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Concessions and Repression in Conflict

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Abstract: We build a model for predicting civil wars where the government bargains with a rebel group using concessions and repression. The equilibrium is either a state of perpetual peace where there are concessions but no repression or a state of repressive equilibrium that can lead to civil wars. At the lowest levels of political competition, a move towards open electoral participation decreases the ability of the state to use repression to limit challengers, increasing the likelihood of war. At higher levels, an increase in competition decreases the probability of war by increasing concessions to the rebel group. Increasing concessions makes war less likely because it decreases the spoils of war and provides one explanation for the non-monotonicity found between probability of civil war and democracy. We test the prediction of this non-linearity using the technique in [Hansen (2000). “Sample Splitting and Threshold Estimation.” *Econometrica* 68:575–603] and find evidence consistent with the model.

Keywords: conflict, repression, political competition, democracy

JEL Codes: D02, D74, O12

1 Introduction

Political concessions are very common in establishing strong regimes. Governments can try to resolve disputes by providing such concessions to the opposition.¹ In Syria, the authoritarian Assad government gave political concessions by lifting the emergency law and opening up a national dialogue with the opposition (BBC News 2011). Similarly, King Hussein resorted to concessions to quell the protests by Muslim Brotherhood in Jordan (Schwedler 2000). However, concessions are only one type of an instrument for negotiation.

Peace and stability may also be established by strengthening an army, thereby creating deterrence. Historically, repression has been used as an effective

¹ See, for example, Bates (2001), North, Wallis, and Weingast (2009) and Azam (2006).

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instrument to muffle the opposition's office and entrench the status quo. One of the fundamental problems facing a government has been juggling concessions and repression.² Stolypin in Russia (1905–1910) appears to have been adept at balancing concessions and repression as agrarian reforms were combined with large numbers of death sentences (Rocco and Ballo 2008). Empirically, however, high levels of repression are associated with civil strife.³ This paper provides a simple framework to think about how a rational government may balance concessions and repression to resolve a dispute with an opposition group.

Democratization can be thought of as an institutional process for giving political concessions to the opposition. Recent studies suggest that democratizing does not necessarily lead to peace. At the extreme ends of polity, both repressive authoritarian states and inclusive democracies have low levels of civil conflict, and middling levels of polity are correlated with civil conflict. Several studies find an inverted-U shaped relationship between probability of civil war and level of democracy (Ellingsen 2000; Fearon and Laitin 2003; Reynal-Querol 2002; Enterline and Greig 2005; Hegre et al. 2001).⁴ This relationship can be thought of as a stylized fact. Yet, there appears to be no theoretically founded model in the civil war literature that sheds light on why the effect of political competition on conflict is non-monotonic. We find consistent results from our model that suggest that repression is correlated with conflict until a threshold level of political competition, but there is no link between repression and conflict once this threshold is crossed.

Theoretically, political concessions to the opposition group could be with or without an increase in repression. Moreover, concessions and repression may be substitutes or complements in equilibrium. Our paper sheds light on the interplay between concessions, repression and institutional regimes to influence conflict and peace. Fearon (1995) lists two possible rational causes for war: one is a credible commitment problem for the state and the second is asymmetric information between the two parties along with incentives to misrepresent private information. Whereas Acemoglu, Ticchi and Vindigni (2011) focus on the first mechanism in Fearon (1995) to explain the correlation of civil wars

² See Schelling (1966) and Morris (1974) for further details. Acemoglu and Robinson (2000) show that the elite may be forced to choose between repression and the most generous concession, a transition to full democracy. However, it is possible to choose a combination of the two in a richer theoretical framework.

³ Indeed, civil wars have been triggered through excessive government repression in Algeria in 1992, Ivory Coast in 2002, Chad in 1963 and 1990, Kenya in 1982 and 1991 and in several other cases (Rocco and Ballo 2008).

⁴ However, Elbadawi and Sambanis (2002) find no robust inverted-U relationship between probability of civil war and democracy.

and repression, we rely on the second.⁵ We do so because it “buys” us a greater degree of freedom in the government using another instrument (concessions) which is not merely the reversal of repression, as in Acemoglu, Ticchi and Vindigni (2011). In our model, the opposition group knows its type that is hidden from the government. This is an important assumption because if there was no asymmetric information about the type (for example, finances, motivations, military capacity, organization, etc.), the government would be able to pay off the opposition group and avoid a costly fight.⁶

