failures

in Russia inspired Prussia, Sweden, and Austria, in turn, to declare war on France in 1813 (Rothenberg 1999).²⁴ The allied anti-Napoleonic powers finally accomplished Napoleon's capitulation in 1814.

To relate the Wars to our theory, it was Britain which played the key role in instigating the continental powers into the Wars. Protected by the Strait of Dover, Britain repeatedly took the initiative to destroy the Napoleonic hegemony jointly with other states. Without such a geographic safeguard and her naval superiority, Britain might have been in a riskier position.

Presumably, other states' political stances to France were also influenced by geography. A general tendency perceived from the Wars is that states and regions near France or the heartland in geopolitical language (e.g., Swiss, Holland, Rhein, Rome, Italy) were obedient or even loyal to France, states in the rimland more opportunistic (Spain, Prussia, Austria), and states in the periphery disobedient or even hostile (Britain, Portugal, Sweden, Russia). This is conceivably because those closer to France tended to recognize her threats more real.

In addition, the Wars escalated gradually as if the challenges snowball. The challenges were sequential, not simultaneous, as anti-Napoleonic alliances developed during the wars, not before them (Haldi 2003: 159).²⁵ To visualize the pattern, the Wars spread from those farther away to those closer as if a siege shrinks (Figure 3). This pattern is consistent with our theoretical prediction that *ceteris paribus*, those stronger and farther (with a larger r_i) tend to fight earlier.

5.2 Boshin War: The Imperial Court as a Coordination Devise

The Boshin War (1868-1869) is one of the historical events that brought about Japan's political transition from Tokugawa's feudal regime to the constitutional empire. Although the War is interpreted to have begun with the Battle of Toba-Fushimi (present Kyoto) in 1868, the initial challenge to Tokugawa's regime provoke much earlier. It was actually in 1864 when the Choshu (Yamaguchi) domain first rose in arms (at the

²⁴Austria was the last among the great powers to join the Wars due partly to Hapsburg's marital bond to Napoleon since 1810.

²⁵Napoleon himself regarded the invasion to Portugal, not to Russia, as his turning point. In his retired life at St. Helena, Napoleon repented for the campaign in Portugal: "C'est ça qui m'a perdu." (This is what lost me.)

Kinmon incident and the first Choshu expedition). Choshu failed these campaigns, but the shogunate's despotic policies in subsequent periods induced the Satsuma (Kagoshima) domain to side with Choshu (Houya 2007: 9-10). In the second Choshu expedition of 1866, Choshu dispelled the shogunate's army, resulting in Tokugawa's loss of military supremacy and, in turn, the Tosa (Kochi) and Aki (Hiroshima) domains' participation in the anti-shogunate alliance.

Echoing the emperor's secret order to attack the shogunate, the alliance advanced its armies toward Kyoto to fight the momentous Battle of Toba-Fushimi, which Tokugawa lost decisively. Imperial flags raised by Choshu and Satsuma during the battle encouraged their soldiers and discouraged those of Tokugawa, demonstrating that Tokugawa and his supporters were no longer legitimate. Choshu and Satsuma were empowered while Tokugawa lost face (Sasaki 1994: 7, 26). With the emperor's order to chastise Tokugawa, Choshu and Satsuma demanded other domains to make the difficult decision of which side they belonged to—the former shogun or the emperor (Houya 2007: 69)—but within a month after Toba-Fushimi, all local domains in the West expressed their obedience to the new government (Houya 2007: 108). Sporadic battles were fought around Edo (Tokyo) and in the East, but the new government conquered the whole terrain by May 1869. In short, the war expanded from the peripheral Southwest to the heartland of Japan (Figure 3).

Two important lessons can be drawn from this incident. First, geography matters. Choshu, Satsuma, Tosa, and Aki were all the farthest from the Tokugawa's influence (Edo) in their islands. Although geography is merely one of the various factors that influence patterns of the spread of war, it is hard to imagine that the War could originate near Edo, where Tokugawa could crack down on rebels easily.

Second, the imperial court functioned as a coordination device across local lords to determine their political positions. In fact, since the emperor was a religious authority in that era, Satsuma and Choshu were eager to acquire the emperor's endorsement of their campaigns and publicize their legitimacy. Despite the fact that the emperor lacked any military force, the emperor's backup greatly influenced the subsequent tide of the war.

