Monopolizing Violence and Consolidating Power*

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Abstract

In weak states in which the faction in control of the government faces an armed opposing faction, the government can decide whether to live with an armed opposition or to try to consolidate its power and monopolize violence by disarming that faction. If the latter, the government can try to disarm the opposition peacefully by buying it off or by defeating it militarily. This paper formalizes this interaction in an infinite-horizon game in which the government in each period decides how much to offer an opposing faction and the rate at which it tries to consolidate its power. The opposition can accept the offer and thereby accede in the government's efforts to consolidate, or the opposition can fight in an attempt to disrupt those efforts. In equilibrium, the government always tries to monopolize violence. When contingent spoils are small, the government buys the opposition off and eliminates it as fast as is peacefully possible. When contingent spoils are large, the government tries to monopolize violence by defeating the opposition militarily. Lower institutional capacity also makes fighting more likely. The equilibrium path may exhibit a temporary truce or cease-fire during which the government, while buying the opposition off, consolidates its power and then fights on better terms.

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Bargaining, Fighting, and State Consolidation

On December 1, 2009, President Barack Obama announced the results of his administration's strategic review of the war in Afghanistan. The United States would surge an additional 30,000 troops in support of its counter-insurgency efforts and then begin to withdraw from Afghanistan in July 2011. Some criticized setting a deadline for withdrawal, arguing that this told the Taliban that they could simply wait the United States out (e.g., Ignatius 2009). Anticipating this criticism, President Obama meeting with journalists prior to his announcement is reported to have said:

> Let's assume that the Taliban does decide to wait us out...the whole point is to create Afghan capacity in terms of governance and security so that you have a more healthy body politic. But [sic] the time the Taliban decide, OK, the U.S. is starting to draw down, they will find that they will have an Afghan society that is more equipped to repulse their violence (Fisher 2009).

The Taliban, in other words, faced a trade off. They could wait it out and thereby avoid the costs of fighting and any immediate risk of defeat. But waiting would also mean running the risk that Afghan government forces would become stronger, the distribution of power would shift against the Taliban, and that they would find themselves in a much worse position in eighteen months. Alternatively, the Taliban could bear the cost of fighting, possibly run some risk of defeat, but in so doing prevent or impede the adverse shift in the distribution of power.[1]

The same fundamental trade off had come up in the war in Iraq. President George W. Bush consistently refused to set a deadline for withdrawal until Iraqi Prime Minister Nuri Kamal al-Maliki ultimately insisted on one during the negotiations leading to the status-of-forces agreement of November 2008.[2] President Bush argued throughout the war that setting a timetable for withdrawal would, among other things, "signal to our enemies that if they wait long enough, America will cut and run and abandon its friends" (Bush 2005). Indeed, some advocates of a timetable thought that this was the strongest

[1] Despite the criticism, the precise meaning of deadline was unclear from the start (Mazzetti 2009).

[2] For background on the agreement, see Bruno 2008.

argument against a timetable (Kristof 2005). Others, by contrast, emphasized that the "insurgents would never stop fighting during, say, a three-year withdrawal period, and let U.S. and Iraqis consolidate and build public loyalty" (Gelb 2005, also see Posen 2006).

Indeed, one of the functions of fighting is to disrupt a government's efforts to build state capacity and consolidate it position. Insurgent groups often use targeted assassinations against local leaders and officials to undermine the central government (e.g., Bowen 2006, Moore 2011). Violence also slows reconstruction and more generally impedes efforts to "win hearts and minds" (Bowen 2006, Dreazen 2010). Twenty days after Sudan completed a new pipeline and oil began to flow, rebels attacked it. "What do they expect us to do?" asked a rebel leader. "Do we wait until they have enough money to come kill us? What we really have to do is stop that oil" (Fisher 1999).

Casting this trade off more generally, the faction controlling the government in weak states often confronts one or more armed opposing factions. The government then faces a choice between living with an armed opposition or trying to consolidate its power and monopolize violence by disarming that faction. If the government chooses the latter course, it can try to disarm the opposition peacefully by buying it off or by defeating it militarily. The opposition can decide whether to accept whatever the government offers and acquiesce in the government's efforts to consolidate, or the opposition can fight to impede these efforts and forestall the adverse shift in the distribution of power.

This paper studies these choices in the context of a simple model in which two factions vie for control of the state and the spoils that come with it. One faction, the government, starts the game in control of the state. In each of possibly infinitely many periods, the government decides how much to offer the opposing faction, whether to try to consolidate its power, and, if so, how fast to do so. The opposition can accept the offer or fight in an attempt to forestall the government's efforts to consolidate.

The analysis makes four main contributions. Although it is widely assumed that governments generally require the opposition to disarm as part of a civil-war settlement (e.g., Licklider 2009; Walter 1997, 2009), it is not immediately clear why this should be

so.[3] Governments may prefer the opposition to disarm, but why insist on it? Why does bargaining over the terms of settlement break down in costly conflict? Since fighting is costly, there generally are agreements which both factions prefer to what they will get from fighting. Why do the factions fail to reach one of these agreements and thereby avoid costly consolidation? This is the "inefficiency puzzle" which has framed much recent work on inter-state and civil war (Fearon 1995, Powell 2006).[4]

It is also unclear what incentive the government has to disarm the opposition peacefully. Once the opposition disarms, it will be in a weaker bargaining position which the government will exploit (Fearon 1998, 2004; Walter 2002). This means that in order to induce the opposition to disarm, the government will have to offer enough to the opposition today to compensate it for being weaker tomorrow. But if the government has to fully compensate the opposition for agreeing to be weaker in the future, what is the incentive for the government to weaken and ultimately eliminate the opposition? Peaceful consolidation would seem to entail an offsetting inter-temporal transfer. The government would pay more today in order to have more tomorrow with no net effect on the government's overall payoff.

The first main result is showing that the government actually does try to consolidate its position by disarming the opposing faction and eliminating it as an independent source of military power. In equilibrium, the government always tries to monopolize violence either by defeating the opposition militarily or by buying it off and eliminating it as fast as is peacefully possible.

The second contribution is to explain why the government would ever choose to consolidate through costly conflict rather than by buying the opposition off. The analysis suggests that "contingent spoils" play an important role. Contingent spoils are benefits which will only begin to flow once the level of state consolidation has reached a high enough level that the state can provide security and protection. These benefits include

[3] See Acemoglu, Robinson, and Santos (2009), Acemoglu, Vindigni, and Ticchi (2010), and Driscoll (2010) for discussions of why some states may fail or choose not to establish a monopoly on violence.
[4] See Blattman and Miguel (2010) and Walter (2009) for surveys of work on civil war.

the returns on domestic and foreign investment as well as reconstruction and development aid. More conceptually, contingent spoils are the added gain that a state reaps from the additional commitment power it attains by being able to ensure security by disarming an opposing faction rather than only agreeing with that faction to stop fighting.

Contingent spoils create a trade off. Peaceful consolidation avoids the losses due to fighting. But it also takes time to buy the opposition off, gradually weaken it, and ultimately eliminate it. If the government tries to consolidate too quickly, it will be unable to offer the opposition enough today to compensate it for being much weaker tomorrow. Thus, there is an upper limit on how fast the government can consolidate if it chooses to do so peacefully. This in turn delays the realization of any contingent spoils. If these gains are small, the cost of fighting outweighs the cost of delay and the government prefers to consolidate peacefully. If, by contrast, the contingent spoils are sufficiently large, the cost of delaying these gains outweighs the cost of fighting and the factions fight.

The "institutional capacity" of the state affects this trade off. The higher this capacity, the more likely a power-sharing agreement between the factions is to hold and the less likely the factions are to fight.

The third contribution centers on the "efficiency puzzle" implicit in truces and cease-fires. One or both parties to a truce frequently believes that the other side is using the respite from fighting to rearm and regroup. Examples abound and include Hamas in Gaza (Barzak 2008, Dunn 2003), Hezbollah in Lebanon (Teslik 2006); Israeli forces in the 1948 Arab-Israeli war (Oren 2002, 5), the Lords Resistance Army in Uganda (Crilly 2008); and the Tamil Tigers in Sri Lanka (Ramesh 2007) to name just a few.

If one party believes that its adversary is using a truce or cease-fire to its advantage, why does that party ever agree to it or abide by it? Because either party can end a truce unilaterally, truces must make both sides better off. But how can truces or cease-fires be Pareto improving?

Uncertainty and misperception may provide one explanation. Each party might be overly optimistic about its ability to use a truce to its advantage. In contrast to many

informational accounts of war in which being overly optimistic about one's power leads to fighting (e.g., Blainey 1983, Slantchev 2003), being overly optimistic here leads to peace rather than war.

The present analysis offers a different explanation based on the technology of coercion and the endogenous cost of fighting rather than on uncertainty and asymmetric information. In equilibrium, the government may initially buy the opposition off and delay fighting in order to fight later on better terms. The opposition, moreover, knows what the government is doing and that the factions will eventually fight. Nevertheless, the government is willing and able to offer enough to the opposition that it is willing to accept.

Finally, the present analysis contributes to the small but growing literature in which the shifts in the distribution of power result from the endogenous efforts of the actors to further their interests. Most models of civil and interstate war take the distribution of power to be exogenous (e.g., Fearon 1995, 2004, 2007; Fearon and Laitin 2007; Powell 1999, 2004, 2011; Leventoğlu and Tarar 2008; Slantchev 2003). By contrast, a few models endogenize the distribution of power. Powell's (1993) guns-versus-butter model is an early example as is Fearon's (1996) analysis of bargaining over objects that influence future bargaining power in which making a concession to an adversary today makes the adversary stronger tomorrow. An important recent example is Slantchev (2010).

The next section describes the model. The subsequent section characterizes the equilibria. Section three generalizes the model to allow for varying degrees of institutional capacity. Proofs of the main results are in the appendix.

A Model

The model formalizes the interaction between a government and an armed opposition in a weakly institutionalized polity where the rule of law is absent or weak. The government must choose whether to try to consolidate its power and, if so, how fast. It must also decide whether to attempt to consolidate peacefully by buying the opposition off or by defeating it militarily. The opposition can either accept the offer and thereby acquiesce

in the government's efforts or the opposition can fight. The substantive import of the assumption of institutional weakness is that the factions cannot commit to how the social "pie" will be divided in the future or, more accurately, whatever division they agree to now can be renegotiated in the future in light of any changes in the distribution of power.[5]

Formally, consider a two-player, infinite-horizon stochastic game in which the faction in charge of the government, G, and an armed rival faction, R, vie for the spoils that come with control of the state. More specifically, G and R are trying to divide a flow of "pies." The size of the pie to be divided in each period is one as long as both factions remain armed. Should one of the factions ever establish a monopoly of violence by disarming the other faction either by force or by agreement, the per-period flow of benefits increases to $1 + \gamma$ where $\gamma \geq 0$ measures the size of the contingent spoils which begin to flow once one faction has obtained a monopoly on violence. The factions share a common discount factor β, each tries to maximize its sum of discounted spoils, and it is convenient to let $V \equiv 1/(1-\beta)$ denote the present value of the flow of pies of size one.

At the start of any round t, G makes a take-it-or-leave-it proposal ρ_t which R can accept or reject by fighting. If R accepts, the proposal is implemented and play moves on to round $t + 1$ which starts with a new proposal from G. We describe the nature of the proposal below. If R fights, G and R get flow payoffs of $f_G \geq 0$ and $f_R \geq 0$ for that period where $f_G + f_R < 1$ since fighting is inefficient. Fighting also means that the round will end in one of two ways: The game ends with one of the factions decisively defeating and eliminating the other. Or the fighting is inconclusive and play continues on to the next round. If one faction defeats the other, the victor gets the entire flow of future spoils and the loser gets nothing. That is, G and R obtain $f_G + \beta(1+\gamma)V$ and f_R if G prevails, and f_G and $f_R + \beta(1 + \gamma)V$ if R prevails.[6]

Let $d_t \in [0, 1]$ be the "decisiveness" of fighting at t, i.e., the probability that the game ends if R fights, and take $p_t \in [0, 1]$ to be the conditional probability that R prevails

[5] See Acemoglu (2003) for a discussion of weakly institutionalized settings and why the Coase Theorem does not apply.

[6] On substantive grounds, both G and R should be able to choose to fight. In effect, G can do this by making an offer R is certain to reject. Such offers are sure to exist as shown below.

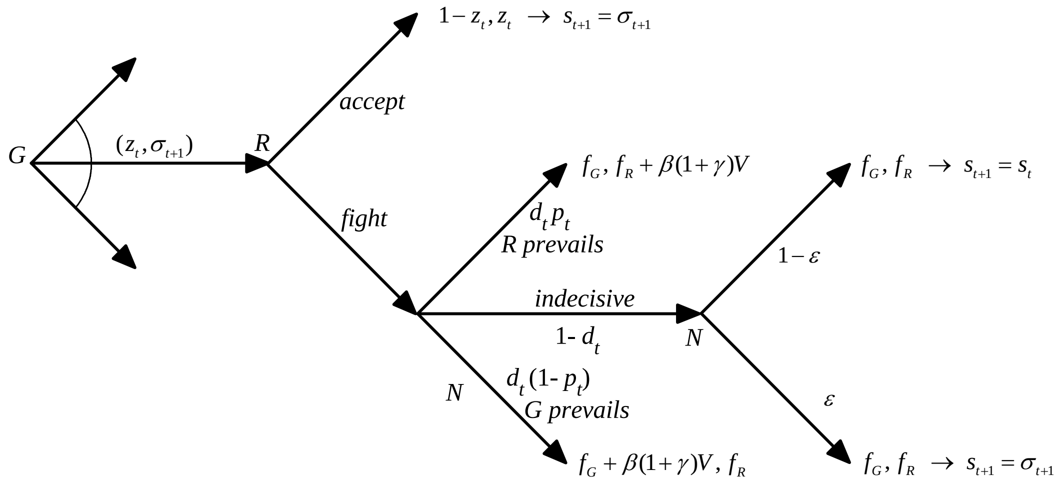

Figure 1: Play in stage s_t.

given that the game ends at t. The pair (d_t, p_t) defines the distribution of power at time t. The distribution of power also defines the state or "stage" of the game with $s_t \equiv (d_t, p_t)$.[7]

G's proposal at ρ_t is composed of two parts with $\rho_t \equiv (z_t, \sigma_{t+1})$. The first, $z_t \in [0,1]$, is the share of the current pie G is offering to R. The second component $\sigma_{t+1} \in [0,1]^2$ is the distribution of power or stage to which play will move if R accepts and thereby acquiesces in the government's efforts to consolidate its power. As discussed below, including σ_{t+1} in the proposal is a reduce-form way of modeling G's efforts to consolidate its power.

Figure 1 illustrates the sequence of play. If R accepts (z_t, σ_{t+1}), R and G respectively get z_t and $1-z_t$ during that round, the distribution of power shifts from s_t to σ_{t+1}, and the next round begins in stage $s_{t+1} = \sigma_{t+1}$ with a new offer (z_{t+1}, σ_{t+2}) from G. Fighting impedes but is not certain to stop G's efforts to consolidate. Formally, if R fights and the fighting is inconclusive, the distribution of power remains the same (i.e., $s_{t+1} = s_t = (d_t, p_t)$) with probability $1-\varepsilon$. With probability $\varepsilon > 0$, G's efforts to consolidate its power succeed despite the fighting and distribution of power in the next round is $s_{t+1} = \sigma_{t+1}$.

To formalize the possibility that G eliminates R through peaceful consolidation rather

[7] We use the term "stages" for the states in the stochastic game in order to avoid confusing the state of the game with the bureaucratic state which is consolidating.

than military defeat, assume that the game also ends if R agrees to be eliminated as an armed opposition by moving to $E \equiv (1, 0)$. Were the factions to fight at E, fighting is sure to be decisive and R is sure to lose. The contingent spoils begin to flow once play moves to E with G and R obtaining payoffs $(1 + \gamma)V - f_R$ and f_R, respectively.[8]

This set up is very spare, and it is useful to elaborate on two aspects of it. First, the motivation for the notion of contingent spoils is that there are some benefits which are contingent on one faction's having a monopoly of violence or, more precisely, of being able to provide a high degree of security and protection. Examples of such spoils might include FDI, the ability to exploit oil or mineral wealth, or some forms of development assistance or foreign aid. More conceptually, contingent spoils are the added gain that a faction reaps from the additional commitment power it attains by being able to ensure security by disarming an opposing faction rather than only agreeing with that faction to stop fighting. These contingent spoils accrue to either G or R should either faction succeed in disarming the other.