Our theoretical model predicts civil wars where the government bargains with a group using two instruments: repression and concessions. Concessions are the transfer from the government to an opposition group and repression is a military investment that increases the government’s chances of winning the war if it happens. We interpret an increase in quality of political institutions as increasing the minimum level of concessions from the state and repression as a form of coercive military control used by the state against an opposition group. In the situation where the government has asymmetric information about the opposition group, we highlight two cases. First, the equilibrium can induce transfers from the state to rule out any chance of civil war. This is shown to happen when there are sufficient constraints and regulations on the nature of political participation between the competing groups and is consistent with most modern democracies that hold “free and fair” elections and do not experience civil wars. Here, opposition parties can be seen to be more inclusive versions of rebel groups in war-torn nations. In contrast, the second type of equilibrium is repressive where wars can occur in equilibrium. The government rationally risks the state of war because state repression can guarantee greater payoffs for the incumbent until a threshold level of political competition is reached. The intuition behind the model is as follows. At the lowest levels of competition, increasing political competition increases the likelihood of war in equilibrium as states can still resort to repression and rationally choose to play a lottery between war and peace. However, since use of repression is limited by political competition, rebel groups attempt wars more frequently. Once a

5 In weakly institutionalized polities, both the persistence of civil wars and the emergence of over-sized armies (or repression) are stylized facts. This is explained in Acemoglu, Ticchi and Vindigni (2011) as a dynamic commitment problem for the elite who cannot credibly commit to lowering repression once the civil war is over.

6 In the complete information case in our model, the government chooses repression and transfers such that it leads to peace. An interesting corollary of this result is that repression can arise even with complete knowledge about the opposition group. However, our focus in the paper will be in developing the asymmetric information case, discussing its comparative statics and finally, testing its central prediction.

threshold level of political competition is achieved, it substantially decreases the probability of war by increasing the concessions to the competing group. This makes fighting especially less favorable because it decreases the spoils of war.

This paper is related to three strands in the political science and economics literature. First, it embodies the theoretical foundations of conflict wherein incentives and constraints of the two parties are modeled and conflict erupts through a contest function technology (see, for example, models by Skaperdas (1992) and Grossman (1991)). Blattman and Miguel (2010) review the extensive research in economics and political science on civil wars and find that the theoretical and empirical literatures seldom intersect and there is a need to test implications of theory as well as model empirical consistencies. Further, theoretical models of conflict and repression are non-existent in economics (Besley and Persson 2011a). Conflict can have both institutional and strategic causes and theoretical models may choose to focus on either dimension. Thus, instead of endogenizing institutions as in Besley and Persson's work, we focus on the technology of government bargaining against a rebel group by endogenizing repression. Our model is consistent with the observation that high levels of repression often go hand-in-hand with civil war. Thirty-nine countries are listed in Besley and Persson (2011b) that have had both, relatively long spells of repression and some civil war since 1950 (for instance, Afghanistan, Cambodia, Nicaragua and Ethiopia among others). Yet, there are also thirty-five cases where similar levels of repression have not led to a civil war (examples include, Bangladesh, Thailand, Ecuador and Kenya). The model in this paper gives a clear prediction on the likelihood of war with use of repression and finds heterogeneous effects depending upon the competition among political groups.

Second, in one of the only studies analyzing repression empirically, Davenport (2007) shows heterogeneous effects of democratization on human rights violations.⁷ Repression is an endogenous variable in our framework as military power can deter opposition and also incapacitate it. Indeed, Azam and Hoeffler (2002) show that repression is effective against rebel groups. Not only is repression able to limit recruitment by rebel groups, weaponization and financing, it also increases the opportunity costs to individuals of engaging in violence (Tilly 1978; Rasler 1996). Similarly, providing concessions improves the outside options for the participants (Carey 2006). Autocratic rulers have also used both repression and seduction to maximize their revenue (Platteau and Sekeris 2013). Our model combines all these ideas into one formalized framework.

7 Davenport (2007) finds that survival and tenure in office are the two primary aims of state repression.

Third, empirical correlates of conflict are usually found by running linear models on a cross-sectional time series (Fearon and Laitin 2003; Collier and Hoeffler 2004; Reynal-Querol 2002). As our model predicts a non-linearity between repression and conflict depending on institutional constraints, we implement a Hansen (2000) test to calculate the threshold of political competition around which the relationship between repression and likelihood of civil war changes. The Hansen test has been employed recently in the sub-field of growth and development. For example, Girma (2005) explores whether the effect of foreign direct investment on productivity growth is dependent on absorptive capacity. The results point to the presence of non-linear threshold effects: the productivity benefit from FDI increases with absorptive capacity until some threshold level beyond which it becomes less pronounced. Similarly, Carter et al. (2007) study the conditions that would lead environmental shocks to push households into poverty traps from which recovery may not be possible without external assistance. They explicitly test for the existence of a critical threshold and directly estimate the critical asset threshold around which asset growth dynamics bifurcate. We test the predictions of our model through a threshold effects regression as in Hansen (2000) and find evidence of non-linearity in the relationship between probability of civil war and repression. This non-linearity depends upon the degree of political competition, as measured by the Polity IV data set. In particular, we find that until a threshold level of political competition, wars become increasingly likely with use of repression. Thereafter, there is no correlation between wars and repression, as expected from equilibrium predictions of the model. Peace is always attained without resorting to repression after crossing the estimated threshold.