5.3 Yugoslav Wars: Partial Coordination

The Yugoslav Wars also escalated gradually but differently from the two previous cases. After Tito's death in 1980, Serbia sought a hegemonic status while other regions claimed greater autonomy. As ethnic tension became tangible, the Federation became politically destabilized. In 1990, Slovenia held a referendum regarding independence, whose motion was approved by the vast majority. This result stimulated Croatian separatist movements because Slovenia's independence would make Serbia even more influential in the Federation (Fearon 1998: 126). In contrast, Croatian separatism would assist Slovenia's independence in the sense that Croatia, as a buffer, could block the Yugoslav National Army's direct invasion of Slovenia's terrain. In light of this mutual interdependence, Slovenia and Croatia arranged to declare their independence on the same day in 1991 (Sudetic 1991a,b). In this sense, Slovenia and Croatia coordinated their challenges.

Slovenia's swift success in independence promoted separatist movements in other republics. Macedonia seceded peacefully in 1991 (by President Gligorov's diplomatic virtue), whereas Bosnia and Herzegovina had to fight harsh battles starting in 1992. The Croatian and Bosnian Wars generated Serbian refugees fleeing to Kosovo, raising the tension between the Serbs and the Albanians in Kosovo (Martus 1999: 306) and later provoking violence. Owing to NATO's tenacious air strikes (Independent International Commission on Kosovo 2000: 5), the Kosovo War ended in 1999 when Serbia had already lost influence over many regions of the former Yugoslavia. Subsequently, Montenegro seceded in 2003, and so did Kosovo in 2008, resulting in Yugoslavia's total dissolution.²⁶

In contrast to the Napoleonic Wars and the Boshin War, where anti-hegemonic or rebellious coalitions were developed *during* wars, the anti-Serbian coalition was formed by Slovenia and Croatia *before* the Yugoslav Wars' onset. Such strategic coordination was possible presumably because they are geographically close and because they share historical roots (i.e., former Austrian territories), religious faith (Catholicism), cultural values (a Latin alphabet), economic interests (they were wealthier than the Serbs), let alone political goals (secession). These entangled factors plausibly influenced the pattern and process of the Wars' diffusion. Another salient feature of the Yugoslav Wars is that like in the two incidents previously discussed, challenges spread

²⁶As of 2013, Kosovo's independence remains internationally disputed.

from peripheral Slovenia and Croatia to more central Bosnia and Kosovo (Figure 3).

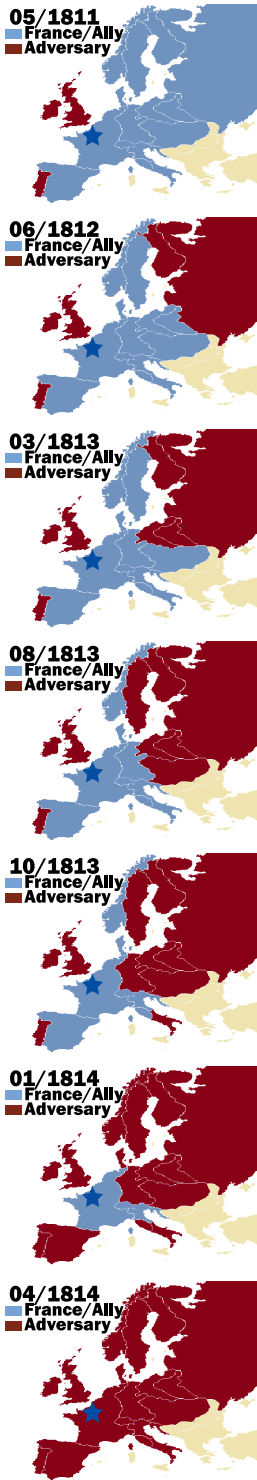
5.4 American Civil War: Prewar Coalition and its Expansion