Second, letting G specify the next stage of the consolidation process is a reduced form. It captures in a simple way the notion that G can take unmodelled observable actions at time t which if unopposed will shift the distribution of power from s_t to σ_{t+1}. These actions might include taking over and politicizing the police, army, and internal security forces; arming its own militia; weakening the opposition by arresting, eliminating, or isolating its leaders; and effectively weakening or disenfranchising opposition groups.[9] The assumption that these actions are costless simplifies the model and analysis.

A pure strategy for G specifies its proposal in each period as a function of the history preceding that period. A pure strategy for R specifies whether it accepts the current offer or fights given the offer and the history leading up to it. Let $\rho_j \equiv (z_j, \sigma_{j+1})$ denote G's offer in round j, and take $a_j \in \{0, 1\}$ be one if R accepts in round j and zero if R fights.

[8] Assuming R to get a residual payoff of f_R when it is disarmed keeps the payoffs to fighting to the finish continuous in d_k and p_k, and this simplifies the analysis.

[9] Fearon (1998), for instance, provides an overview of Franjo Tujman's efforts to consolidate power in Croatia. For examples of al-Maliki's efforts to consolidate power in Iraq, see Fadel 2010, Robertson and Maher 2008, Schmidt and Healy 2011, and Sly 2011. Driscoll (2010) describes efforts to consolidate power in Georgia and Tajikistan.

Then a history leading up to round $t \geq 1$ is given by $h_t = \{(s_j, \rho_j, a_j)\}_{j=0}^{t-1} \cup s_t$ where $s_{j+1} \in \{s_j, \sigma_{j+1}\}$. For $t = 0$, $h_0 = s_0 = (d_0, p_0)$. Let H_t be the set of all histories leading up to t. It follows that a strategy for G is a sequence of offer functions $\{(\zeta_t, \sigma_t)\}_{t=0}^{\infty}$ such that $\zeta_t : H_t \rightarrow [0,1]$ specifies how much of today's pie G offers to R and $\sigma_t : H_t \rightarrow [0,1]^2$ is the stage to which play will move if R accepts. A pure strategy for R is a sequence of acceptance functions $\alpha_t : H_t \times [0,1]^3 \rightarrow \{0,1\}$ for $t = 0, 1, ...$ where $\alpha_t(\pi | h_t) = 1$ if R accepts ρ and zero otherwise. A strategy is Markov for G if its offer depends on the current stage but not on the history leading up to that stage. A strategy for R is Markov if R's acceptance function depends only on the current stage. We denote a strategy profile by (ζ, σ, α).

Paths to Consolidation

This section characterizes the equilibrium paths and payoffs of the pure-strategy, Markov Perfect equilibria (MPE). In equilibrium, the government always tries to monopolize violence by disarming the opposition and does so in one of two ways. When the contingent spoils are small, the government buys the opposition off and eliminates it as fast as is peacefully possible, i.e., induces R to move to E as fast as is peacefully possible. If the contingent spoils are sufficiently large, the government tries to eliminate the opposition by defeating it militarily.

To gain some intuition for why the government eliminates the opposition as fast as is peacefully possible if it decides to buy the opposition off, suppose G offers (z_k, s_{k+1}) in s_k and R accepts.[10] R's acceptance implies that the offer must satisfy the incentive compatibility condition

$$z_k + \beta V_R(s_{k+1}) \geq f_R + \beta d_k p_k (1+\gamma) V + \beta(1-d_k)[(1-\varepsilon)V_R(s_k) + \varepsilon V_R(s_{k+1})]. \quad \text{(IC)}$$

Assuming $z_k > 0$ (as will be the case in equilibrium), this inequality must bind. Otherwise G could profitably deviate to (z_k', s_{k+1}) for a $z_k' < z_k$. G, in other words,

[10] Abusing notation to simplify the exposition, we write proposals as (z_k, s_{k+1}) rather than (z_k, σ_{k+1}).

exploits the bargaining power inherent in making take-it-or-leave-it offers and holds R down to its reservation value which is its payoff to fighting.

When IC binds, there is an inverse relation between z_k and $V_R(s_{k+1})$. The larger z_k, the smaller $V_R(s_{k+1})$. This formalizes the trade-off facing G when it tries to buy R off. G must offer more today (a higher z_k) in order to get R to agree to being weaker tomorrow (a lower $V_R(\sigma_{k+1})$.

Note, however, that the inter-temporal transfers do not cancel out and G prefers to weaken R as much as possible by offering $z_k = 1$. Assume for the sake of intuition that G maximizes its payoff among all peaceful paths starting from s_k by minimizing R's payoff. (This assumption will be shown to hold below). Then G will minimize the left side of IC which is R's payoff to accepting (z_k, s_{k+1}). This in turn is equivalent to minimizing the right side of IC or, more specifically, to minimizing $V_R(s_{k+1})$ subject to $z_k \in [0, 1]$. Given the inverse relation between z_k and $V_R(s_{k+1})$, minimizing the latter means offering $z_k = 1$.[11]

Repeating the argument at s_{k+1}, G minimizes $V_R(s_{k+1})$ by offering $z_{k+1} = 1$, and so on. In brief, if G does not fight, it will weaken and eliminate R as quickly as is peacefully possible.

We now characterize a peaceful equilibrium path more formally. Let $\{(z_k, s_{k+1})\}_{k=0}^{N-1}$ denote a peaceful equilibrium path, i.e., R accepts G's proposal (z_k, s_{k+1}) for all k. If this path ends in R's elimination, then $s_N = E$. If G never eliminates R, let $N = \infty$.

Since R accepts (z_k, s_{k+1}), $V_R(s_k) = z_k + \beta V_R(s_{k+1})$. Using $z_k \leq 1$ gives $V_R(s_{k+1}) \leq [V_R(s_k) - 1]/\beta$. Moreover, $V_R(s_{k+1}) \geq f_R$ because $V_R(E) = f_R$ and R can always obtain at least f_R by fighting at any $s_{k+1} \neq E$. Thus $V_R(s_{k+1}) \geq \max\{[V_R(s_k) - 1]/\beta, f_R\}$. R's acceptance of (z_k, s_{k+1}) also means that IC holds, so $V_R(s_k) \geq f_R + \beta d_k p_k(1+\gamma)V + \beta(1-$

[11] This argument depends crucially on $\varepsilon > 0$, i.e., that there is some chance that the government will consolidate to s_{k+1} even if the opposition fights. When $\varepsilon > 0$, G can not only hold R down to its reservation value, G can also lower R's reservation value by lowering $V_R(s_{k+1})$. Were $\varepsilon = 0$, R's reservation value would be constant. Any increase in z_k would be exactly offset by a discounted decrease in $V_R(s_{k+1})$. G's inter-temporal transfers would cancel out, and G would be indifferent between buying R out now or later.

$d_k)[(1-\varepsilon)V_R(s_k)+\varepsilon\max\{[V_R(s_k)-1]/\beta, f_R\}]$. It follows that R's payoff to buying R off and eliminating it peacefully is bounded below by $V_R(s_k)\geq \Pi_R(s_k)\equiv \max\{B(s_k), B'(s_k)\}$ where

$$B(s_k) \equiv \frac{f_R+\beta d_k p_k(1+\gamma)V-\varepsilon(1-d_k)}{1-\beta(1-d_k)(1-\varepsilon)-\varepsilon(1-d_k)}$$

$$B'(s_k) \equiv \frac{f_R+\beta d_k p_k(1+\gamma)V+\beta\varepsilon(1-d_k)f_R}{1-\beta(1-d_k)(1-\varepsilon)}.$$

Algebra shows that $B(s_k)\geq B'(s_k)$ if and only if $B'(s_k)\leq 1+\beta f_R$.

To put an upper bound on G's payoff along any peaceful path starting from s_k observe that R agrees to E and the contingent spoils begin to flow in $N-k$ periods. Hence, $V_G(s_k)+V_R(s_k)=V+\beta^{N-k}\gamma V$ and, consequently, $V_G(s_k)\leq V+\beta^{N-k}\gamma V-\Pi_R(s_k)$. How long it takes G to eliminate R, $N-k$, is also bounded below. G must transfer at least $\Pi_R(s_k)$ to R to induce R to move to E. Recalling that $V_R(E)=f_R$, let $q(s_k)$ be the smallest integer m such that $\Pi_R(s_k)\leq(1-\beta^m)V+\beta^m f_R$ for $\Pi_R(s_k)<V$ where the expression on the right of the weak inequality is the payoff to getting one for $m-1$ periods and then a final payoff of f_R. Then it takes at least $q(s_k)$ rounds to move R from s_k to E. This implies $N-k\geq q(s_k)$ and that G's payoff to buying R off as fast as is peacefully possible is bounded above by $\Pi_G(s_k)\equiv(1+\beta^{q(s_k)}\gamma)V-\Pi_R(s_k)$ when $\Pi_R(s_k)<V$. For completeness, define $\Pi_G(s_k)\equiv V-\Pi_R(s_k)$ when $\Pi_R(s_k)\geq V$.

It follows that if G's continuation payoff equals Π_G with $\gamma>0$, then G must be buying R off as quickly as possible.

LEMMA 1: *Suppose $\gamma>0$. If $\Pi_R(s_k)\geq V$, the factions fight in the continuation game. If the continuation game is peaceful, i.e., the probability of fighting along the equilibrium path is zero, and $V_G(s_k)=\Pi_G(s_k)$, then G is eliminating R as quickly as is peacefully possible in the continuation game.*[12]

Proof: Suppose $\gamma>0$ and $\Pi_R(s_k)\geq V$. If the latter inequality is strict, $V_R(s_k)>V$. But the most that G can transfer to R in a peaceful continuation game is V. Hence,

[12] If $\gamma=0$ and $d_k<1$, G still weakens R as much as possible by offering $z_k=1$ if $\Pi_R(s_k)>1+\beta f_R$ and by eliminating R in a single round if $\Pi_R(s_k)<1+\beta f_R$ (see the proof of Lemma 4A). If $\gamma=0$ and $d_k=1$, G is indifferent to how fast it eliminates R.

the factions must fight. If $\Pi_R(s_k) = V$, G's payoff to buying R off peacefully is 0. G, however, can always obtain at least f_G by fighting to the finish. So, $V_G(s_k) \geq f_G > 0$ and G will prefer to fight which it can always do by proposing $(0, E)$. This contradiction establishes the claim when $\Pi_R(s_k) \geq V$.

Now assume $\Pi_R(s_k) < V$ and that the continuation game is peaceful, but G does not eliminate G as quickly as is peacefully possible. That is, G eliminates R peacefully at $s_{k+n} = E$ where $n > q(s_k)$. (If G never eliminates R, take $n = \infty$.) Then $V_G(s_k) = \sum_{j=0}^{n-1} \beta^j (1 - z_{k+j}) + \beta^n (V + \gamma V - f_R)$. Since the equilibrium is peaceful, $z_{k+j} = V_R(s_{k+j}) - \beta V_R(s_{k+j+1})$ with $V_R(s_{k+n}) = V_R(E) = f_R$. Substitution then gives $V_G(s_k) = (1+\beta^n\gamma)V - V_R(s_k) \leq (1 + \beta^n\gamma)V - \Pi_R(s_k) < \Pi_G(s_k)$. $\square$

Because it takes $m \geq q(s_k)$ rounds to eliminate R peacefully, G faces a trade-off between the cost of fighting and the cost of having to wait m periods for the contingent spoils to begin to flow. This suggests that there will only be two types of equilibrium path. When the contingent spoils are large, the cost of delay is high and G will fight at the outset, i.e., at s_0. When the contingent spoils are small, the cost of fighting at s_0 outweighs the cost of delay, and G buys R off and play moves to s_1 where the contingent spoils are only $m - 1$ periods away. If the cost of fighting outweighed the cost of delay at s_0, that would also seem to be the case at s_1 and subsequently at s_2 and so on. The resulting intuition is that the factions will either fight at the outset or G will eliminate R as quickly as is peacefully possible.

This is not quite right. Buying R off at s_0 reduces the cost of delay. But it also weakens R and reduces the cost of fighting at s_1. Even if the contingent spoils are sufficiently large that the factions fight in equilibrium, G may prefer to buy R off at s_0 in order to fight at s_1 on more favorable terms. The equilibrium path takes one of two forms when the contingent spoils are large enough to induce fighting. The factions fight at the outset of the game or at s_1.[13]

[13] Because of the simplifying assumption that play can costlessly move from any s_k to any s_{k+1}, G can fully realize the gains from weakening R in a single round. It does this by moving to a stage s_1 where $d_1 = 1$ (see Lemma 3A). As a result, G will never buy R off at s_0 through s_k in order to fight at s_{k+1} for any $k \geq 1$.

To characterize these paths further, it is useful to determine the factions' equilibrium payoffs to fighting at any s_k if they are at s_k and to fighting at s_1 starting from s_0. Observe first that G can ensure that the factions fight at any s_k by proposing $(0, E)$. R is sure to fight since accepting brings $\beta V_R(E) = \beta f_R$ whereas fighting brings at least f_R. If $d_k = 1$, fighting at s_k respectively brings G and R payoffs of $f_G + \beta(1 - p_k)(1 + \gamma)V$ and $f_R + \beta p_k(1 + \gamma)V$. Lemma 2 shows that if the factions fight in equilibrium at s_k with $d_k < 1$, then $s_{k+1} = E$. The key intuition is that since the transition probabilities do not depend on what G names as the next stage, G names the stage that gives it its highest continuation payoff which is stage E.

LEMMA 2: *Let (ζ, σ, α) be any MPE. If $d_k < 1$ and the factions fight at s_k, then G names E as the next stage, $\sigma(s_k) = E$.*

Proof: Since G fights at s_k, its continuation value satisfies $V_G(s_k) = f_G + \beta d_k(1 - p_k)(1 + \gamma)V + \beta(1 - d_k)[(1 - \varepsilon)V_G(s_k) + \varepsilon V_G(s_{k+1})]$. $V_G(s_k)$ is clearly increasing in $V_G(s_{k+1})$. It therefore attains its unique maximum at $s_{k+1} = E$ if $V_G(s_{k+1}) < V_G(E) = (1 + \gamma)V - f_R$ for all $s_{k+1} \neq E$. Since $V_R(s_{k+1}) \geq f_R$, it suffices to show $V_G(s_{k+1}) + V_R(s_{k+1}) < (1 + \gamma)V$ for $s_{k+1} \neq E$. But, the maximal flow of benefits starting from $s_{k+1} \neq E$ is $1 + \beta(1 + \gamma)V = V + \beta\gamma V$ since the soonest the contingent spoils can begin to flow is in the next period. Hence, $V_G(s_{k+1}) + V_R(s_{k+1}) \leq V + \beta\gamma V$. $\square$

Lemma 2 implies that once fighting begins in an MPE, it is a fight to the finish. If the factions fight at s_k, the game ends if either faction defeats the other or if play moves (with probability $\varepsilon(1 - d_k)$) to E. If fighting succeeds in blocking G's efforts to consolidate, the play remains at s_k where the factions fight again.