In the following sections, we lay out the theory in Section 2, provide the empirical strategy for testing the model and results in Section 3, and conclude in Section 4.

2 Theory

There are two risk-neutral players – an incumbent government and an opposition group. Let $K \in \mathbb{R}$ be an exogenous parameter of political competition, a higher value of which intuitively makes the government's repression capabilities more restricted and correspondingly, the opposition group is also more protected through a greater check on the political power of the incumbent. It can be defined as (1) the degree of institutionalization, or regulation, of political competition and (2) the extent of government restriction on political competition. This democratic

protection is offered through a decrease in the maximum amount of repression the government can use and also an increase in the minimum concessions that it needs to make.

The government makes two political decisions. First, it decides the level of military investment to be used as repression against the opposition group, represented by $p \in [0, \bar{p}(K)]$ where $\bar{p}(K)$ is the maximum military investment level and depends on K . Second, the government also decides its transfers (concessions) to the opposition group $t \geq \underline{t}(K)$ where $\underline{t}(K) \geq 0$ is the minimum transfer that the incumbent needs to make to the opposition group in line with Besley and Persson (2011a). In their model, however, Besley and Persson do not consider the impact of the institutional restriction on military discretion.⁸ Thus, more democratic institutions can restrict the maximum military investment the state can use and guarantee the minimum transfers to the opposition.

The opposition group has private information, $\theta \in [\underline{\theta}, \bar{\theta}]$, which can be interpreted as its financial strength, degree of foreign assistance, military capacity, motivation or organizational strength. The incumbent does not know the type of the opposition group but knows that it is distributed according to cumulative distribution $F(\theta)$ with density $f(\theta)$. We assume that $F(\theta)$ is log-concave and $f(\theta)$ is continuous in $\theta \in [\underline{\theta}, \bar{\theta}]$. These assumptions are common in the literature and are satisfied by many standard distributions such as Uniform, Normal and Poisson distributions.⁹

The game is played as follows:

1. The opposition privately observes θ .
2. The government chooses military power p and transfer to the opposition group t .
3. The opposition chooses whether or not to wage war against the government.

We assume that there are $R > 0$ units of resources that exist originally for the incumbent government. The resources include for example the natural resources and exogenous sources of revenue. After military investment p , it is reduced to $R - p$.

If the opposition does not start fighting, then the payoff is t for the opposition and $R - t - p$ for the government. By contrast, if the opposition chooses to start fighting, then a war breaks out and the government responds with armed force p . We assume that the probability with which the government wins is given by a contest function

⁸ Our main result still holds even if the institutional restriction has no impact on military discretion.

⁹ See Bagnoli and Bergstrom (2005) for details.

$$\pi(p, \theta) = \begin{cases} 1 & \text{if } p \geq \theta \\ 0 & \text{if } p < \theta. \end{cases}$$

This means that the government wins if and only if the military power p is greater than or equal to the opposition's true strength θ . Regardless of the winner's identity, the war generates a deadweight loss $g > 0$, which is exogenous. This can be thought of the value of destruction of life and infrastructure that takes place during war. The winner takes all the remaining resources $R - g - p$ and the loser gets 0. The timing of the decisions and the *ex post* payoff are described in Figure 1.

Figure 1: The timing of the decisions and the *ex post* payoff.

The parameters are assumed as follows.

- Assumption 1:** 1. $\underline{t}(K)$ is non-negative and non-decreasing in K .
 2. $\bar{p}(K)$ is non-increasing in K .
 3. $R > \underline{t}(K) + g$ and $0 \leq \underline{\theta} < \bar{p}(K)$ for all $K \in \mathbb{R}$.

Parts 1 and 2 of Assumption 1 imply that greater political competition guarantees greater minimum transfers to the opposition and more restrictions on military investment. One can expect that in more democratized countries, the use of military power against local violence and the right to confiscate wealth in the country would be limited by political or legal constraints due to the democratic checks and balances. Part 3 implies that the total resource is sufficiently high relative to the minimum transfer and the deadweight loss (i. e., $R > \underline{t}(K) + g$) and the military investment is meaningful for deterring wars (i. e., $\bar{p}(K) > \underline{\theta}$).