As with the Yugoslav Wars, the American Civil War exhibits the properties of a partially coalitional rebellion, though, unlike the Yugoslav Wars, the rebel Confederacy utterly failed. By the outbreak of war, a subset of future rebels had formed a coalition in the periphery. The original members of the Confederacy were South Carolina, Mississippi, Florida, Alabama, Georgia, Louisiana, and Texas—all in the Deep South. After the War broke out, four states in the Upper South joined—Virginia, Arkansas, Tennessee, and North Carolina. Fighting diffused inward, that is, the challenges spread from the peripheral Deep South to the more central Upper South (Figure 3). Nonetheless, some slave states along the border (Delaware, Kentucky, Maryland, Missouri, West Virginia) did not join the Confederacy. In this regard, geography mattered for the states' political stands (between the Union and the Confederacy) as well as for the pattern of the War's diffusion.

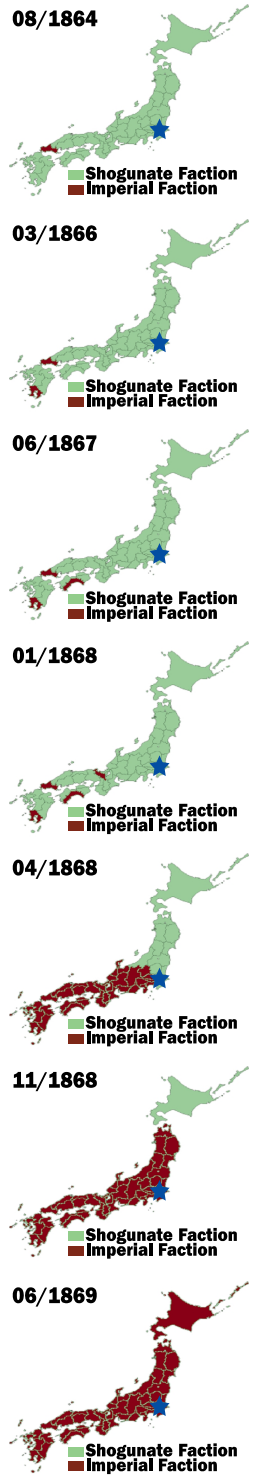
5.5 American Revolution: Collective Challenge

The American Revolution constitutes a fully coalitional rebellion as we have defined it. To secede from the British regime, thirteen colonies declared independence as a single political unit and initiated war. The bond among the colonies was plausibly strengthened by the facts that these colonies shared common interests and that they were geographically contiguous but distanced away from Britain. These factors might make it feasible for the colonies to enforce their agreements while making it difficult for Britain to appease and alienate a particular colony from the rest.