Letting $F_G(s_k)$ and $F_R(s_k)$ denote the factions' payoffs to fighting at s_k. Then $F_G(s_k)$ satisfies the recursive relation $F_G(s_k) = f_G + \beta d_k(1 - p_k) + \beta(1 - d_k)[(1 - \varepsilon)F_G(s_k) + \varepsilon[(1 + \gamma)V - f_R]]$ and is given by

$$F_G(s_k) = \frac{f_G + \beta d_k(1 - p_k)(1 + \gamma)V + \beta\varepsilon(1 - d_k)[(1 + \gamma)V - f_R]}{1 - \beta(1 - d_k)(1 - \varepsilon)}.$$

Similarly, R's payoff to fighting at s_k is defined by $F_R(s_k) = f_R + \beta d_k p_k + \beta(1 - d_k)[(1 -$

$\varepsilon)F_R(s_k) + \varepsilon f_R]$ and explicitly by

$$F_R(s_k) = \frac{f_R + \beta d_k p_k(1+\gamma)V + \beta\varepsilon(1-d_k)f_R}{1-\beta(1-d_k)(1-\varepsilon)}.$$

Note further that $F_R(s_k) = B'(s_k)$. If G can buy R off and eliminate it with a single offer, then G will name E as the next stage and transfer just enough to R to leave it indifferent between fighting and accepting. In these circumstances, R's payoff to being bought off at s_k will also satisfy the recursive relation defining $F_R(s_k)$. The equality $F_R(s_k) = B'(s_k)$ is the formal statement of R's indifference between fighting and being bought off. The previous equality also means $\Pi_R(s_k) = \max\{B(s_k), F_R(s_k)\}$ with $B(s_k) \geq F_R(s_k)$ if and only if $F_R(s_k) \geq 1 + \beta f_R$ where $1 + \beta f_R$ is the most that G can transfer to R if G tries to eliminate R peacefully with a single offer. (Recall that R obtains f_R when play moves to E.)

Now consider the factions' equilibrium payoffs if G buys R off at s_0 and the factions fight at s_1. Then $V_G(s_0) = 1 - z_0 + \beta F_G(s_1)$. Using $V_R(s_0) = z_0 + \beta F_R(s_0)$ gives $V_G(s_0) = 1 - V_R(s_0) + \beta[F_G(s_1) + F_R(s_1)]$. If G weakens R as much as possible at s_0, G will offer $z_0 = 1$ and set s_1 so that IC binds. This leaves $V_R(s_0) = 1 + \beta F_R(s_1)$ and $V_R(s_0) = f_R + \beta d_k p_k + \beta(1-d_k)[(1-\varepsilon)V_R(s_0) + \varepsilon(V_R(s_0) - 1)/\beta]$. The latter equality implies $V_R(s_0) = B(s_0)$. Substitution gives $V_G(s_0) = 1 - B(s_0) + \beta[F_G(s_1) + F_R(s_1)]$.

As fighting becomes more decisive, the expected duration of a fight to the finish decreases and the total payoff to fighting, $F_G(s_1)+F_R(s_1)$, increases. That is, $F_G(s_1)+F_R(s_1)$ is increasing in d_1 which in turn implies that $V_G(s_0)$ is increasing in d_1.

It follows that G's payoff to buying R off at s_0 and fighting at s_1 is bounded above by what G obtains by proposing $(1, \widetilde{s})$ and then fighting at $\widetilde{s}$ where $\widetilde{s} \equiv (1, \widetilde{p})$ and $\widetilde{p}$ is the probability at which IC binds. (That is, $\widetilde{p}$ satisfies $B(s_0) = 1 + \beta[f_R + \beta\widetilde{p}(1+\gamma)]$ where the expression in brackets is R's payoff to fighting at $\widetilde{s}$.) Lemma 4A in the Appendix shows that such a proposal exists and that G can induce R to accept it.

This leaves $V_G(s_0) = 1 - B(s_0) + \beta[f_G + f_R + \beta(1+\gamma)V]$ since $F_G(s_1) + F_R(s_1) = f_G + f_R + \beta(1+\gamma)V$ at $d_1 = 1$. Using $\beta V = \beta + \beta^2 V$ gives $V_G(s_0) = (1+\beta^2\gamma)V - \beta[1 - f_G - f_R] - \Pi_R(s_0)$. The first term on the right is the sum of all the benefits given that

the contingent spoils begin to flow in the period immediately after the factions fight, i.e., at $t = 2$. The second term is the cost of fighting at $\widetilde{s}$ where fighting is sure to be decisive, and the third term is the minimal cost of satisfying IC at s_0 and thus being able to induce R to accept $(1, \widetilde{s})$. More simply, $V_G(s_0) = 1 - \widetilde{z} + \beta F_G(\widetilde{s}) = \beta[f_G + \beta(1 - \widetilde{p})(1 + \gamma)V]$.

Proposition 1 describes the equilibrium paths starting from any stage s_0 except for a set of stages of measure zero.

PROPOSITION 1: *Let $\{\zeta, \sigma, \alpha\}$ be a pure-strategy MPE and assume $B(s_0) \neq V - \beta^n(V - f_R)$ for any integer $n \geq 1$. (i) If $F_R(s_0) < 1 + \beta f_R$, the equilibrium path is peaceful with $V_R(s_0) = F_R(s_0)$ and $V_G(s_0) = \Pi_G(s_0)$. (ii) If $F_R(s_0) > 1 + \beta f_R$, the factions fight at s_0 with $V_R(s_0) = F_R(s_0)$ and $V_G(s_0) = F_G(s_0)$ when $F_G(s_0) > \max\{\Pi_G(s_0), \beta F_G(\widetilde{s})\}$. The factions fight at $\widetilde{s}$ with $V_R(s_0) = \Pi_R(s_0)$ and $V_G(s_0) = \beta F_G(\widetilde{s})$ when $\beta F_G(\widetilde{s}) > \max\{\Pi_G(s_0), F_G(s_0)\}$. The equilibrium path is peaceful with $V_R(s_0) = \Pi_R(s_0)$ and $V_G(s_0) = \Pi_G(s_0)$ when $\Pi_G(s_0) > \max\{F_G(s_0), \beta F_G(\widetilde{s})\}$.*[14]

When the factions fight at $t = 1$, there is a Pareto improving truce or cease-fire at $t = 0$. G proposes $(1, \widetilde{s})$ and R agrees knowing that the factions are going to fight at $\widetilde{s}$. As long as IC binds, as it does at $(1, \widetilde{s})$, R is indifferent between accepting and fighting. But the expected duration and thus the cost of fighting decreases as it becomes more decisive. Since R is indifferent between fighting at s_0 and accepting $(1, \widetilde{s})$ and then fighting at $\widetilde{s}$, the "surplus" saved by fighting at $\widetilde{s}$ rather than at s_0 must be going to G. Hence, the truce at $t = 0$ is Pareto improving even though both factions know that it will break down at $t = 1$.

A direct consequence of Proposition 1 is that the factions fight when the contingent spoils are large and G monopolizes power peacefully when they are small. To establish this, observe that G must transfer at least $\Pi_R(s_0)$ to R to eliminate it peacefully. This is clearly impossible when $\Pi_R(s_0) > V$ as the most that G can transfer to R is one in each period. Since $\Pi_R(s_0)$ is increasing in γ, there exists a $\overline{\overline{\gamma}}$ such that $\Pi_R(s_0) > V$ at

[14] If $\Pi_1(s_0) \neq V - \beta^n(V - f_R)$ for a positive integer $n \geq 1$, then R is indifferent between accepting and rejecting offers of 1 if G tries to buy R off as quickly as possible. We disregard this case as nongeneric. If $\gamma = 0$, then $V_R(s_k) = \Pi_R(s_k)$ and G must still transfer $\Pi_R(s_k)$ to R in a peaceful equilibrium. If $\gamma = 0$ and $d_k < 1$, then $z_k = 1$ and G weakens R as much as possible when making an offer. If $\gamma = 0$ and $d_k = 1$, G has no incentive to weaken R since the doings so requires a completely offsetting intertemporal transfer.

$\overline{\overline{\gamma}}$. If $\gamma > \overline{\overline{\gamma}}$, G cannot transfer enough to R to eliminate it peacefully. More formally, if $\Pi_R(s_0) > V$, then, by definition, $\Pi_G(s_0) = V - \Pi_R(s_0) < 0 < f_G \leq \max\{F_G(s_0), \beta F_G(\widetilde{s})\}$. Proposition 1 now ensures that there are no peaceful equilibrium paths.

If $\gamma < \overline{\overline{\gamma}}$, G can transfer enough to R to eliminate it peacefully and will want to when $\Pi_G(s_0) > \max\{F_G(s_0), \beta F_G(\widetilde{s})\}$. $F_G(s_0)$ and $F_G(\widetilde{s})$ are linearly increasing in γ. Recalling that $\Pi_G(s_0) = (1 + \beta^{q(s_0)}\gamma)V - \Pi_R(s_0)$ when $\Pi_R(s_0) < V$, we can use $(1 - \beta^{q(s_0)-1})V + \beta^{q(s_0)-1} f_R < \Pi_R(s_0) \leq (1 - \beta^{q(s_0)})V + \beta^{q(s_0)} f_R$ to bound $\Pi_G(s_0)$ by eliminating $\beta^{q(s_0)}$. This gives $\underline{\Pi}_G(s_0) < \Pi_G(s_0) \leq \overline{\Pi}_G(s_0)$ where

$$\begin{aligned}
\underline{\Pi}_G(s_0) &\equiv [(1 + \beta\gamma)V - f_R]\left[\frac{V - \Pi_R(s_0)}{V - f_R}\right] \\
\overline{\Pi}_G(s_0) &\equiv [(1 + \gamma)V - f_R]\left[\frac{V - \Pi_R(s_0)}{V - f_R}\right].
\end{aligned}$$

$\underline{\Pi}_G(s_0)$ and $\overline{\Pi}_G(s_0)$ are quadratic and concave in γ. Moreover, they are increasing at $\gamma = 0$ with $\underline{\Pi}_G(s_0) = \overline{\Pi}_G(s_0) > \max\{F_G(s_0), \beta F_G(\widetilde{s})\}$. At $\gamma = \overline{\overline{\gamma}}$, $\Pi_R(s_0) = V$ and $\underline{\Pi}_G(s_0) = \overline{\Pi}_G(s_0) = 0$. As a result, $\Pi_G(s_0) < \max\{F_G(s_0), F_G(\widetilde{s})\}$. It follows that there exists $\underline{\gamma}$ and $\overline{\gamma}$ such that $0 < \underline{\gamma} < \overline{\gamma} < \overline{\overline{\gamma}}$ and that the factions fight when $\overline{\gamma} < \gamma < \overline{\overline{\gamma}}$ even though G can eliminate R peacefully. When $0 < \gamma < \underline{\gamma}$, G eliminates R as fast as is peacefully possible. Proposition 2 summarizes these results.

Proposition 2: *There exists thresholds $0 < \underline{\gamma} < \overline{\gamma} < \overline{\overline{\gamma}}$ such that $\overline{\overline{\gamma}}$ solves $\Pi_G(s_0) = V$, and: (i) If $\gamma > \overline{\overline{\gamma}}$, there are no peaceful equilibrium paths. G cannot transfer enough to eliminate R even if it wanted to. (ii) If $\overline{\gamma} < \gamma < \overline{\overline{\gamma}}$, there are peaceful consolidation paths., G can offer R enough to eliminate it peacefully, but the opportunity cost of buying R off peacefully is too high. Either G declares the next stage to be E at the outset of the game, and the equilibrium path is a fight to the finish. Or G consolidates its position and the factions fight at time $t = 1$. (iii) If $0 \leq \gamma < \underline{\gamma}$, there is no fighting in equilibrium, and G eliminates R as quickly as is peacefully possible.*[15]

[15] The gap between $\underline{\gamma}$ and $\overline{\gamma}$ results from a discontinuity in G's payoff to eliminating R as fast as is peacefully possilble. If $F_R(s_0)$ is very close to but slightly less than $(1 - \beta^m)V + \beta^m f_R$, then a slight increase in γ may require G to take an additional period to buy R off. This postpones the contingent gain for a period and results in a discontinuous loss for G of $\beta^m\gamma$.

Power Sharing with Limited Institutional Capacity

The fundamental source of inefficiency and cause of fighting is the factions' inability to commit to future divisions of the spoils. Regardless of what the factions agree to today, those arrangements are always subject to renegotiation tomorrow in light of the *de facto* distribution of power that exists tomorrow. Whatever political arrangements or institutions the factions put in place today to determine the distribution of future benefits are completely ineffectual. The distribution of *de jure* power defined by those institutions has no effect on the distribution of future benefits; the distribution of benefits at a future time t is determined solely by the distribution of *de facto* power (d_t, p_t). Institutional capacity is zero in the sense that institutions lack any ability to bind or commit the factions in the future.[16]

This section relaxes the assumption of zero institutional capacity. Institutions are assumed to have some institutional capacity which enables the government to transfer some of the future benefits to R at least in expectation. As a result, R is more willing to move to E, and G can induce R to disarm peacefully in fewer rounds. This lowers the opportunity cost of monopolizing violence peacefully and makes G less likely to opt for fighting.

Roughly a third of civil wars end in negotiated settlements and many of those entail some form of power sharing.[17] We model limited institutional capacity and power sharing in a very simple, highly reduced form. Suppose that G can offer to share power with R in return for R's disarming. Formally, if G names E as the next stage, then the proposal takes the form (z, y, E) where, as before, $z \in [0, 1]$ is the share of the current pie on offer, and $y \in [0, (1 + \gamma)V]$ is the share of the future spoils that G promises to R. Implicit in this proposal (and unmodeled) are the political and institutional arrangements designed to implement this division of benefits, e.g., dividing up ministries, granting regional autonomy, using quotas to allocate parliamentary seats, etc. If R agrees to this proposal,

[16] See Acemoglu and Robinson (2006) for a discussion of *de facto* and *de jure* power.

[17] On the frequency of negotiated settlements, see Pillar (1983), Licklider (1995), Walter (2002), and Fearon and Laiting (2007). On the prevalance of power-sharing agreements, see Hartzell and Hoddie (2003), Mukherjee (2006), and Fearon and Laitin (2007).

R obtains $z + \beta y$ if the power-sharing arrangements holds and f_R if the arrangements break down where, recall, f_R is R's payoff at E. The power-sharing agreement holds with probability h. Consequently, G and R's expected payoffs the agree on (z, y, E) are $h(z+\beta y)+(1-h)(z+\beta f_R) = z+\beta f_R+\beta h(y-f_R)$ and $1-z+\beta[(1+\gamma)V-f_R-h(y-f_R)]$.

The parameter h is a highly reduced-form measure of institutional capacity or commitment power. The higher h, the more likely today's agreements about future divisions are to hold. The analysis above focused on the case in which today's agreements have no effect on tomorrow's outcomes ($h = 0$). If, by contrast, power-sharing agreements are sure to hold ($h = 1$), G can always induce R to agree to move to E in a single round and does so in equilibrium. IC binds at the optimal offer (z_0^*, y_0^*, E), so $z_0^*+\beta y_0^* = f_R+\beta d_0 p_0(1+\gamma)V+\beta(1-d_0)[(1-\varepsilon)(z_0^*+\beta f y_0^*)+\varepsilon f_R]$ or $z_0^*+\beta y_0^* = F_R(s_0)$. In keeping with the idea of a weak state, we assume h is small.[18]

Paralleling part (i) of Proposition 1, if G tries to eliminate R at s_k by moving to E in a single round, the most that G can transfer to R (in expectation) is $1 + \beta f_R + \beta h[(1 + \gamma)V - f_R]$. If this exceeds R's payoff to fighting $F_R(s_k)$, then G can induce R to move to E. Doing so also maximizes G's payoff as it avoids the cost of fighting and does not delay the arrival of the contingent spoils. Hence, G's equilibrium strategy peacefully eliminates R in a single round when $F_R(s_k) < 1 + \beta f_R + \beta h[(1 + \gamma)V - f_R]$. IC binds at G's equilibrium offer (z, y, E), so $V_R(s_k) = z + \beta f_R + \beta h(y - f_R) = f_R + \beta d_k p_k(1 + \gamma)V + \beta(1 - d_k)[(1 - \varepsilon)V_R(s_0) + \varepsilon f_R]$. This leaves $z + \beta f_R + \beta h(y - f_R) = F_R(s_0)$. We also have $V_G(s_0) + V_R(s_0) = 1 + \beta(1 + \gamma)V$ and consequently $V_G(s_0) = 1 + \beta(1 + \gamma)V - F_R(s_0)$.