In the following, we derive a pure strategy perfect Bayesian equilibrium in which the players are sequentially rational and the government has a belief on the opposition's type consistent with Bayesian updating.¹⁰ We assume that the opposition group does not choose to fight if it is indifferent between starting a

¹⁰ The government has no opportunity to update its belief. Hence the consistency of the beliefs does not matter here for characterizing equilibria.

war and not. It assures us that the opposition's best response is uniquely determined. We further assume that if the government has multiple best response to the opposition group, then it chooses the social optimum, i. e., the utilitarian optimal outcome amongst them.¹¹ Hereafter, we call our equilibrium concept political equilibrium.

2.1 Benchmark: Complete Information

As a benchmark, we first derive a political equilibrium where the government knows the opposition's type θ . The political equilibrium can be characterized by backward induction.

Given θ , p , and t , the opposition keeps peace, it receives transfer t . If it attempts war, it wins with probability $1 - \pi(p, \theta)$ and gains $R - g - p$. The opposition chooses to maintain peace if and only if the expected payoff from the war is less than or equal to the transfers;

$$t \geq (1 - \pi(p, \theta))(R - g - p) \quad [1]$$

It can be shown that whenever the government knows the opposition's strength, the government always chooses p and t to satisfy eq. [1], which implies that peace is always achieved. Nevertheless, the optimal decision depends on the opposition type and the degree of political competition.

Proposition 1: *In case of complete information where the government knows the type of the opposition group, the government always chooses p and t such that peace is necessarily achieved in political equilibria. The equilibrium military strength and transfer (p^I, t^I) are characterized as follows;*

$$(p^I, t^I) = \begin{cases} (0, R - g) & \text{if } \theta > \bar{p}(K) \text{ or } \theta \geq R - g - \underline{t}(K) \\ (\theta, \underline{t}(K)) & \text{if } \theta \leq \bar{p}(K) \text{ and } \theta < R - g - \underline{t}(K). \end{cases}$$

The equilibrium payoff for the government is

$$\begin{cases} g & \text{if } \theta > \bar{p}(K) \text{ or } \theta \geq R - g - \underline{t}(K) \\ R - \theta - \underline{t}(K) & \text{if } \theta \leq \bar{p}(K) \text{ and } \theta < R - g - \underline{t}(K). \end{cases}$$

¹¹ If a change of K does not change either $\underline{t}(K)$ or $\bar{p}(K)$, then the equilibrium does not change at all. In this sense, when we explain interpretations of the formal results, we implicitly assume that K affects at least either $\underline{t}(K)$ or $\bar{p}(K)$. We thank an anonymous reviewer for this point.

Since $t \geq \underline{t}(K) \geq 0$, eq. [1] implies that if a war happens, then the opposition wins with probability 1 (i. e., $\theta > p$) and the government obtains zero payoff. However, the government can obtain at least a positive expected payoff by avoiding war. Hence the government strictly prefers peace to war.¹²

Although peace is achieved independent of the opposition's type, the equilibrium property depends on θ and K . If the opposition's type is sufficiently high, then the payoff for the government is equal to the deadweight loss. In this case, the government makes no investment on military power and the resource is exploited by the opposition. Nevertheless the government can gain positive benefit generated by deterring war, which is the deadweight loss g . This is interpreted as bargaining surplus of avoiding war.¹³ When the opposition's type is low, military threat is effective in preventing the opposition from attempting a war and keeps the resources with the government.

As the polity becomes more competitive, the government does not use military power for peace. Assumption 1 guarantees that the thresholds $\bar{p}(K)$ and $R - g - \underline{t}(K)$ are non-increasing in K . Thus as K increases, the government is more likely to give up using military threat to prevent a war. Competition restricts freedom on military investment and forces the government to distribute its resources, which in turn makes peace *via* military threat more costly and less attractive for the government.

2.2 Asymmetric Information

In this section, we examine the case of asymmetric information. Even if the opposition's type is private information, the condition for keeping peace is the same as in the symmetric information case; given p , t , and θ , peace is realized if and only if eq. [1] is satisfied. Since the government cannot observe θ , whether a war happens or not may be uncertain for the government. Under certain conditions, the government optimally allows a possibility of war.

Similar to the case of symmetric information, the equilibrium property is either “concessive” where the government emphasizes the use of concessions or “repressive” where the government emphasizes military repression. When the government takes an optimal concessive strategy, it makes no military investment ($p = 0$) and transfers all the resources barring the deadweight loss. It buys

¹² Formal proofs of all propositions are in the Appendix.