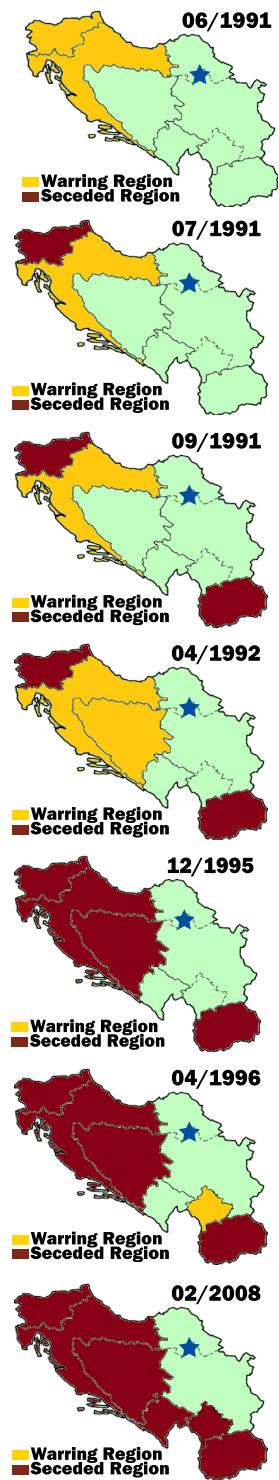
Napoleonic Wars



Boshin War



Yugoslav Wars



American Civil War

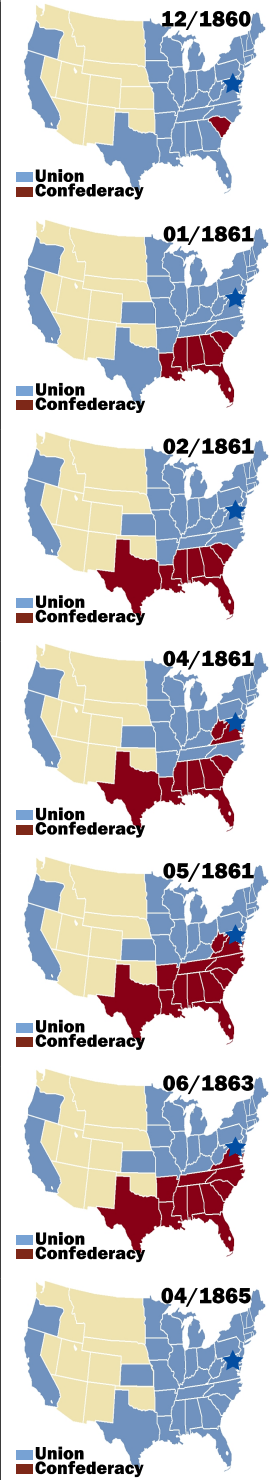


Figure 3: Geographic diffusion of challenges.

6 Conclusion

In this article, we have developed an intertemporal and spatial theory of rebellion that illuminates patterns of collective challenges. The following summarizes our findings:

- Even without strategic coordination across rebel groups, a rebellion can break out. An instigator may promote and coordinate others' challenges by demonstrating in his military campaigns that there is a sizable chance to subvert the government. In this sense, strategic coordination might gradually develop during the rebellion, not before it.
- In contrast, if no instigator exists who is willing to solely provoke an insurgency, rebels may seek a prewar alliance to ensure their success.
- Geographically, rebel movements tend to spread inward; i.e., a rebellion may originate around geographic fringes and then spread toward the state's capital. This is because rebels in remote areas are more difficult for the government to suppress than those nearby. As distant rebels fight well, those closer are inclined to bandwagon. This pattern is not addressed in the literature but can be observed in the four wars discussed in this article (i.e., Boshin War, Napoleonic Wars, American Civil War, Yugoslav Wars).
- Depending on the structural and geographic relations among the warring parties, rebel movements may evolve in one of four patterns: a snowballing rebellion; a catalytic rebellion; a partially coalitional rebellion; and a fully coalitional rebellion (Table 1).

One of our work's contributions is to advance the theoretical literature on war widening. While the outbreak and termination of war have been formally theorized, the escalation and spread of war has not yet been theorized in a compelling manner, despite the growing empirical work on the topic (Haldi 2003; Walter 2009). This is in part because of the complexity and difficulty with formalizing multilateral war (Jackson and Morelli 2011). We tackle this issue by focusing on a class of war between a government and its adversaries in relation to geography and structure.²⁷ Multilateral war remains a promising theoretical research agenda.

²⁷Apparently, geography and structure are not the only factors that determine the patterns of war diffusion. Looking back on the historical incidents in our discussion, other factors that potentially influence the shape and pattern of war might include economic interests (tax in the American Rev-

Rebellion	Snowballing	Catalytic	Partially coalitional	Fully coalitional
Pattern of challenges	Sequential $\alpha \rightarrow \beta \rightarrow \gamma$	Suddenly escalated $\alpha \rightarrow (\beta, \gamma)$	Initiated by a few $(\alpha, \beta) \rightarrow \gamma$	Simultaneous (α, β, γ)
Historical incidents	Napoleonic Wars	Boshin War	Yugoslav Wars American Civil War	American Revolution Glorious Revolution
Instigators	Sole (Britain)	Sole (Choshu Domain)	Collective (Slovenia & Croatia) (States in the Deep South)	All (13 colonies) (Tories & Whigs)
Coalition	Interim war	Interim war upon a galvanizing event	Prewar among some rebel groups	Prewar among all rebel groups
Military capabilities	Possibly heterogeneous among rebel groups			Homogeneous among rebel groups
Geographic relations	Unevenly distanced from the government			Close-by among rebel groups
Model pattern				

Table 1: Summary comparison.