[18] Besley and Persson (2009, 2010) formulate state capacity in a related way. They formalize state fiscal capacity in terms of an upper bound $\overline{\tau}$ on the tax rate the government can impose. The larger $\overline{\tau}$, the greater state capacity. In effect, the state can fully commit to any tax rate below this threshold and is unable to commit to any rate above it. Commitment in this formalization is all or nothing. By contrast, the factions can commit to any $y > f_R$ with probability h in the present analysis.

An obvious generalization incorporating both of these specifications as special cases is to let $h(y)$ or $h(\tau)$ be the probability y or τ is implemented with h nonincreasing. Then $h(y)$ is a constant in the present formulation whereas $h(\tau) = 1$ for $\tau \leq \overline{\tau}$ and $h(\tau) = 0$ for $\tau > \overline{\tau}$ in Besley and Persson's analysis. Modelling institution capacity in this somewhat more general way has no effects on the qualitative results.

When $F_R(s_k) > 1+\beta f_R+\beta h[(1+\gamma)V-f_R]$, it takes more than one round to monopolize violence peacefully. As shown above, IC must hold along the path when G tries to eliminate R peacefully. As a result, $V_R(s_k) \geq \Pi_R(s_k) = \max\{B(s_k), F_R(s_k)\} = B(s_k)$ where $B(s_k) > F_R(s_k)$ since $F_R(s_k) > 1 + \beta f_R$. Let $q(s_k, h)$ be the smallest number off offers needed to eliminate R peacefully, i.e., to transfer $B(s_k)$ to R given that G can transfer as much as $1+\beta f_R+\beta h[(1+\gamma)V-f_R]$ when making the final offer. In other words, $q(s_k, h)$ is the smallest integer such that $B(s_k) \leq (1-\beta^{m-1})V + \beta^{m-1}[1 + \beta f_R + \beta h[(1+\gamma)V - f_R]] = (1-\beta^m)V+\beta^m[f_R+h[(1+\gamma)V-f_R]$. It follows that it takes $q(s_k, h)$ offers for G to eliminate R as fast as is peacefully possible. Let $\Pi_G(s_k, h) \equiv V+\beta^{q(s_k,h)}\gamma V-\Pi_R(s_k)$.

When $h > 0$ and $F_R(s_0) > 1 + \beta f_R + \beta h[(1+\gamma)V - f_R]$, G faces the same trade off it faced in the analysis above where $h = 0$ and $F_R(s_0) > 1 + \beta f_R$. G can avoid the cost of fighting by eliminating R peacefully. But this comes at the cost of having to wait $q(s_0, h)$ periods for the contingent spoils to begin to flow. Since $q(s_0, h)$ is weakly decreasing in h, the number of rounds it takes to eliminates R peacefully and the corresponding cost of delay decreases as institutional capacity increases. The greater institutional capacity, the less likely the factions are to fight.[19]

Recalling that $\widetilde{p}$ satisfies $B(s_0) = 1 + \beta[f_R + \beta\widetilde{p}(1+\gamma)V]$, Proposition 3 summarizes the results.

Proposition 3: *Let $\{\zeta, \sigma, \alpha\}$ be a pure-strategy MPE and assume $B(s_0) \neq (1-\beta^n)V + \beta^n[f_R+h[(1+\gamma)V-f_R]$ for any integer $n \geq 1$. (i) If $F_R(s_0) < 1+\beta f_R+\beta h[(1+\gamma)V-f_R]$, the equilibrium path is peaceful with $V_R(s_0) = \Pi_R(s_0)$ and $V_G(s_0) = \Pi_G(s_0, h)$. (ii) If $F_R(s_0) > 1 + \beta f_R + \beta h[(1+\gamma)V - f_R]$, the factions fight at s_0 with $V_R(s_0) = F_R(s_0)$ and $V_G(s_0) = F_G(s_0)$ when $F_G(s_0) > \max\{\Pi_G(s_0, h), \beta F_G(\widetilde{s})\}$. The factions fight at $\widetilde{s}$ with $V_R(s_0) = \Pi_R(s_0)$ and $V_G(s_0) = \beta F_G(\widetilde{s})$ when $\beta F_G(\widetilde{s}) > \max\{\Pi_G(s_0, h), F_G(s_0)\}$. The equilibrium path is peaceful with $V_R(s_0) = \Pi_R(s_0)$ and $V_G(s_0) = \Pi_G(s_0, h)$ when $\Pi_G(s_0, h) > \max\{F_G(s_0), \beta F_G(\widetilde{s})\}$.*

Conclusion

When the government in a weak state faces an armed opposing faction, the government has to decide whether to live with an armed opposition or to try to consolidate its power

[19] Fearon and Laitin (2003) find that civil wars are more likely in weaker states.

and monopolize violence by disarming it. If the latter, the government can try to disarm the opposition peacefully by buying it off or by defeating it militarily. Although the incentives to monopolize power are not immediately clear, the government always does prefer to eliminate an armed opposition.

The government faces a trade off in deciding how to disarm the opposition. Eliminating the opposition peacefully takes time and this delays the the contingent spoils. Forcefully eliminating the opposition incurs the cost of fighting and possibly the risk of defeat. When the contingent gains are small, the cost of delay is small and the government monopolizes violence by eliminating the opposition as fast as is peacefully possible. When the contingent spoils are large, the government uses force and the factions fight.

Stronger institutions mitigate this trade off. The higher the state's institutional capacity, the more the readily the government can buy the opposition off, and the less likely the factions are to fight.

Appendix

The appendix proves Propositions 1 and 2. Let $\mathcal{E}$ =$\{(\zeta, \sigma, \alpha)\}$ be any pure-strategy MPE and take $V_i(s_k)$ for $i \in \{G, R\}$ to be j's continuation payoff starting from any stage s_k if the factions play according to $\mathcal{E}$. The sequence (z_k, s_{k+1}), (z_{k+1}, s_{k+2}), ... denotes the path of play starting from s_k.

Although the details of the proof of the Proposition 1 are cumbersome, the underlying intuition is straightforward. Lemma 1A characterizes the equilibrium starting from any stage at which fighting is sure to be decisive, i.e., any s_k with $d_k = 1$. Because fighting is decisive, the continuation payoffs and path are relatively easy to specify. Lemma 2A shows that if the factions do not fight at s_k in $\mathcal{E}$, then G can move play to a stage where fighting is sure to be decisive. More specifically, if R accepts (z_k, s_{k+1}) at s_k in $\mathcal{E}$, then G can induce R to move to an $s'_{k+1} = (1, p'_{k+1})$. Lemmas 3A and 4A demonstrate that if R accepts (z_k, s_{k+1}), then R's continuation payoff at s_{k+1} is equal to its continuation payoff at an s' where fighting is sure to be decisive, i.e., $V_R(s_{k+1}) = V_R(s')$ where $s' = (1, p')$ for a $p' \in [0, 1)$. Taken together, Lemmas 2A through 4A imply that if R accepts G's offer at s_k, then there exists a sequence of stages $s'_{k+j} = (1, p'_{k+j})$ which are payoff equivalent to R's continuation payoffs along the path from s_k, i.e., $V_R(s_{k+j}) = V_R(s'_{k+j})$ for $j \geq 1$. Proposition 1 uses this equivalence and Lemma 1A's characterization of the continuation games starting from stages where fighting is decisive to specify equilibrium behavior and payoffs starting from any stage.

Lemma 1A characterizes the equilibrium starting from s_k with $d_k = 1$. Note that $B(s_k) = B'(s_k) = \Pi_R(s_k) = F_R(s_k) = f_R + \beta p_k(1 + \gamma)V$ when $d_k = 1$.

LEMMA 1A: *Let $s_k = (1, p_k)$ and assume $\gamma > 0$. Then (i) $V_R(s_k) = f_R + \beta p_k(1 + \gamma)V$ and (ii) $F_G(s') > \Pi_G(s')$ whenever $F_G(s) > \Pi_G(s)$, $s = (1, p)$, $s' = (1, p')$, and $p' > p$. If $V > B(s_k) \neq V - \beta^n(V - f_R)$ for any integer $n \geq 1$ also holds, then (iii) the factions fight at s_k with $V_G(s_k) = F_G(s_k)$ if $F_G(s_k) > \Pi_G(s_k)$ and (iv) G eliminates R as is peacefully possible if $\Pi_G(s_k) > F_G(s_k)$.*

Proof: To establish (ii), suppose $\Pi_R(s) < V$ and $F_G(s) > \Pi_G(s)$. Since $\Pi_G(s) = (1 + \beta^{q(s)}\gamma)V - F_R(s)$, we have $F_G(s) + F_R(s) > (1 + \beta^{q(s)}\gamma)V$. Observe further that $F_G(s) + F_R(s) = F_G(s') + F_R(s') = f_G + f_R + \beta(1 + \gamma)V$. Hence, $F_G(s') > (1 + \beta^{q(s)}\gamma)V - F_R(s') \geq$

$(1+\beta^{q(s')}\gamma)V - F_R(s') = \Pi_G(s')$ where the weak inequality holds since $q(s') \geq q(s)$. Suppose alternatively that $\Pi_R(s) \geq V$. Trivially, $\Pi_R(s) \geq V$ implies $\Pi_R(s') \geq V$ and, consequently, that $\Pi_G(s') \leq 0$. This leaves leaves $F_G(s') > f_G > 0 \geq \Pi_G(s')$.

Before establishing the other claims, we begin by determining upper bounds on G's continuation payoff at any $s_j \in [01,1]^2$ if the factions fight in the continuation game. If the factions fight s_{j+m}, then $V_G(s_j)+V_R(s_j) = (1-\beta^m)V + \beta^m[F_R(s_{j+m}) + F_G(s_{j+m})]$ where $F_G(s_{j+m}) + F_R(s_{j+m}) = [f_G + f_R + \beta(1+\gamma)V[d_{j+m}(1-\varepsilon)+\varepsilon]/[1-\beta(1-d_{j+m})(1-\varepsilon)]$. The expression on the right is increasing in d_{j+m}, so $V_G(s_j)+V_R(s_j) \leq (1-\beta^m)V + \beta^m[f_R + f_G + \beta(1+\gamma)V] = V - \beta^m(1-f_R-f_G-\beta\gamma V)$. If $1-f_R-f_G-\beta\gamma V \leq 0$, then $V_G(s_j)+V_R(s_j) \leq f_G + f_R + \beta(1+\gamma)V$ when the factions fight in the continuation game at s_j or later (i.e., $m \geq 0$) and $V_G(s_j)+V_R(s_j) \leq V - \beta(1-f_R-f_G-\beta\gamma V) = 1+\beta[f_G+f_R+\beta(1+\gamma)V]$ when the factions fight at s_{j+1} or later. If $1-f_R-f_G-\beta\gamma V > 0$, $V_G(s_j)+V_R(s_j) \leq V$ regardless of when the factions fight.

To establish (i), observe that we are done if the factions fight at $s_k = (1,p_k)$ since $V_R(s_k) = f_R + \beta p_k(1+\gamma)V$. Assume therefore that the R accepts (z_k, s_{k+1}) at s_k. If $z_k > 0$, then IC must bind. Otherwise G could profitably deviate to $(z_k - \delta, s_{k+1})$ for a $\delta > 0$. Because IC binds, we have $V_R(s_k) = z_k + \beta V_R(s_{k+1}) = f_R + \beta p_k(1+\gamma)V$.

Suppose then that R accepts (z_k, s_{k+1}), $z_k = 0$, and $B(s_k) < V$. Then $B(s_k) < (1-\beta^{q(s_k)}\gamma)V + \beta^{q(s_k)}f_R$ for a finite $q(s_k)$. Assume first that the previous inequality is strict. Because $B(s_k) \leq (1-\beta^{q(s_k)}\gamma)V + \beta^{q(s_k)}f_R$, G can transfer slightly more than $B(s_k)$ to R in $q(s_k)$ offers and, consequently, $V_G(s_k) \geq \Pi_G(s_k)$. To verify this lower bound on $V_G(s_k)$, let $s'_{k+1} = (1, p'_{k+1} + \delta_1)$ where $\delta_1 > 0$ and p'_{k+1} satisfies $1 + \beta[f_R + \beta p'_{k+1}(1+\gamma)V] = f_R + \beta p_k(1+\gamma)V$. Then R is sure to accept s'_{k+1} at s_k since $1 + \beta V_R(s'_{k+1}) \geq 1 + \beta[f_R + \beta(p'_{k+1}+\delta_1)(1+\gamma)V] > f_R + \beta p_k(1+\gamma)V$. Repeating the argument, R is sure to accept $(1, s'_{k+2})$ at s'_{k+1} where $s'_{k+2} = (1, p'_{k+2} + \delta_2)$, $\delta_2 > 0$, and $1 + \beta[f_R + \beta p'_{k+2}(1+\gamma)V] = f_R + \beta(p'_{k+1}+\delta_1)(1+\gamma)V$. By choosing δ_j small enough we can continue in this way until $f_R + \beta(p'_{k+q(s_k)-1} + \delta_{q(s_k)-1})(1+\gamma)V < 1 + \beta f_R$ at which point R is sure to accept $(f_R + \beta(p'_{k+q(s_k)-1} + \delta_{q(s_k)-1})(1+\gamma)V + \delta_{q(s_k)}, E)$ for any $\delta_{q(s_k)} > 0$.

Let $V'_G(s_k, \overline{\delta})$ and $V'_R(s_k, \overline{\delta})$ denote the factions' continuation payoffs for $\overline{\delta} = \max\{\delta_1, ..., \delta_{q(s_k)}\}$. Then $V'_R(s_k, \overline{\delta}) > V'_R(s_k, 0) = f_R + \beta p_k(1+\gamma)V$ and continuity ensures $\lim_{\overline{\delta}\to 0} V'_R(s_k, \overline{\delta}) = V'_R(s_k, 0)$. Since R agrees to move to E after $q(s_k)$ offers, $V'_G(s_k, \overline{\delta}) + V'_R(s_k, \overline{\delta}) = V + \beta^{m(s_k)}\gamma V$. This gives $V'_G(s_k, \overline{\delta}) = V + \beta^{q(s_k)}\gamma V - V'_R(s_k, \overline{\delta})$. Since this cannot be a profitable deviation $V_G(s_k) \geq V'_G(s_k, \overline{\delta})$ for all $\overline{\delta} > 0$. Thus, $V_G(s_k) \geq V'_G(s_k, 0) = V + \beta^{q(s_k)}\gamma V - V'_R(s_k, 0) = V + \beta^{q(s_k)}\gamma V - B(s_k) = \Pi_G(s_k)$, which verifies the claim.

If the continuation game starting at s_k is peaceful, then $V_G(s_k) + V_R(s_k) \leq V + \beta^{q(s_k)}\gamma V = \Pi_G(s_k) + B(s_k)$. The lower bounds $V_G(s_k) \geq \Pi_G(s_k)$ and $V_R(s_k) \geq f_R + \beta p_k(1+\gamma)V = B(s_k)$ imply $V_G(s_k) = \Pi_G(s_k)$ and $V_R(s_k) = f_R + \beta p_k(1+\gamma)V$.

If the factions fight in the continuation game starting at s_k, then they must fight at s_k and $V_R(s_k) = f_R + \beta p_k(1+\gamma)V$. Arguing by contradiction, suppose the factions fight at s_{k+1} or later. Assuming $1 - f_R - f_G - \beta\gamma V < 0$, then $V_G(s_k) + V_R(s_k) \leq 1 + \beta[f_G + f_R + \beta(1+\gamma)V]$. This leaves $V_G(s_k) \leq 1 + \beta[f_G + f_R + \beta(1+\gamma)V] - [f_R + \beta p_k(1+\gamma)V]$. Algebra shows that the expression on the right is strictly less than $F_G(s_k) = f_G + \beta(1-p_k)(1+\gamma)V$ when $1 - f_R - f_G - \beta\gamma V < 0$. But $V_G(s_k) < F_G(s_k)$ is a contradiction as G could profitably deviate by fighting at s_k. If $1 - f_R - f_G - \beta\gamma V \geq 0$, then $V_G(s_k) + V_R(s_k) \leq V$. This yields the contradiction $V_G(s_k) \leq V - B(s_k) < V + \beta^{q(s_k)}\gamma V - B(s_k) = \Pi_G(s_k) \leq V_G(s_k)$. Hence, $V_R(s_k) = f_R + \beta p_k(1+\gamma)V$ if R accepts (z_k, s_{k+1}), $z_k = 0$, and $B(s_k)$ <and $B(s_k) = (1 - \beta^{q(s_k)})V + \beta^{q(s_k)} f_R$.