¹³ The timing of the game implies that the government makes a take it or leave it offer to the opposition. Thus, the government has full bargaining power over the surplus saved by avoiding a war.

peace with certainty and guarantees the payoff g at the very least. The government optimally chooses another repressive strategy if it can gain the payoff greater than g .

The optimal repressive strategy satisfies low transfers and high military power relative to the optimal concessive strategy. When the government chooses a repressive strategy, with probability $F(p)$ the opposition does not attempt war and the government can gain the whole remaining resource $R - t - p$. With probability $1 - F(p)$ the opposition group attempts and wins war. It follows that the government's *ex ante* payoff is given by $F(p)(R - t - p)$. This is the direct utility function for the government. Since the payoff is decreasing in t , the government reduces transfers to the greatest possible extent (i. e., $t = \underline{t}(K)$). Thus, the optimal military power should maximize $F(p)(R - \underline{t}(K) - p)$.

The marginal effect of increasing military power is decomposed into marginal benefit and the marginal cost. Specifically, the first derivative with respect to p is expressed by

$$\Delta(p, K) \equiv f(p)[R - \underline{t}(K) - p] - F(p).$$

The first term is the marginal benefit of military investment, which is the resource the government can receive after avoiding wars ($R - \underline{t}(K) - p$) multiplied by the marginal increase in the probability of avoiding war ($f(p)$). The second term corresponds to the marginal cost, which is the probability of avoiding wars ($F(p)$) multiplied by the marginal decrease of the resource ($d(-p)/dp = -1$).

Marginal benefit is equal to the marginal cost for optimal military power. In our model, however, such a military power may be above the cap of the military power $\bar{p}(K)$. In this case, since the marginal benefit is always greater than the marginal cost, the government chooses the maximum military power $\bar{p}(K)$.

Summarizing the above discussion provides the characterization of the political equilibrium in the case of asymmetric information. To state the formal result, define $\hat{p}(K) \in [\underline{\theta}, \bar{\theta}]$ which satisfies $\Delta(\hat{p}(K), K) \geq 0$ with inequality only when $\hat{p}(K) = \bar{\theta}^{14}$ and $\bar{\hat{p}}(K) \equiv \min\{\hat{p}(K), \bar{p}(K)\}$.

Let $V^r(K) \equiv F(\bar{\hat{p}}(K))[R - \underline{t}(K) - \bar{\hat{p}}(K)]$, which is the government's payoff when it chooses $(t, p) = (\underline{t}(K), \bar{\hat{p}}(K))$ and is the government's indirect utility function.

Proposition 2: *The equilibrium military strength and transfer (p^*, t^*) are characterized as follows;*

¹⁴ The assumption that $F(\theta)$ is log-concave assures that such $\hat{p}(K)$ uniquely exists in $[\underline{\theta}, \bar{\theta}]$. See the proof of Proposition 2 for detail.

$$(p^*, t^*) = \begin{cases} (0, R - g) & \text{if } g \geq V^r(K) \\ (\bar{p}(K), \underline{t}(K)) & \text{if } g < V^r(K). \end{cases}$$

When $g \geq V^r(K)$, peace is always achieved whereas when $g < V^r(K)$, peace is achieved with probability $F(\bar{p}(K))$. The equilibrium payoff for government is $\max\{V^r(K), g\}$.

It should be emphasized that informational imperfections create a possibility of war. When the opposition's strength is private information and the government chooses the repressive strategy, war takes place with probability $1 - F(\bar{p}(K))$, implying that the government does not prevent war with certainty unless it chooses $\bar{p}(K) = \bar{\theta}$.¹⁵

2.3 Comparative Statics

We now discuss how the parameter of political competition K can affect the equilibrium outcome. Hereafter we say a strategy or equilibrium is concessive if $p = 0$ and repressive if $p = \bar{p}(K)$. The following proposition shows that political competition does not necessarily affect likelihood of peace in a monotonic way.

Proposition 3: *There uniquely exists a threshold $\hat{K} \in \mathbb{R} \cup \{-\infty, +\infty\}$ such that the equilibrium is concessive if $K > \hat{K}$ and repressive if $K < \hat{K}$. (When $\hat{K} \in \mathbb{R}$, the equilibrium is concessive if $K = \hat{K}$). For $K < \hat{K}$, the probability of peace is non-increasing in K . If $\hat{K} \neq -\infty$ and $\bar{p}(K)$ is decreasing in K , then the probability of peace is decreasing in $K < \hat{K}$. For $K > \hat{K}$, the probability of peace is 1.*

Figure 2 draws the government's payoff under the concessive and repressive strategies. The intersection of $V^r(K)$ and g expresses the threshold of political competition $\hat{K}$ which distinguishes between concessive and repressive equilibrium. The bold lines drawn in the figure plot the payoffs when the government chooses a strategy that yields higher payoff. Recall that $V^r(K) \equiv F(\bar{p}(K))[R - \underline{t}(K) - \bar{p}(K)]$. The payoff under the repressive strategy, $V^r(K)$, is non-increasing in K . First, since $\underline{t}(K)$ is non-decreasing in K , a greater transfer must be made to the opposition, which directly reduces the government benefit when peace is achieved. Second, since $\bar{p}(K)$ is non-increasing, the government cannot use enough military strength to threaten the opposition group.