APPENDIX

Proof of Lemma 2-(iii). If β decides to fight in period $T + 1$ based on α 's T -round "holdout," its expected payoff is $V_{\beta|T+1}^I(\text{hold}_{\alpha|T})$. By contrast, if β acquiesces in $T + 1$, β 's expected payoff and rational decision in the subsequent period depend on α 's battle outcome in $T + 1$. If α "wins," β should fight in $T + 2$, and if α "loses," β should acquiesce permanently (Lemma 2-(i,ii)). If α "holds out," β should fight or acquiesce in $T + 2$, depending on the latest belief as to the government's strength $\Pr(g|\text{hold}_{\alpha|T+1})$.

When β decides to fight or not in $T + 1$, it estimates the payoff from postponing fighting for one more period:

$$V_{\beta|T+2}^I(\text{hold}_{\alpha|T}) \equiv \sum_{g \in \{g^L, g^H\}} \Pr(g|\text{hold}_{\alpha|T}) \Pr(\text{win} \cup \text{hold}|G_{\alpha}) (\Pi_{\beta}(G_{\alpha, \beta}) - c_{\beta}), \quad (\text{A1})$$

for which β 's decision in $T + 2$ is to fight unless α "loses" in $T + 1$.

The comparison between $V_{\beta|T+1}^I(\text{hold}_{\alpha|T})$ and $V_{\beta|T+2}^I(\text{hold}_{\alpha|T})$ indicates that there are two effects of "acquiesce" in a period. The gain from "acquiesce" can be expressed as an increase in β 's payoff by $\Pr(g^H|\text{hold}_{\alpha|T}) \Pr(\text{loss}|G_{\alpha}^H) (c_{\beta} - \Pi_{\beta}(G_{\alpha, \beta}^H))$, and the loss expressed as a reduction by $\Pr(g^L|\text{hold}_{\alpha|T}) \Pr(\text{loss}|G_{\alpha}^L) (\Pi_{\beta}(G_{\alpha, \beta}^L) - c_{\beta})$. By Assumption 4, the gain is larger than the loss in the first period. As α 's battle continues, the gain falls, while the loss rises, because $\Pr(g^H|\text{hold}_{\alpha|T})$ converges to zero while $\Pr(g^L|\text{hold}_{\alpha|T})$ converges to one. Therefore, the net benefit from postponing fighting monotonically decreases; i.e., if $V_{\beta|T+1}^I(\text{hold}_{\alpha|T}) > V_{\beta|T+2}^I(\text{hold}_{\alpha|T})$, it must be that $V_{\beta|T+2}^I(\text{hold}_{\alpha|T}) > V_{\beta|T+\tau}^I(\text{hold}_{\alpha|T})$ for any $\tau \geq 3$.

This means, if one-period "acquiesce" is not worthwhile, then neither is any longer "acquiesce." Therefore, β 's rational decision in a period can be derived simply by examining the payoff from fighting today versus the payoff from fighting tomorrow. Group β decides to fight if and only if immediate fighting is at least as good both as perpetual acquiescing and as one-period lagged fighting:

$$V_{\beta|T+1}^I(\text{hold}_{\alpha|T}) \geq \max\{0, V_{\beta|T+2}^I(\text{hold}_{\alpha|T})\}. \quad (\text{A2})$$

olution; slavery in the American Civil War; inequality in the Yugoslav Wars), religion (Catholicism vs. Orthodoxy in the Yugoslav Wars), past hatred (covert hostility since Sekigahara in Boshin War, attitudes toward Nazism in the Yugoslav Wars), and even letters (Latin vs. Cyrillic in the Yugoslav Wars).

Below we show that there exists a finite T such that Inequality (A2) holds. In period T when the gain from "acquiesce" is smaller than the loss (i.e., $V_{\beta|T+1}^I(hold_{\alpha|T}) \geq V_{\beta|T+2}^I(hold_{\alpha|T})$), it must be that $V_{\beta|T+1}^I(hold_{\alpha|T}) \geq 0$, because $\Pr(loss|G_{\alpha}^H) > \Pr(loss|G_{\alpha}^L)$ in Inequality (3). Also, as T rises, the gain converges to zero, while the loss continues to increase, so that β enters period T when "acquiesce" is no longer worthwhile or Inequality (A2) holds. That is T_{β} . ■

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