Now assume that R accepts (z_k, s_{k+1}), $z_k = 0$, and $B(s_k) = (1 - \beta^{q(s_k)})V + \beta^{q(s_k)} f_R$. The latter equality implies that transferring slightly more than $B(s_k)$ to R takes $q(s_k)+1$ offers. Repeating the argument above gives $V_G(s_k) \geq V + \beta^{m(s_k)+1}\gamma V - B(s_k)$.

If the continuation game starting from s_k is peaceful, we have $\beta V_R(s_{k+1}) \geq B(s_k)$ since $z_k = 0$. This means that it takes at least $q(s_k)+1$ offers to transfer $B(s_k)$ to R. As a result, $V_G(s_k) + V_R(s_k) \leq V + \beta^{q(s_k)+1}\gamma V$ and, consequently, $V_G(s_k) \leq V + \beta^{q(s_k)+1}\gamma V - B(s_k)$. The identical upper and lower bounds on $V_G(s_k)$ imply $V_G(s_k) = V + \beta^{q(s_k)+1}\gamma V - B(s_k)$. It follows that $V_R(s_k)$ is bounded above and below and hence equal to $f_R + \beta p_k(1+\gamma)V$. If the factions fight in the continuation game, repeating the argument above shows that the factions must fight at s_k and hence that $V_R(s_k) = f_R + \beta p_k(1+\gamma)V$.

Finally assume R accepts (z_k, s_{k+1}), $z_k = 0$, and $B(s_k) \geq V$. Then $f_G + f_R + \beta(1+\gamma)V > V$ or $1 - f_G - f_R - \beta\gamma V < 0$. This implies that $V_G(s_k) + V_R(s_k) \leq 1 + [f_G + f_R + \beta(1+\gamma)V]$ if the factions fight in the continuation game starting from s_{k+1}. But, $V_G(s_k) + V_R(s_k) \geq f_G + f_R + \beta(1+\gamma)V$. Combining the bounds on the continuation payoffs yields the contradiction $0 \leq (1-\beta)[\ 1 - f_G - f_R - \beta\gamma V]$. Hence the continuation game must be peaceful. This too leads to a contradiction as the most that G can transfer to R is V, so $V_R(s_k) \leq V < B(s_k) = F_R(s_k)$.

Turning to claims (iii), and (iv), Lemma 2 ensures that when establishing (iv) it suffices to show that the continuation game is peaceful and that $V_G(s_k) = \Pi_G(s_k)$. Suppose, first, that that $\Pi_R(s_k) \geq V$. Since $V_R(s_k) \geq \Pi_R(s_k)$, eliminating R peacefully means transferring at least $\Pi_R(s_k)$ to R. This is impossible if $\Pi_R(s_k) > V$. If $\Pi_R(s_k) = V$, R might be able to eliminate G peacefully if $V_R(s_k) = \Pi_R(s_k)$. But this would require $z_{k+j} = 1$ for all $j \geq 0$, and clearly G would do better by fighting at s_k which brings at least f_G. Hence, the factions must fight in the continuation game if $B(s_k) \geq V$.

This inequality also implies $f_G + f_R + \beta(1+\gamma)V > B(s_k) \geq V$. This means $1 - f_G - f_R - \beta\gamma V < 0$, and it implies that G's payoff to fighting at s_k is strictly better than its payoff to fighting later. To establish this, recall that $V_G(s_k) + V_R(s_k) \leq V - \beta(1 - f_R - f_G - \beta\gamma V)$ when the factions fight at s_{k+1} or later and $1 - f_R - f_G - \beta\gamma V < 0$. Consequently, $V_G(s_k) \leq V - \beta(1 - f_R - f_G - \beta\gamma V) - F_R(s_k)$. It now suffices to show that $F_G(s_k) > V - \beta(1 - f_R - f_G - \beta\gamma V) - F_R(s_k)$. This is equivalent to $f_G + f_R + \beta(1+\gamma)V > V - \beta(1 - f_R - f_G - \beta\gamma V)$ or $0 > (1-\beta)[\ 1 - f_G - f_R - \beta\gamma V]$ which is sure to hold. G, therefore, fights at s_k when $B(s_k) \geq V$. Since $\Pi_G(s_k) \leq 0$ when $\Pi_R(s_k) \geq V$, we also have $F_G(s_k) > \Pi_G(s_k)$. Hence (iii) holds as, vacuously, (iv) does when $\Pi_R(s_k) \geq V$.

Now suppose $B(s_k) < V$. We proceed by induction to establish (iii) and (iv). That is, we show that the claims hold for $B(s_k) \in (f_R, 1 + \beta f_R)$. Then we assume they hold for $B(s_k) \in (V - \beta^{n-1}(V - f_R), V - \beta^n(V - f_R))$ and demonstrate that they hold for $B(s_k) \in (V - \beta^n(V - f_R), V - \beta^{n+1}(V - f_R))$.

Assume $f_R < B(s_k) < 1 + \beta f_R$. If G eliminates R peacefully, then $V_R(s_k) + V_G(s_k) \leq (1 + \beta\gamma)V$. Consequently, $V_R(s_k) + V_G(s_k) \leq \max\{(1+\beta\gamma)V, V, f_R + f_G + \beta(1+\gamma)V\} =$

$(1+\beta\gamma)V$ regardless of the way the game ends.

R can always reject any offer, so $V_R(s_k) \geq f_R + \beta p_k(1+\gamma)V = B(s_k)$. R, moreover, is sure to accept $(B(s_k) - \beta f_R + \delta, E)$ for any $\delta > 0$ since $B(s_k) + \delta > f_R + \beta p_k(1+\gamma)V = B(s_k)$. Hence, $V_G(s_k) \geq (1+\beta\gamma)V - B(s_k) - \delta$ for any $\delta > 0$ and, consequently, $V_G(s_k) \geq (1+\beta\gamma)V - B(s_k)$. The lower bounds on $V_G(s_k)$ and $V_R(s_k)$ along with the upper bound on $V_G(s_k)+V_R(s_k)$ imply $V_R(s_k) = B(s_k)$ and $V_G(s_k) = \Pi_G(s_k) = (1+\beta\gamma)V - B(s_k)$ when an equilibrium exists. Assuming R accepts $(B(s_k) - \beta f_R, E)$ ensures existence. Finally, observe that $F_G(s_k) = f_G + \beta(1-p_k)(1+\gamma)V < \Pi_G(s_k)$. Hence, (iii) and (iv) hold when $B(s_k) \in (f_R, 1 + \beta f_R)$.

Now suppose $B(s_k) \in (V - \beta^n(V - f_R), V - \beta^{n+1}(V - f_R))$ and that (iii) and (iv) hold for any $s = (1, p)$ such that $B(s) = f_R + \beta p(1+\gamma)V < V - \beta^n(V - f_R)$ and that $B(s) \neq V - \beta^j(V - f_R)$ for any $j \leq n$. Arguing by contradiction to establish (iii), assume $F_G(s_k) > \Pi_G(s_k)$ and that R does not fight at s_k. If equilibrium path is peaceful, G's payoff is bounded above by $\Pi_G(s_k)$. Hence, fighting at s_k would be a profitable deviation.

Assume then that the factions must fight at some s_{k+m} for $m \geq 1$ in the continuation game. As a result, $V_G(s_{k+1}) + V_R(s_{k+1}) \leq \max\{V, f_G + f_R + \beta(1+\gamma)V\}$. But $F_G(s_k) > \Pi_G(s_k)$ implies $f_G + f_R + \beta(1+\gamma)V > V$, so $V_G(s_k) + V_R(s_k) \leq 1 + \beta[f_G + f_R + \beta(1+\gamma)V]$. Using $V_R(s_k) \geq f_R + \beta p_k(1+\gamma)V$ gives $V_G(s_k) \leq 1 + \beta[f_G + f_R + \beta(1+\gamma)V] - [f_R + \beta p_k(1+\gamma)V] = F_G(s_k) - (1-\beta)[f_G + f_R + \beta(1+\gamma)V - V]$. Thus, fighting at s_k is a profitable deviation, and this contradiction ensures that the factions fight at s_k. This leaves $V_R(s_k) = F_R(s_k)$ and $V_G(s_k) = F_G(s_k)$ and establishes (iii).

To show that (iv) holds, assume that $\Pi_G(s_k) > F_G(s_k)$ and that G does not eliminate R as fast as is peacefully possible. Define $s'_{k+1}(\delta) \equiv (1, p' + \delta)$ where p' uniquely satisfies $f_R + \beta p_k(1+\gamma)V = 1 + \beta[f_R + \beta p'(1+\gamma)V]$. Then R is sure to accept $s'_{k+1}(\delta)$ for any $\delta > 0$. Note further that $q(s'_{k+1}(0)) = q(s_k) - 1$. The assumption that $B(s_k) \in (V - \beta^n(V - f_R), V - \beta^{n+1}(V - f_R))$ also implies $q(s'_{k+1}(\delta)) = q(s'_{k+1}(0))$ for δ small enough. As a result, G can obtain $V + \beta^{q(s_k)}\gamma V - B(s_k) - \beta^2\delta(1+\gamma)V = \Pi_G(s_k) - \beta^2\delta(1+\gamma)V$ by proposing $(1, s'_{k+1}(\delta))$ and then eliminating R as quickly as is peacefully possible. Hence, $V_G(s_k) \geq \Pi_G(s_k)$. Since G's payoff to eliminating R peacefully in $m > q(s_k)$ rounds is

strictly less than $\Pi_G(s_k)$, G would have a profitable deviation if it eliminated R peacefully at s_k but not as quickly as possible.

Suppose then that the factions fight in the continuation game. If $1 - f_G - f_R - \beta\gamma V \leq 0$, then $V_G(s_k) + V_R(s_k) \leq f_R + f_G + \beta(1+\gamma)V$. This means $V_G(s_k) \leq f_R + f_G + \beta(1+\gamma)V - F_R(s_k) = F_G(s_k)$. Since $\Pi_G(s_k) > F_G(s_k)$, G can profitably deviate by offering $(1, s'_{k+1}(\delta))$ for a δ sufficiently small and then eliminating R as quickly as is peacefully possible. If $1 - f_G - f_R - \beta\gamma V > 0$, then $V_G(s_k) + V_R(s_k) \leq V$. This implies $V_G(s_k) \leq V - B(s_k) < V + \beta^{q(s_k)}\gamma V - B(s_k) = \Pi_G(s_k)$ and G again has a profitable deviation.

Thus, G eliminates R as quickly as is peacefully possible when $\Pi_G(s_k) > F_G(s_k)$. This leaves $V_G(s_k) + V_R(s_k) = V + \beta^{q(s_k)}\gamma V$. This along with the lower bounds $V_G(s_k) \geq \Pi_G(s_k)$ and $V_R(s_k) \geq f_R + \beta p_k(1+\gamma)V = B(s_k)$ imply $V_G(s_k) = \Pi_G(s_k)$ and $V_R(s_k) = f_R + \beta p_k(1+\gamma)V$. This establishes (iv). $\square$

Now consider stages at which $d_k < 1$. Lemma 2A shows that if R accepts (z_k, s_{k+1}) at s_k in an MPE, then G can move play to a stage in which fighting is decisive. That is, G can make a possibly out of equilibrium proposal (z'_k, s'_{k+1}) which R is sure to accept and in which $d'_{k+1} = 1$.

LEMMA 2A: *If R accepts (z_k, s_{k+1}) at s_k with $d_k < 1$, then there exists a $z'_k \in [0,1]$ and an $s'_{k+1} = (1, p'_{k+1})$ such that R accepts (z'_k, s'_{k+1}).*

Proof: Assume $V_R(s_{k+1}) < f_R + \beta(1+\gamma)V$. Since $V_R(s_{k+1}) \geq f_R$, there exists a $\widetilde{p} \in [0,1)$ such that $V_R(s_{k+1}) = f_R + \beta\widetilde{p}(1+\gamma)V$. Moreover, $V_R(s'_{k+1}) = f_R + \beta\widetilde{p}(1+\gamma)V$ by Lemma 1A where $s'_{k+1} \equiv (1, \widetilde{p}))$. R's acceptance of (z_k, s_{k+1}) means that IC holds. Substituting $f_R + \beta\widetilde{p}(1+\gamma)V$ for $V_R(s_{k+1})$ gives $z_k + \beta[f_R + \beta\widetilde{p}(1+\gamma)V] = V_R(s_k) \geq f_R + \beta d_k p_k(1+\gamma)V + \beta(1-d_k)[(1-\varepsilon)V_R(s_k) + \varepsilon[f_R + \beta\widetilde{p}(1+\gamma)V]]$. Hence, R is sure to accept $(z_k, (1, \widetilde{p} + \delta))$ for an arbitrarily small $\delta > 0$.

Now assume $V_R(s_{k+1}) \geq f_R + \beta(1+\gamma)V$. If $1 + \beta[f_R + \beta(1+\gamma)V] > V_R(s_k)$, then R strictly prefers $(1, (1, 1-\delta))$ for δ small enough since $1 + \beta[f_R + \beta(1+\gamma)V] > V_R(s_k) \geq f_R + \beta d_k p_k(1+\gamma)V + \beta(1-d_k)[(1-\varepsilon)V_R(s_k) + \varepsilon[f_R + \beta(1+\gamma)V]$. The remainder of the proof establishes that $1 + \beta[f_R + \beta(1+\gamma)V] > V_R(s_k)$.

To establish this bound on $V_R(s_k)$, recall that $V_G(s_j) + V_R(s_j) \leq \max\{V, f_G +$

$f_R + \beta(1+\beta)]\}$ if the factions fight in the continuation game starting from s_j. Since $V_G(s_j) \geq f_G$, $V_R(s_j) \leq \max\{V - f_G, f_R + \beta(1+\gamma)V\}$. If the factions do not fight in the continuation game, then $V_R(s_j) \leq V$. Hence, $V_R(s_j) \leq \max\{V, f_R + \beta(1+\gamma)V\}$ regardless of the way the continuation game ends.

R's acceptance of z_k then ensures $V_R(s_k) = z_k + \beta\ V_R(s_{k+1}) \leq z_k + \beta \max\{V, f_R + \beta(1+\gamma)V\}$. The bound on $V_R(s_k)$ follows immediately if $z_k = 0$. If $f_R + \beta(1+\gamma)V \geq V$, $1 + \beta[f_R + \beta(1+\gamma)V] > \beta \max\{V, f_R + \beta(1+\gamma)V\} \geq V_R(s_k)$. If $f_R + \beta(1+\gamma)V < V$, then $\beta V \geq V_R(s_k)$ and we are done if $1 + \beta[f_R + \beta(1+\gamma)V] > \beta V$. But this inequality is equivalent to $1 - \beta + \beta f_R + \beta^2\gamma > 0$ which clearly holds.

Taking $z_k > 0$, there are three cases to consider: (i) the factions fight at s_{k+1}; (ii) the factions do not fight at s_{k+1} with $V_R(s_k) + V_G(s_k) \leq V$; and (iii) the factions do not fight at s_{k+1} with $V_R(s_k) + V_G(s_k) > V$. To establish that $1 + \beta[f_R + \beta(1+\gamma)V] > V_R(s_k)$ in case (i), note that an upper bound on what R can obtain if it fights at s_{k+1} is one in stage k and then the payoff to fighting in the best possible circumstances in the next stage. This leaves $V_R(s_k) \leq 1 + \beta[f_R + \beta(1+\gamma)V]$. Moreover, this inequality must be strict. If not, then $V_G(s_k) \leq \beta f_G$ since $V_R(s_k) + V_G(s_k) \leq 1 + \beta[f_R + f_G + \beta(1+\gamma)V]$. But this means that G could have profitably deviated by fighting at s_k. This contradiction establishes the claim in case (i).