¹⁵ It is possible to see that for each K , $\bar{p}(K) < \bar{\theta}$ if and only if $\lim_{p \rightarrow \bar{\theta} - 0} \Delta(\bar{\theta}, K) \leq 0$ or $\bar{\theta} > \bar{p}(K)$. The former condition is satisfied when for example $R - \underline{t}(K) - \bar{\theta}$ is negative or close to zero.

Figure 2: Government payoff in repressive and concessive equilibria.

In contrast, the payoff in the concessive equilibrium, g , is constant in K since the government gives up resources until a maximum of $R - g$ regardless of K .

Figure 3 describes the probability of peace. For $K > \hat{K}$, the equilibrium is concessive and the probability of peace is 1 whereas, for $K < \hat{K}$, the equilibrium is repressive and the probability of peace is given by $F(\bar{p}(K))$, which is positively correlated with the equilibrium military power $\bar{p}(K)$. Given $K < \hat{K}$, increasing competition causes a negative effect on military investment and the probability of peace due to two reasons. First, the cap on feasible military investment $\bar{p}(K)$ is lower by competition, which may directly reduce the military investment on

Figure 3: Probability of peace in repressive and concessive equilibria.

equilibrium. Second, since $\underline{t}(K)$ is non-decreasing, government must give greater resources to the opposition even if war is deterred.¹⁶

The likelihood of peace is not monotonic with respect to the degree of competition. When K is sufficiently low, government chooses a repressive strategy. As political competition increases, government loses its discretion on military investment and transfer, which leads to two effects. First, equilibrium military strength is reduced and the probability of peace decreases as long as the equilibrium is repressive. Second, the concessive equilibrium becomes more likely for the government. Then as K achieves threshold $\hat{K}$, government switches to a concessive strategy and peace is bought with certainty. Recall that in the case of complete information, there are also two kinds of equilibria depending on the parameters: government emphasizes repressive threat if K is low and concessive transfer if K is high. However, regardless of equilibrium property, the probability of peace is always one. Asymmetric information between the parties gives an additional prediction on the non-monotonic relationship between the parameter of political competition and probability of peace.¹⁷ The prediction from the asymmetric model is that probability of war should be non-monotonic in terms of the parameter of political competition. It should show a positive correlation with repression before a threshold level of this parameter and there should be no link between war and repression after crossing the threshold.

16 We could modify the assumption such as timing or the choice set of the opposition, which may allow us to discuss possibilities of signalling. In this case, our model would still be valid. First, if the signalling action does not yield a full-separating equilibrium, then the government will still be faced with asymmetric information about the type of the opposition group and the structure of our model with asymmetric information would still be useful in providing insights about concessive and repressive equilibrium. Second, if the signalling action perfectly separates the type, then the situation will correspond to our benchmark model with complete information.

17 We have assumed that the parameter of quality of institution K affects the maximum military investment level $\bar{p}(K)$ and the minimum transfer $\underline{t}(K)$. One may imagine another assumption that more democratic institutions may have a more positive impact on the financial or organizational strength of various local groups. In the model, this assumption would imply that as K increases, the strength of the opposition group increases or higher types are more likely to be realized.

We obtain the same result even if K has such an effect. In case of complete information, suppose that the type of the opposition is increasing in K . Then Proposition 1 immediately implies that the equilibrium is concessive if K is high. In case of incomplete information, suppose that $F(\theta)$ is non-increasing in K , meaning that the cumulative distribution function for K first-order stochastically dominates that for $K' > K$. Then the government's payoff given the repressive strategy is non-increasing in K . Therefore, the equilibrium switches from repressive to concessive as K increases.

2.4 Other Contest Functions

The contest technology we adopt, $\pi(p, \theta)$, has a specific assumption that if the military power p is equal to the opposition's strength θ , then the government certainly wins, whereas the government always loses as long as p is strictly less than θ . In other words, the winning probability of the government is discontinuous in p and θ . Such a contest function with discontinuity successfully yields a clear result of the non-monotonic relationship between the political competition and probability of peace.

We would be able to obtain the same implication for other continuous contest functions.¹⁸ Specifically, let the contest function be modified as

$$\pi(p, \theta) = \begin{cases} 1 & \text{if } \frac{1}{2} + \rho(p - \theta) > 1, \\ \frac{1}{2} + \rho(p - \theta) & \text{if } \frac{1}{2} + \rho(p - \theta) \in [0, 1], \\ 0 & \text{if } \frac{1}{2} + \rho(p - \theta) < 0, \end{cases} \quad [2]$$

where $\rho > 0$. This piecewise-linear and continuous function is in a class of difference-form contest functions studied by Che and Gale (2000).¹⁹ Note that given that $\pi(p, \theta) \in (0, 1)$, $\partial\pi/\partial p = -\partial\pi/\partial\theta = \rho$, implying that ρ is the marginal effect of the military power or the opposition's strength.

We leave the formal analysis of the model with the piecewise-linear function to the Appendix A.4. In case of complete information, there is still either a concessive or repressive equilibrium depending on parameter K , as in our main model, if ρ is sufficiently high. Furthermore, although the equilibrium is not fully characterized in case of incomplete information, the intuition can be captured graphically. The bold-dotted line in Figure 4 illustrates the contest function $\pi(p, \theta)$ in our main model with the discontinuous contest function, in particular when $\theta = \underline{\theta}$ and $\theta = \bar{\theta}$. In the incomplete information case, the equilibrium military power is either zero in the concessive equilibrium or a positive number $\bar{p}(K)$ in the repressive equilibrium. An important insight from this figure is that $p = \underline{\theta}$ is never an equilibrium military power. Such an “intermediate” military investment does not increase the winning probability at all. The government would rather optimally choose no military investment and large concessions for the opposition in order to avoid the deadweight loss from the war.

The piecewise-linear contest function can be similarly illustrated as in Figure 5. The piecewise-linear contest function can approximate the discontinuous

¹⁸ See Konrad (2009) for a survey of various contest models in economics and political science.

¹⁹ See also Corchón and Dahm (2010).

Figure 4: Contest function in the main model.

Figure 5: Piecewise linear contest function.

contest function by taking ρ to be sufficiently high. Given that ρ is sufficiently high, $\bar{\theta} - 1/2\rho$, which is positive, is never an equilibrium military power due to the same reason as with the discontinuous contest function. Hence, we again obtain a similar characterization of concessive and repressive equilibrium but here, the opposition does not necessarily win the war. Recall that the discontinuous contest function $\pi(p, \theta)$ takes a value of only zero or one. Then the opposition chooses war only if its winning probability is one, implying that the opposition always wins in war. Adopting the continuous function is also a way to overcome this peculiar feature.

3 Empirical Evidence

3.1 Hypothesis

Our central hypothesis is that probability of civil war incidence should be positively correlated with repression across countries and time until a threshold

level of political competition. For all values greater than this threshold, there should be no correlation between civil war incidence and repression. Formally,

$$y_{it} = \begin{cases} \theta_1 x_{it} + e_{it}, & q_{it} \leq \gamma \\ \theta_2 x_{it} + e_{it}, & q_{it} > \gamma \end{cases}$$

where y_{it} is probability of civil war incidence for country i in year t , x_{it} is repression, e_{it} is the error term and q_{it} is the “threshold” variable or political competition. We expect θ_1 to be positive and significant and θ_2 to be insignificant. Finally, we hypothesize that a finite value of γ exists. A sample-split model takes the form above. To write the model in a single equation, define the dummy variable $d_{it}(\gamma) = \{q_{it} \leq \gamma\}$ where $\{\cdot\}$ is the indicator function, set $x_{it}(\gamma) = x_{it}d_{it}(\gamma)$, so that:

$$y_{it} = \theta_2 x_{it} + \theta x_{it} d_{it}(\gamma) + e_{it}$$

where $\theta = \theta_1 - \theta_2$.

3.2 Data

To test for the model, an EITM approach is followed. We assemble data on civil wars and repression to operationalize our predictions from theory. We use the standard UCDP/PRIO (1946–2006) data set for capturing the incidence of civil wars, which will be the dependent variable. The variable “warinci2” measures the incidence of intrastate war and is coded 1 in all country years with at least one active war.²⁰ The variable “repression” is Political Terror Scale by the U. S. State Department from 1976–2006. It ranges from (1) to (5) in increasing order of state repression:

- (1) Countries under secure rule of law, people not imprisoned for their view, torture rare or exceptional, political murders extremely rare.
- (2) Limited amount of imprisonment for nonviolent political activity, few persons are affected, torture or beatings are exceptional.
- (3) Extensive political imprisonment, execution, political murders common, unlimited detention for political views accepted.
- (4) Civil and political rights violations have expanded to large numbers of population, murder, torture, disappearances common, only people interested in politics or ideas affected.
- (5) Terror has expanded to whole population.