To establish $1 + \beta[f_R + \beta(1+\gamma)V] > V_R(s_k)$ in cases (ii) and (iii), it suffices to show that $V_R(s_k) \geq V_R(s_{k+1})$. To see why, note that since $z_k > 0$, IC must bind. Consequently, $V_R(s_k) = f_R + \beta d_k p_k(1+\gamma)V + \beta(1-d_k)[(1-\varepsilon)V_R(s_k) + \varepsilon V_R(s_{k+1})]$. This equation and $V_R(s_k) \geq V_R(s_{k+1})$ yield $V_R(s_k) \leq [f_R + \beta d_k p_k(1+\gamma)V]/[1-\beta(1-d_k)]$. The expression on the right takes on its maximum value at $d_k = p_k = 1$. This leaves $V_R(s_k) < f_R + \beta(1+\gamma)V$ since $d_k < 1$. R's acceptance of z_k also means that $V_R(s_k) \leq 1 + \beta V_R(s_{k+1})$. Using $V_R(s_k) \geq V_R(s_{k+1})$ again yields $V_R(s_k) \leq 1 + \beta V_R(s_k) < 1 + \beta[f_R + \beta(1+\gamma)V]$.

To show that $V_R(s_k) \geq V_R(s_{k+1})$ in case (ii), suppose the contrary. Then $V_R(s_k) + V_G(s_k) \leq V$ and $V_R(s_k) < V_R(s_{k+1})$. It follows that G can profitably deviate at s_k by slowing things down by repeating s_k rather than moving on to s_{k+1}. To establish this, define z' so that IC binds if G proposes (z', s_k) at s_k. Then z' satisfies $z' + \beta V_R(s_k) =$

$f_R + \beta d_k p_k(1+\gamma)V + \beta(1-d_k)[(1-\varepsilon)V_R(s_k) + \varepsilon V_R(s_k)]$.

It follows that $z' \leq 1$. To verify this, note that R's indifference between (z_k, s_{k+1}) and fighting along with the definition of z' imply $z' + \beta V_R(s_k) = V_R(s_k) - \beta\varepsilon(1-d_k)[V_R(s_{k+1}) - V_R(s_k)]$. By assumption $V_R(s_{k+1}) > V_R(s_k)$, so $z' + \beta V_R(s_k) < V_R(s_k) - \delta$ for a $\delta > 0$. Accordingly, $z' + \delta < (1-\beta)V_R(s_k) < 1$ because $V_R(s_k) < V_R(s_k) + V_G(s_k) \leq V$.

The definition of z' also ensures that R is sure to accept $(\max\{0, z' + \delta\}, s_k)$. Consequently, G's payoff to making this proposal is $V'_G(s_k) = 1 - \max\{0, z' + \delta\} + \beta V_G(s_k)$. If $z' + \delta > 0$, we have $V'_G(s_k) = 1 - z' - \delta + \beta V_G(s_k)$. This along with $z' + \delta < (1-\beta)V_R(s_k)$ yield $V'_G(s_k) - V_G(s_k) > 1 - (1-\beta)[V_R(s_k) + V_G(s_k)]$. But $V_G(s_k) + V_R(s_k) \leq V$, so $1 - (1-\beta)[V_G(s_k) + V_R(s_k)] \geq 0$. Hence, $V'_G(s_k) - V_G(s_k) > 0$ which means that G has a profitable deviation.

Suppose alternatively that $z' + \delta \leq 0$. Then $V'_G(s_k) = 1 + \beta V_G(s_k)$ or, equivalently, $V'_G(s_k) - V_G(s_k) = 1 - (1-\beta)V_G(s_k) > 0$ where the strict inequality follows from the fact that $V_G(s_k) + f_R \leq V_R(s_k) + V_G(s_k) \leq V$. Once again, G has a profitable deviation and this contradiction ensures that $V_R(s_k) \geq V_R(s_{k+1})$ and consequently $1 + \beta[f_R + \beta p_k(1+\gamma)V] > V_R(s_k)$ in case (ii).

To show that $V_R(s_k) \geq V_R(s_{k+1})$ in case (iii), suppose the factions do not fight at s_{k+1}, $V_R(s_k) + V_G(s_k) > V$, and $V_R(s_k) < V_R(s_{k+1})$. Because $V_R(s_k) + V_G(s_k) > V$, the factions must either fight in the continuation game or G must eliminate R peacefully. Either way, play must reach E in finitely many rounds. Assume $s_{k+m} = E$. Since R accepts (z_{k+1}, s_{k+2}) at s_{k+1}, $m \geq 2$. If R agrees to move to E, then $V_R(s_{k+m-1}) \leq 1 + \beta f_R$. If the factions fight at s_{k+m-1}, we can repeat the argument made in case (i) to show that $1 + \beta[f_R + \beta(1+\gamma)V] > V_R(s_{k+m-1})$. Hence, $1 + \beta[f_R + \beta(1+\gamma)V] > V_R(s_{k+m-1})$ whether or not the factions fight in the continuation game. We are done if $V_R(s_{k+m-1}) \geq V_R(s_{k+1})$ since $V_R(s_{k+1}) > V_R(s_k)$.

Suppose therefore that $V_R(s_{k+1}) > V_R(s_{k+m-1})$. Then R's continuation values $V_R(s_k)$, $V_R(s_{k+1})$,... $V_R(s_{k+m-1})$ must peak at some stage. We show that G can profitably deviate by speeding things up by skipping this stage. Formally, since R accepts (z_k, s_{k+1}) and (z_{+1}, s_{k+2}), $V_G(s_k) + V_R(s_k) > V$, and $V_R(s_k) < V_R(s_{k+1})$, there must exist an s_n, s_{n+1},

and s_{n+2} such that $V_R(s_n) < V_R(s_{n+1})$ and $V_R(s_{n+1}) \geq V_R(s_{n+2})$ for an n satisfying $k \leq n \leq k+m-3$. To verify this, suppose the that it does not hold for $n = k$, then $V_R(s_{n+1}) < V_R(s_{n+2})$. But then if the claim does not hold for $n = k+1$, it must be that $V_R(s_{n+2}) < V_R(s_{n+3})$. If we repeat the argument and the claim never holds, we have the contradiction $V_R(s_{k+1}) < V_R(s_{k+2}) < \cdots < V_R(s_{k+m-1})$.

To see that G can profitably deviate by speeding things up by skipping s_{n+1}, define $z' \equiv V_R(s_n) - \beta V_R(s_{n+2})$. Then $z' < 1$ since $1 \geq V_R(s_{n+1}) - \beta V_R(s_{n+2}) > V_R(s_n) - \beta V_R(s_{n+2})$ where R's acceptance of (z_{n+1}, s_{n+2}) guarantees that the weak inequality holds. R's acceptance of (z_n, s_{n+1}) ensures $0 \leq V_R(s_n) - \beta V_R(s_{n+1}) \leq V_R(s_n) - \beta V_R(s_{n+2})$. Hence, $z' \in [0, 1)$ and is therefore feasible.

R is sure to accept $(z' + \delta, s_{n+2})$ at s_n for any $\delta > 0$ since $z' + \beta V_R(s_{n+2}) = V_R(s_n) \geq f_R + \beta d_n p_n (1+\gamma)V + \beta(1-d_n)[(1-\varepsilon)V_R(s_n) + \varepsilon V_R(s_{n+1})]$ and $V_R(s_{n+1}) \geq V_R(s_{n+2})$. Now consider G's payoff it proposes $(z'+\delta, s_{n+2})$ and then follows $\mathcal{E}$. G obtains $V'_G(s_k) = 1 - z' - \delta + \beta V_G(s_{n+2}) = 1 - V_R(s_n) + \beta V_R(s_{n+2}) + \beta V_G(s_{n+2}) - \delta$. This leaves $V'_G(s_k) - V_G(s_k) = 1 - [V_R(s_n) + V_G(s_n)] + \beta[V_R(s_{n+2}) + \beta V_G(s_{n+2})] - \delta$. Since R accepts (z_j, s_{j+1}) for $k \leq j \leq k+m-1$, $V_R(s_j) + V_G(s_j) = 1 + \beta[V_R(s_{j+1}) + V_G(s_{j+1})]$ for $k \leq j \leq k+m-2$. Hence, $V'_G(s_k) - V_G(s_k) = [V_R(s_n) + V_G(s_n) - 1]/\beta - [V_R(s_n) + V_G(s_n)] - \delta$. That $V_R(s_n) + V_G(s_n) > V$ ensures that we can choose $\delta > 0$ small enough so that $V'_G(s_k) - V_G(s_k) > 0$ and $z' + \delta < 1$. G therefore has a profitable deviation, and this contradiction ensures $V_R(s_k) \geq V_R(s_{k+1})$ in case (iii). □

Lemma 2A showed that G can move play to stages where fighting is sure to be decisive. The next lemma demonstrates that if G is going to provoke a fight in the next round, it first moves play to a stage at which fighting is sure to be decisive.

LEMMA 3A: *If R accepts (z_k, s_{k+1}) at s_k and the factions fight at s_{k+1} in $\mathcal{E}$, then $s_{k+1} = (1, p_{k+1})$ for a $p_{k+1} \in [0, 1)$.*

Proof: Arguing by contradiction, assume that R accepts (z_k, s_{k+1}), the factions fight at s_{k+1}, and $d_{k+1} < 1$. Then G has a profitable deviation. To construct this deviation, observe first that $V_G(s_k) + V_R(s_k) = 1 + \beta[f_R + f_G + \beta d_{k+1}(1+\gamma)V + \beta\varepsilon(1-d_{k+1})(1+\gamma)V]/[1-\beta(1-d_{k+1})(1-\varepsilon)] < 1 + \beta[f_G + f_R + \beta(1+\gamma)V] - \delta$ for a sufficiently small

$\delta > 0$ where the strict holds because $d_k < 1$.

Because $d_k < 1$, we also have $f_R + \beta(1+\gamma)V > F_R(s_{k+1}) = V_R(s_{k+1}) > f_R$. Thus, there exists a $p' \in (0,1)$ such that $V_R(s_{k+1}) = f_R + \beta p'(1+\gamma)V$. Since $z_k > 0$ and R accepts (z_k, s_{k+1}), IC holds at (z_k, s_{k+1}) and consequently at $(z_k, (1, p'))$. This means that R is sure to accept $(z_k, (1, p' + \delta'))$ for any $\delta' > 0$. If G offers $(z_k, (1, p' + \delta'))$, and then fights, $V_G'(s_k) + V_R'(s_k) = 1 + \beta[f_R + f_G + \beta(1+\gamma)V > V_G(s_k) + V_R(s_k) + \cancel{\delta}$. This leaves $V_G'(s_k) - V_G(s_k) = V_R(s_k) - V_R'(s_k) + \cancel{\delta}$. But $V_R'(s_k) = z_k + \beta[f_R + \beta(p' + \delta)(1+\gamma)] = V_R(s_k) + \beta^2\delta'(1+\gamma)V$. This leaves $V_G'(s_k) - V_G(s_k) > \delta - \beta^2\delta'(1+\gamma)V$. Taking δ' sufficiently small ensures that this is a profitable deviation.

The last lemma shows that if R accepts (z_k, s_{k+1}), then there is a stage $s' = (1, p')$ which is payoff equivalent for R to s_{k+1}, i.e., $V_R(s_{k+1}) = V_R(s')$.

LEMMA 4A: *If $d_k < 1$ and R accepts (z_k, s_{k+1}), there exists a $p' \in [0,1)$ such that $V_R(s_{k+1}) = f_R + \beta p'(1+\gamma)V$.*

Proof: Lemma 3A establishes the result if the factions fight at s_{k+1}. Observe further that there is nothing to show if it $V_R(s_{k+1}) < f_R + \beta(1+\gamma)V$ since $V_R(s_{k+1}) \geq f_R$. Assume, therefore, that the factions do not fight at s_{k+1} and that $V_R(s_{k+1}) \geq f_R + \beta(1+\gamma)V$. The proof of Lemma 2A establishes that $1 + \beta[f_R + \beta(1+\gamma)V] > V_R(s_k)$. There are now two cases to consider.

Case (i): $V_R(s_k) \geq 1 + \beta f_R$. With $1 + \beta[f_R + \beta(1+\gamma)V] > V_R(s_k)$, it suffices to show that $z_k = 1$ since $V_R(s_{k+1}) = [V_R(s_k) - z_k]/\beta$. The first step is to demonstrate that the factions must fight in the continuation game. Arguing by contradiction, assume that the continuation games is peaceful. Then G has a profitable deviation.

To construct a profitable deviation, note that since $1+\beta[f_R+\beta(1+\gamma)V] > V_R(s_k)$ and $V_R(s_k) \geq 1 + \beta f_R$, there exists a $p' \in (0,1)$ such that $V_R(s_k) = 1 + \beta[f_R + \beta p'(1+\gamma)V]$. The fact that R weakly prefers accepting (z_k, s_{k+1}) to fighting ensures that R strictly prefers accepting $(1, (1, p' - \delta))$ at s_k to fighting for a $\delta > 0$ sufficiently small. That is, $1 + \beta[f_R + \beta p'(1+\gamma)V] = V_R(s_k) \geq f_R + \beta d_k p_k(1+\gamma)V + \beta(1-d_k)[(1-\varepsilon)V_R(s_k) + \varepsilon V_R(s_{k+1})] > f_R + \beta d_k p_k(1+\gamma)V + \beta(1-d_k)[(1-\varepsilon)V_R(s_k) + \varepsilon[f_R + \beta p'(1+\gamma)V]$ where the strict inequality follows from $V_R(s_{k+1}) \geq f_R + \beta(1+\gamma)V$ and $p' < 1$.

To ease the notation, define $s' = (1, p')$. Assume $p' > 0$ and recall that $q(s')$ is the

smallest integer m such that $(1-\beta^m)V + \beta^m f_R \geq \Pi_R(s') = f_R + \beta p'(1+\gamma)V$. Take δ sufficiently small so that $f_R + \beta(p'-\delta)(1+\gamma)V \neq V - \beta^n(V - f_R)$ for any integer n. Lemma 1A ensures that G can obtain at least $V'_G(s_k) \geq \beta[V - [f_R + \beta(p'-\delta)(1+\gamma)V] + \beta^{q(s')}\gamma V]$ by offering $(1,(1,p'-\delta))$ and then eliminating R as quickly as is peacefully possible at $(1, p'-\delta)$.

If, by contrast, G plays according to its equilibrium strategy, it will take at least $q(s')+1$ offers to eliminate R since and $V_R(s_{k+1}) \geq f_R + \beta(1+\gamma)V$. As a result, $V_G(s_k) \leq V + \beta^{q(s')+1}\gamma V - V_R(s_k) = \beta[V + \beta^{q(s')+1}\gamma V - [f_R + \beta p'(1+\gamma)V]]]$. But this means that G has a profitable deviation since $V'_G(s_k) - V_G(s_k) \geq \beta^2\delta(1+\gamma)V > 0$. This contradiction means that p' must be zero if the continuation game is peaceful.

Suppose $p' = 0$. Then $V_R(s_k) = 1 + \beta f_R$. R's acceptance now gives $1 + \beta f_R = V_R(s_k) \geq f_R + \beta d_k p_k(1+\gamma)V + \beta[(1-\varepsilon)V_R(s_k) + \varepsilon V_R(s_{k+1})]$. Since $V_R(s_{k+1}) \geq f_R + \beta(1+\gamma)V > f_R$, R strictly prefers accepting $(1-\delta, E)$ at s_k for δ sufficiently small. This leaves G with $V'_G(s_k) = \delta + \beta[(1+\gamma)V - f_R]$. That $V_R(s_{k+1}) > f_R$ also implies $s_{k+1} \neq E$ and that it therefore takes at least two offers to eliminate R. This means $V_G(s_k) \leq V - V_R(s_k) + \beta^2\gamma V$. As before, G has a profitable deviation with $V'_G(s_k) - V_G(s_k) \geq \delta + \beta\gamma$. These profitable deviations mean that the continuation game cannot be peaceful.

Given that the factions must fight in the continuation game, we now argue by contradiction to show that $z_k = 1$. Assume the factions fight in the continuation game but $z_k < 1$. As shown in the proof of Lemma 1A, $V_R(s_j) + V_G(s_j) \leq \max\{V, f_R + f_G + \beta(1+\gamma)V\}$ for any $s_j \neq E$ when the factions fight at s_j or in the continuation game. Assume first that $V < f_R + f_G + \beta(1+\gamma)V$. Then $V_G(s_{k+1}) > f_G$ if $s_{k+1} \neq (1,1)$ since G can always fight at s_{k+1}. This yields the contradiction $V_R(s_{k+1}) < f_R + \beta(1+\gamma)V$. If $s_{k+1} = (1,1)$, then $V_R(s_{k+1}) = 1 + \beta(1+\gamma)V$ by Lemma 1A. But $V_G(s_{k+1}) + V_R(s_{k+1}) \leq f_G + f_R + \beta(1+\gamma)V$, so $V_G(s_k) \leq f_G + f_R\_1 < 0$. This Contradiction means that $V \geq f_G + f_R + \beta(1+\gamma)V$ if $z_k < 1$.

Now assume $V \geq f_R + f_G + \beta(1+\gamma)V$ with $z_k < 1$. If $p' > 0$, G has a profitable deviation. As shown above, R strictly prefers $\widehat{s} \equiv (1,(1,\widehat{p}))$ to fighting for $\widehat{p} \equiv p' - \delta$ and δ small enough. As long as we also choose δ so that $(1-\beta^n)V + \beta^n f_R \neq f_R + \beta\widehat{p}(1+$

$\gamma)V$, Lemma 1A ensures that G's payoff at $(1, \widehat{p})$ satisfies $V_G(\widehat{s}) = \max\{\Pi_G(\widehat{s}), F_G(\widehat{s})\}$. Moreover, $\Pi_G(\widehat{s}) > V - [f_R + \beta\widehat{p}(1+\gamma)V] \geq F_G(\widehat{s})$ where the weak inequality follows from the assumption that $V \geq f_R + f_G + \beta(1+\gamma)V$. Consequently, G's payoff to offering $(1, \widehat{s})$ and then eliminating R as quickly as possible is $V_G'(s_k) = \beta\Pi_G(\widehat{s}) > \beta[V - (f_R + \beta\widehat{p}(1+\gamma)V)] = \beta[V - (f_R + \beta p'(1+\gamma)V)] + \beta^2\delta(1+\gamma)V = V - V_R(s_k) + \beta^2\delta(1+\gamma)V$. But $V_R(s_k) + V_G(s_k) \leq V$. As a result, $V_G'(s_k) > V_G(s_k)$ and proposing $(1, \widehat{s})$ is a profitable deviation for δ sufficiently small. This contradiction implies that $z_k = 1$ if the factions fight in the continuation game and $p' > 0$.

If the factions fight and $p' = 0$, we have another contradiction. Once more, $V_R(s_k) = 1 + \beta f_R$ and R strictly prefers $(1-\delta, E)$ to fighting. Thus $V_G(s_k) \geq \delta + \beta[1 - f_R + \beta(1+\gamma)V] = \delta + V - V_R(s_k) + \beta^2\gamma V$. But, $V_G(s_k) + V_R(s_k) \leq 1 + \beta\max\{V, f_G + f_R + \beta(1+\gamma)V\} = 1 + \beta V = V$. This leaves the contradiction $V_G(s_k) \leq V - V_R(s_k)$. This contradiction implies $z_k = 1$ which in turn implies $V_R(s_{k+1}) < f_R + \beta(1+\gamma)V$.

Case (ii): $V_R(s_k) < 1 + \beta f_R$. Clearly, G can do no better than buying R off in a single offer. Hence, $s_{k+1} = E$ and $V_R(s_{k+1}) = f_R$.$\square$

The preceding lemmas characterize equilibrium play when $d_k = 1$; show that if R accepts (z_k, s_{k+1}) at s_k, then G can move play to an $\widehat{s} = (1, \widehat{p})$ with $\widehat{p} < 1$; and that there exists an $\widehat{s} = (1, \widehat{p})$ with $\widehat{p} < 1$ such that $V_R(s_{k+1}) = V_R(\widehat{s}) = f_R + \beta\widehat{p}(1+\gamma)V$. The proof of Proposition 1 uses these results to demonstrate that the factions fight at s_0 or s_1 or the continuation game is peaceful with G eliminating R as fast as peacefully possible.

Proof of Proposition 1: There is nothing to show if $d_0 = 1$ as Proposition 1 is simply a restatement of Lemma 1A when $d_0 = 1$. Assume then that $d_0 < 1$ and define $s' \equiv (1, p')$ and $s'(\delta) \equiv (1, p' + \delta)$ where $V_R(s_1) = V_R(s_1') = f_R + \beta p'(1+\gamma)V$. Lemma 4A guarantees that $(1, p')$ exists with $p' \in [0, 1)$.

We first show that IC binds at s_0 if R accepts (z_0, s_1) if G proposes (z_0, s') at s_0. Arguing by contradiction, assume that R strictly prefers (z_0, s_1). This implies $z_0 + \beta V_R(s_1) > f_R + \beta d_0 p_0(1+\gamma)V + \beta(1-d_0)[(1-\varepsilon)V_R(s_0) + \varepsilon V_R(s_1)]$. This is equivalent to $z_0 + \beta[f_R + \beta p'(1+\gamma)V] > f_R + \beta d_0 p_0(1+\gamma)V + \beta(1-d_0)[(1-\varepsilon)V_R(s_0) + \varepsilon[f_R + \beta p'(1+\gamma)V]]$. If $z_0 > 0$, then $(z_0 - \delta, s_1)$ is an obviously profitable deviation. If $z_0 = 0$ but $p' > 0$,

there exists a $\delta > 0$ such that R strictly prefers $(0, (1, p' - \delta))$, and this clearly would also be a profitable deviation for G. If, however, $z_0 = p' = 0$, then $V_R(s_0) = \beta f_R$. This is a contradiction as R can always obtain at least f_R by fighting. Thus, IC binds at s_0 if R accepts (z_0, s_1).

It is also the case that if the factions fight, they do so at s_0 or s_1. Suppose to the contrary that they fight at s_m where $m > 1$. Lemma 3A implies $d_m = 1$ and $p_m < 1$. Consequently, $V_G(s_0) + V_R(s_0) = (1 - \beta^m)V + \beta^m[f_R + f_G + \beta(1 + \gamma)V - V]$. We show that G has a profitable deviation.

To construct this deviation, observe that since IC binds at (z_0, s_1) and $V_R(s_1) = V_R(s')$, IC also binds at (z_0, s'). That is, $z_0 + \beta[f_R + \beta p'(1+\gamma)V] = z_0 + \beta V_R(s_1) = f_R + \beta d_0 p_0(1+\gamma)V + \beta(1-d_0)[(1-\varepsilon)V_R(s_0) + \varepsilon V_R(s_1)] = f_R + \beta d_0 p_0(1+\gamma)V + \beta(1-d_0)[(1-\varepsilon)V_R(s_0) + \varepsilon[f_R + \beta p'(1 + \gamma)V]]$. R, therefore, strictly prefers $(z_0, s'(\delta))$ for $\delta > 0$.

If G offers $(z_0, s'(\delta))$ and then fights at $s'(\delta)$, $V'_G(s_0) + V'_R(s_0) = 1 + \beta[f_R + f_G + \beta(1+\gamma)V]$. Algebra then gives $V'_G(s_0) - V_G(s_0) = V_R(s_0) - V'_R(s_0) + (\beta - \beta^m)[f_R + f_G - 1 + \beta\gamma V]$. Furthermore, $V'_R(s_0) = z_0 + \beta[f_R + \beta(p' + \delta)(1 + \gamma)V] = V_R(s_0) + \beta^2\delta(1 + \gamma)V$. Hence, $V'_G(s_0) - V_G(s_0) = (\beta - \beta^m)[f_R + f_G - 1 + \beta\gamma V] - \beta^2\delta(1 + \gamma)V$. Assuming the contingent spoils are sufficiently large that $f_R + f_G - 1 + \beta\gamma V > 0$, then $V'_G(s_0) - V_G(s_0) > 0$ and we have a profitable deviation for δ sufficiently small.

The fact that G fights at s_m ensures that the contingent spoils are this large. To establish $f_R + f_G - 1 + \beta\gamma V > 0$, consider first the case in which $f_R + \beta p_m(1 + \gamma)V \neq (1 - \beta^n)V - \beta^n f_R$ for any $n \geq 1$. Then Lemma 1A and the fact that G fights at s_m implies $f_G + \beta(1 - p_m)(1 + \gamma)V \geq \Pi_G(s_m) = V + \beta^{q(s_m)}\gamma V - [f_R + \beta p_m(1 + \gamma)V]$. This leaves $f_R + f_G - 1 + \beta\gamma V \geq \beta^{q(s_m)}\gamma V > 0$. Hence the factions fight at s_0 or s_1 if they fight in the continuation game.

Now suppose $f_R + \beta p_m(1 + \gamma)V = V - \beta^n(V - f_R)$ for some $n \geq 1$ and let $\widetilde{p}_{m+1}$ satisfy $f_R + \beta p_m(1 + \gamma)V = 1 + \beta[f_R + \beta\widetilde{p}_{m+1}(1 + \gamma)V]$. R is indifferent between fighting at s_m and accepting $(1, \widetilde{p}_{m+1})$ and, consequently, is sure to accept $(1, \widetilde{p}_{m+1} + \delta)$ for any $\delta > 0$. This means that G can obtain $V + \beta^{q(1,\widetilde{p})+1}\gamma V - [f_R + \beta p_m(1 + \gamma)V] - \beta^2\delta(1 + \gamma)V$ by initially offering $(1, \widetilde{p}_{m+1} + \delta)$ and then eliminating R as quickly as is peacefully possible.

Since G at least weakly prefers to fight at s_m, this payoff must be no larger than what G gets by fighting. That is, $f_G + \beta(1-p_m)(1+\gamma)V \geq V + \beta^{q(1,\widehat{p})+1}\gamma V - [f_R + \beta p_m(1+\gamma)V] - \beta^2\delta(1+\gamma)V$. Taking δ sufficiently small shows that $f_R + f_G - 1 + \beta\gamma V > 0$. Thus, the factions either fight at s_0 or s_1 or the equilibrium path is peaceful.

Now define $\widehat{p}$ so that IC binds if G proposes $(1, \widehat{s})$ at s_0 where , i.e., $\widehat{s} \equiv (1, \widehat{p})$. That is, $\widehat{p}$ satisfies $1 + \beta[f_G + \beta\widehat{p}(1+\gamma)V] = f_R + \beta d_0 p_0(1+\gamma)V + \beta(1-d_0)[(1-\varepsilon)V_R(s_0) + \varepsilon[f_G + \beta\widehat{p}(1+\gamma)V]]$.

Turning directly to claim (ii), assume $B(s_0) > 1+\beta f_R$. This condition ensures $B(s_0) > B'(s_0)$. If R accepts (z_0, s_1), then $z_0 = 1$, $V_R(s_0) = B(s_0)$, and $V_R(s_1) = f_R + \beta\widetilde{p}(1+\gamma)V$. To establish this, assume R accepts (z_0, s_1). As shown above, R's acceptance also implies that IC binds, so $z_0 + \beta[f_R + \beta p'(1+\gamma)V] = f_R + \beta d_0 p_0(1+\gamma)V + \beta(1-d_0)[(1-\varepsilon)V_R(s_0) + \varepsilon[f_R + \beta p'(1+\gamma)V]]$ where, recall, $V_R(s_1) = f_R + \beta p'(1+\gamma)V$ for a $p' \in [0, 1)$.

Since R accepts (z_0, s_1), the factions must fight at s_1 or the continuation game must be peaceful. Suppose the factions fight at s_1. Lemma 3A ensures $V_G(s_0) + V_R(s_0) = 1 + \beta[f_G + f_R + \beta(1+\gamma)V]$. Arguing by contradiction to establish that $z_0 = 1$, assume the contrary. Because $z_0 < 1$ and IC binds at (z_0, s') and $(1, \widehat{s})$, we have $\widehat{p} < p' < 1$. Assume further that $\widehat{p} \geq 0$. By construction, R is sure to accept $(1, \widehat{s}(\delta))$ where $\widehat{s}(\delta) \equiv (1, \widehat{p} + \delta)$ and $\delta > 0$.

It follows that proposing $(1, \widehat{s}(\delta))$ and then fighting at $\widehat{s}(\delta)$ is a profitable deviation for G. To verify this, observe that $V'_G(s_0) + V'_R(s_0) = 1 + \beta[f_G + f_R + \beta(1+\gamma)V]] = V_G(s_0) + V_R(s_0)$, so the deviation will be profitable if $V'_R(s_0) < V_R(s_0)$. Since IC binds at (z_0, s') and $(1, \widehat{s})$, it follows that $1 + \beta[1-\varepsilon(1-d_0)][f_R + \beta\widehat{p}(1+\gamma)V] = z_0 + \beta[1-\varepsilon(1-d_0)][f_R + \beta p'(1+\gamma)V]$. This implies $V'_R(s_0) = 1 + \beta[f_R + \beta\widehat{p}(1+\gamma)V] < z_0 + \beta[f_R + \beta p'(1+\gamma)V] = V_R(s_0)$ for δ sufficiently small. Hence G has a profitable deviation if $z_0 < 1$ and $\widehat{p} \geq 0$.

Suppose then that $z_0 < 1$ and $\widehat{p} < 0$. Define $\widehat{z}$ so that IC binds if G offers $(\widehat{z}, E)$ at s_0. Then R is sure to accept $(\widehat{z} + \delta, E)$ at s_0 where $\widehat{z} \leq z_0 < 1$ ensures $\widehat{z} + \delta$ is feasible for a sufficiently small δ. If G deviates in this way, then $V'_G(s_0) + V'_R(s_0) = V + \beta\gamma V > V_G(s_0) + V_R(s_0)$. The fact that IC binds at $(\widehat{z}, E)$ and (z_0, s') also implies $\widehat{z} - z_0 - \beta^2 p'[1-\varepsilon(1-d_0)](1+\gamma)V = 0$ or $V'_R(s_0) = \widehat{z} + \delta + \beta f_R < z_0 + \beta[f_R + \beta p'(1+\gamma)V] =$

$V_R(s_0)$ for δ small enough. Thus, G has a profitable deviation if $z_0 < 1$ and the factions fight at s_1.

If $z_0 = 1$, then $V_R(s_0) = 1 + \beta V_R(s_1)$. Solving IC for $V_R(s_0)$ gives $V_R(s_0) = \Pi_R(s_0)$ and $V_R(s_1) = (B(s_0) - 1)/\beta = f_R + \beta\widetilde{p}(1+\gamma)V$ if the factions fight at s_1.

Suppose that $z_0 < 1$ and the continuation game is peaceful. Then $s_m = E$ for some $m \geq 2$ (where $m = \infty$ if R never agrees to E) and $V_G(s_0) + V_R(s_0) = V + \beta^m \gamma V$. Once again G has a profitable deviation. Suppose $\widehat{p} \geq 0$ and that G proposes $(1, \widehat{s}(\delta))$ and then eliminates R as fast as peacefully possible. Since IC binds at (z_0, s') and $(1, \widehat{s})$, $1 - z_0 + \beta^2[1 - \varepsilon(1 - d_0)](\widehat{p} - p')(1+\gamma)V = 0$. This implies $\widehat{p} < p'$ and consequently $q(s') \geq q(\widehat{s}(\delta))$ for δ sufficiently small. We also have $m \geq q(s') + 1$, so $V'_G(s_0) + V'_R(s_0) = V + \beta^{q(s')+1}\gamma V \geq V_G(s_0) + V_R(s_0)$. Moreover, $V'_R(s_0) = 1 + \beta[f_R + \beta(\widehat{p} + \delta)(1+\gamma)V] < z_0 + \beta[f_R + \beta p'(1+\gamma)V] = V_R(s_0)$ for δ small enough. This leaves the contradiction $V'_G(s) > V_G(s_0)$.

Suppose that $z_0 < 1$ and $\widehat{p} < 0$. Then R is sure to accept $(1, E)$. If G deviates in this way, $V'_G(s_0) + V'_R(s_0) = V + \beta\gamma V > V_G(s_0) + V_R(s_0)$. Moreover, $V'_R(s_0) = 1 + \beta f_R < B(s_0) \leq V_R(s_0)$. Hence, this is a profitable deviation, and this contradiction ensures $z_0 = 1$ if the continuation game is peaceful. Repeating the argument above when $z_0 = 1$ gives $V_R(s_0) = B(s_0)$ and $V_R(s_1) = f_R + \beta\widetilde{p}(1+\gamma)V$.

Now suppose $F_G(s_0) > \max\{\Pi_G(s_0), \beta F_G(s')\}$ and that the factions do not fight at s_0. Then $z_0 = 1$ and $V_R(s_0) = B(s_0)$ since R accepts (z_0, s_1). If the factions fight at s_1, $d_1 = 1$ by Lemma 3A and $V_R(s_1) = f_R + \beta p_1(1+\gamma)V$. But $V_R(s_1) = f_R + \beta\widetilde{p}(1+\gamma)V$, so $s_1 = \widetilde{s}$. It follows that G can profitable deviate by fighting at s_0 since $F_G(s_0) > \beta F_G(\widetilde{s})$. This contradiction ensures that the factions do not fight at s_1.

If the continuation game is peaceful, $V_G(s_0) \leq \Pi_G(s_0)$. Because $F_G(s_0) > \Pi_G(s_0)$, G can profitably deviate by fighting at s_0. This contradiction means that the factions fight at s_0 with $V_G(s_0) = F_G(s_0)$ and $V_R(s_0) = F_R(s_0)$ when $F_G(s_0) > \max\{\Pi_G(s_0), \beta F_G(\widetilde{s})\}$.

Arguing again by contradiction, assume $\beta F_G(\widetilde{s}) > \max\{\Pi_G(s_0), F_G(s_0)\}$ and that the factions do not fight at s_1. If the continuation game is peaceful, R's acceptance of (z_0, s_1) means $z_0 = 1$ and $V_R(s_0) = \Pi_R(s_0)$. This in turn leaves $V_G(s_0) \leq V - B(s_0) + \beta^{q(s_0)}\gamma V =$

$\Pi_G(s_0)$. Since $z_0 = 1$ and $V_R(s_1) = f_R + \beta\widetilde{p}(1+\gamma)V$, R is sure to accept $(1,(1,\widetilde{p}+\delta))$ for any $\delta > 0$. G, therefore, can obtain $V_G'(s_0) = \beta F_G(\widetilde{s}) - \delta\beta^2(1+\gamma)V$ by offering $(1,(1,\widetilde{p}+\delta))$ and then fighting. This is clearly profitable for δ is sufficiently small.

If the factions fight at s_0, $V_R(s_0) = F_R(s_0) = B'(s_0)$. Recalling that $B(s_0) > B'(s_0)$ in claim (ii), algebra shows that R strictly prefers $(1,\widetilde{s})$ to fighting. As a result, G can deviate by proposing $(1,\widetilde{s})$ and then fight there. This brings $V_G'(s_0) = \beta F_G(\widetilde{s})$ and is clearly profitable. This contradiction ensures that the factions fight at s_1 when $\beta F_G(\widetilde{s}) > \max\{\Pi_G(s_0), F_G(s_0)\}$.

The factions payoffs follow immediately. Fighting at s_1 means that R accepts (z_0, s_1). As a result, $z_0 = 1$, $s_1 = \widetilde{s}$, $V_G(s_0) = 1 - z_0 + \beta F_G(s_1) = \beta F_G(\widetilde{s})$, and $V_R(s_0) = B(s_0)$.

Finally, assume $\Pi_G(s_0) > \max\{F_G(s_0), \beta F_G(\widetilde{s})\}$ and that the factions fight at s_0 or s_1. The former means $V_G(s_0) = F_G(s_0)$. As just shown, this implies $V_R(s_0) = B'(s_0) < B(s_0)$ and that R is sure to accept $(1,\widetilde{s})$. It follows that G can deviate to $(1,\widetilde{s})$ and then eliminate R as quickly as possible. This yields $V_G'(s_0) = \Pi_G(s_0)$ and would be a profitable deviation.

If the factions fight at s_1, then, as before, $z_0 = 1$, $s_1 = \widetilde{s}$, $V_R(s_0) = B(s_0)$, and $V_G(s_0) = \beta F_G(\widetilde{s})$. If, however, G eliminates R as quickly as possible at $\widetilde{s}$, it obtains $V_G'(s_0) = V - B(s_0) + \beta^{q(\widetilde{s})+1}\gamma V = \Pi_G(s_0)$. G again has a profitable deviation which means that the equilibrium path is peaceful when $\Pi_G(s_0) > \max\{F_G(s_0), F_G(s_0)\}$.

As for G's payoff, the fact that the continuation game is peaceful ensures $V_G(s_0) \leq \Pi_G(s_0)$. We also have $z_0 = 1$ and $s_1 = \widetilde{s}$. By assumption $B(s_0) \neq V - \beta^n(V - f_R)$ for any integer $n \geq 1$. G, therefore, can eliminate R from $(1,\widetilde{p}+\delta)$ in the same number of rounds as from $\widetilde{s}$ if δ is sufficiently small, i.e., $q(\widetilde{s}) = q(\widetilde{s}(\delta))$ where $\widetilde{s}(\delta) = (1,\widetilde{p}+\delta)$. Proposing $\widetilde{s}(\delta)$ and then eliminating R as quickly as possible cannot be profitable, so $V_G(s_0) \geq V - B(s_0) + \beta^{q(s_0)}\gamma V - \delta\beta^2(1+\gamma)V = \Pi_G(s_0) - \delta\beta^2(1+\gamma)V$ for arbitrarily small δ. Hence, $V_G(s_0) = \Pi_G(s_0)$, and this establishes claim (ii).

Now consider claim (i) and assume $B(s_0) < 1 + \beta f_R$. This inequality implies $B'(s_0) > B(s_0)$. It follows that R accepts (z_0, s_1). To establish this, suppose the factions fight at s_0. Then $V_R(s_0) = F_R(s_0) = B'(s_0)$. Since $F_G(s_0) + F_R(s_0) < f_G + f_R + \beta(1+\gamma)V$,

then $V_G(s_0) = F_G(s_0) < f_G + f_R + \beta(1+\gamma)V - B'(s_0)$. Moreover, R strictly prefers $(B'(s_0) - \beta f_R + \delta, E)$ to fighting for any $\delta > 0$ since $B'(s_0) + \delta > f_R + \beta d_0 p_0(1+\gamma)V + \beta(1-d_0)[(1-\varepsilon)B'(s_0) + \varepsilon f_R] = B'(s_0)$. Deviating in this way brings G a payoff of $V'_G(s_0) = V + \beta\gamma V - \Pi_R(s_0) - \delta$. Hence G has a profitable deviation if δ is sufficiently small. This contradiction means that the factions cannot fight at s_0.

Since R accepts (z_0, s_1), $V_R(s_1) = f_R + \beta p'(1+\gamma)V$ for a $p' \in [0,1)$ and IC binds at (z_0, s_1) This leaves $V_R(s_0) = z_0 + \beta[f_R + \beta p'(1+\gamma)V] = f_R + \beta d_0 p_0(1+\gamma)V + \beta(1-d_0)[(1-\varepsilon)V_R(s_0) + \varepsilon[f_R + \beta p'(1+\gamma)V]]$.

Arguing by contradiction to show that factions do not fight at s_1, suppose they do. Then $V_G(s_0) + V_R(s_0) = 1 + \beta[f_G + f_R + \beta(1+\gamma)V]$, and G has a profitable deviation. Assuming that $\widehat{p} \geq 0$, R is sure to accept $(1, \widehat{s}(\delta))$ for any $\delta > 0$. Suppose then that G offers this and fights at $(1, \widehat{s}(\delta))$. We have $V'_G(s_0) + V'_R(s_0) = 1 + \beta[f_G + f_R + \beta(1+\gamma)V]$, so this will be a profitable deviation for G if $V'_R(s_0) < V_R(s_0)$.

Because IC binds at $(1, \widehat{s})$ and at $(1, s'))$, $1 + \beta[1 - \varepsilon(1-d_0)][f_G + \beta\widehat{p}(1+\gamma)V] = z_0 + \beta[1-\varepsilon(1-d_0)][f_G + \beta p'(1+\gamma)V]$. If $z_0 < 1$, then $1 - z_0 < \beta^2(p' - \widehat{p} - \delta)(1+\gamma)V$ for a δ small enough. This implies $V'_R(s_0) = 1 + \beta[f_G + \beta(\widehat{p} + \delta)(1+\gamma)V] < z_0 + \beta[f_G + \beta p'(1+\gamma)V] = V_R(s_0)$. Hence G has a profitable deviation if $\widehat{p} \geq 0$ and $z_0 < 1$.

Assume $z_0 = 1$. Using $V_R(s_0) = 1 + \beta V_R(s_1)$ and the fact that IC binds, solving for $V_R(s_0)$ gives $V_R(s_0) = B(s_0) < B'(s_0)$. R, therefore is sure to accept $(B'(s_0) - \beta f_R, E)$ as $B'(s_0) > B(s_0) = V_R(s_0) \geq f_R + \beta d_0 p_0(1+\gamma)V + \beta(1-d_0)[(1-\varepsilon)V_2(s_0) + \varepsilon f_R]$. Deviating in this way brings $V'_G(s_0) = 1 + \beta(1+\gamma)V - B'(s_0) > \beta(1+\gamma)V - \beta f_R$ where the strict inequality follows from the condition defining the case. If, however, G fights at s_1 with $z_0 = 1$, its payoff is bounded by $V_G(s_0) \leq \beta[f_G + \beta(1+\gamma)V]$. Algebra shows that $\beta(1+\gamma)V - \beta f_R > \beta[f_G + \beta(1+\gamma)V]$. Hence, G has a profitable deviation if the factions fight at s_1 and $\widehat{p} \geq 0$.

Assume $\widehat{p} < 0$. Then R strictly prefers $(1, E)$. Deviating in this way brings $V'_G(s_0) = \beta(1+\gamma)V - \beta f_R$ which, as just shown, is a profitable deviation. These contradictions imply that the factions cannot fight at s_1. The continuation game must therefore be peaceful.

If $s_1 = E$, we are done. To wit, $V_R(s_0) = z_0 + \beta V_R(E) = f_R + \beta d_0 p_0(1+\gamma)V + \beta(1 - d_0)[(1-\varepsilon)V_R(s_0) + \varepsilon V_R(E)]$. Hence, $V_R(s_0) = B'(s_0)$ and $z_0 = B'(s_0) - \beta f_R$. This in turn leaves $V_G(s_0) = \Pi_G(s_0)$.

To show that $s_1 = E$, assume the continuation game is peaceful but $s_1 \neq E$. Then $V_G(s_0) + V_R(s_0) = V + \beta^m \gamma V$ where $s_m = E$ for some $m \geq 2$. G again has a profitable deviation. Suppose $\widehat{p} \geq 0$, $z_0 < 1$, and G deviates by proposing $(1, \widehat{s}(\delta))$ and eliminating R as quickly as is peacefully possible with δ chosen so that $f_R + \beta(\widehat{p} + \delta)(1+\gamma)V \neq V - \beta^n(V - f_R)$ for any integer $n \geq 1$. Since $z_0 < 1$, it follows that $\widehat{p} \leq p'$ and as a result $q(s_1) = q(s') \geq q(\widehat{s}(\delta))$ and $m \geq q(\widehat{s}(\delta)) + 1$ for δ sufficiently small. This leaves $V'_G(s_0) + V'_R(s_0) = V + \beta^{q(\widehat{s}(\delta))+1}\gamma V \geq V + \beta^m \gamma V = V_G(s_0) + V_R(s_0)$. G therefore has a profitable deviation if $V'_R(s_0) < V_R(s_0)$. Repeating the argument above shows this to be the case when $z_0 < 1$ and $\widehat{p} \geq 0$.

If $z_0 = 1$ and $\widehat{p} \geq 0$, repeating the argument above shows that R strictly prefers $(B'(s_0) - \beta f_R, E)$ to fighting. Thus, $V'_G(s_0) + V'_R(s_0) = V + \beta\gamma V \geq V + \beta^m \gamma V = V_G(s_0) + V_R(s_0)$. Furthermore, $V'_R(s_0) = \Pi(s_2(s_0)) < 1 + \beta f_R = V_R(s_0)$. Hence, $V'_G(s_0) > V_G(s_0)$.

Finally, assume $\widehat{p} < 0$ and recall that IC binds if G proposes $(\widehat{z}, E)$ at s_0. Then R is sure to accept $(\widehat{z} + \delta, E)$ for any $\delta > 0$, and $V'_G(s_0) + V'_R(s_0) = V + \beta\gamma V \geq V + \beta^m \gamma V = V_G(s_0) + V_R(s_0)$. Repeating the arguments above also shows $\widehat{z} - z_0 - \beta^2[1 - \varepsilon(1-d_0)]p'(1+\gamma)V = 0$. As a result, $\widehat{z} + \delta + \beta f_R < z_0 + \beta[f_R + \beta p'(1+\gamma)V]$. Hence, $V'_G(s_0) > V_G(s_0)$ and G has a profitable deviation if $s_1 \neq E_1\square$

It is now straightforward to characterize G's payoffs as a function of the contingent gain γ and establish Proposition 2:

Proof of Proposition 2. Proposition 1 ensures that G always prefers to eliminate R peacefully when $B(s_0, \gamma) < 1 + \beta f_R$. Take γ' to solve $B(\gamma) = 1 + \beta f_R$ (where we suppress the stage in order to simplify the notation). Then $\Pi_G(\gamma) > \max\{F_G(\gamma), \beta F_G(\widetilde{s}(\gamma))\}$ for $\gamma < \gamma'$.

When $B(\gamma) \geq 1 + \beta f_R$, we have $\Pi_G(\gamma) = V + \beta^{q(\gamma)}\gamma V - B(\gamma)$ where recall $q(\gamma)$ is the integer such that $V - \beta^{q(\gamma)}(V - f_R) \geq B(\gamma) > V - \beta^{q(\gamma)-1}(V - f_R)$. This implies $\underline{\Pi}_G(\gamma) \equiv (V - B(\gamma))[1 + \beta\gamma V/(V - f_R)] < \Pi_G(\gamma) \leq (V - B(\gamma))[1 + \gamma V/(V - f_R)] \equiv \overline{\Pi}_G(\gamma)$. Both

$\underline{\Pi}_G(\gamma)$ and $\overline{\Pi}_G(\gamma)$ are quadratic and concave in γ with $\underline{\Pi}_G(\gamma') > \max\{F_G(\gamma'), \beta F_G(\widetilde{s}(\gamma'))\}$. Both $F_G(\gamma')$ and $\beta F_G(\widetilde{s}(\gamma'))$ are linearly increasing in γ. All of this ensures that there exists a unique $\underline{\gamma} > \gamma'$ such that $\underline{\Pi}_G(\gamma') > \max\{F_G(\gamma'), \beta F_G(\widetilde{s}(\gamma'))\}$ for all $\gamma < \underline{\gamma}$ and a unique $\overline{\gamma} > \underline{\gamma}$ such that $\overline{\Pi}_G(\gamma) < \max\{F_G(\gamma'), \beta F_G(\widetilde{s}(\gamma'))\}$ for all $\gamma > \overline{\gamma}$. $\square$

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