²⁰ War is defined by more than 1000 battle deaths.

Finally, the proxy for political competition is the variable “polcomp” from the commonly used Polity IV data set. The Polcomp index measures the two dimensions of political competition in a country: the first, the extent to which the alternative preferences of the opposition can be pursued, and the second, which focuses on the existence of rules that may limit the exercise of the right of expressing political preferences. Although “quality of institutions” that changes minimum concessions and maximum repression allowed is a more general term, we wanted to operationalize the concept that would allow for more “voice” to the opposition. Note that K determines the degree of minimum concessions and maximum repression that can be used by the state. The ordered values of political competition concept (polcomp) adequately describe the leverage that the opposition has against the government. For example, totalitarian systems with no limit on repression and with no minimum concessions take a value of 1 for polcomp. As limits on repression decrease and minimum concessions increase, polcomp values increase. A polcomp value of 6 allows for some repression by the state but there is factional competition that makes some concessions likely without free elections. This is followed by factional competition but free elections and limited accommodation across factions (polcomp value of 7). As polcomp increases to 9, there are open electoral polities with transition to or from institutionalized competitive participation (which has a value of 10). These values are briefly defined in the Data Appendix with the Polity IV definitions (Marshall and Jaggers 2007) but greater details on the definition are available from Addendum C in Marshall and Jaggers (2007). Other papers that have used the polcomp measure have correlated polcomp with growth, agricultural protection and rainfall shocks (Leonida, Patti, and Navarra 2010; Falkowski and Olper 2012; Brückner and Ciccone 2011).

3.3 Testing for Non-linearity

The test of non-linearity by Hansen (2000) involves a set of asymptotic procedures that estimate a threshold regression by least squares, compute confidence intervals for the parameters, and provide asymptotic simulation tests of the null of linearity against the alternative of a threshold. We aim to test the linearity of the relationship between repression and civil war incidence using political competition as our threshold. If, for example, the relationship is linear regardless of the level of political competition, the Hansen test will not reject the null of linearity. If the relationship is non-linear by level of political competition, the test should reject the null and estimate the threshold level of political competition around which the non-linearity occurs. Finally, we can also test for the strength of the relationship between repression and civil war incidence before and after the

threshold. As described in the theoretical model, we predict a positive correlation between repression and civil war incidence before the threshold level of competition. However, after the threshold is reached, there should be no correlation as there is no use of repression and peace is achieved. Recall from the proposition in the previous section that there uniquely exists a threshold $\hat{K} \in \mathbb{R} \cup \{-\infty, +\infty\}$ such that the equilibrium is concessive if $K > \hat{K}$ and repressive if $K < \hat{K}$.

Table 1: Test of null of no threshold against alternative of threshold.

Under maintained assumption of homoscedastic errors	
Number of bootstrap replications	1,000
Trimming percentage	0.15
Threshold estimate	9
F-test for no threshold	124.238
Bootstrap p -value	0
Threshold estimation	
Threshold variable	polcomp
Threshold estimate	9
0.95 Confidence interval	[9, 9]

Table 1 shows the results from the Hansen test and it strongly rejects the null of linearity between war incidence and repression with an F-test value of almost 112. Figure 6 also illustrates rejection of linearity as the sequence exceeds the critical value as provided by the test. Next, it estimates the threshold level of political competition around which the non-linearity exists. We obtain a value of 9 for political competition and this estimate is also the 95 % confidence interval for the threshold (note that political competition equal to 9 conforms to Democratic Retrenchment: Decreasing Overt Coercion as defined in the previous section). In Table 2, the relationship between war incidence and repression is presented separately: one for a regime where political competition less than or equal to 9 and one where it is equal to 10. We find a positive correlation between incidence of civil war and repression when political competition is under the threshold. This is consistent with the prediction of the repressive equilibria. There is no correlation between war and repression at the highest level of political competition. Theoretically, a concessive equilibria was achieved when there was no repression and only peace. Although the number of observations for the last category of political competition are only a sixth of the number for the first nine categories, we do observe a result consistent with our theoretical prediction based on comparative statics. However, note that these are mere correlations that complement the theory as there may be omitted variables

Figure 6: Testing the linearity of the relationship between repression and civil war incidence using political competition (polcomp) as our threshold variable. Sequence exceeding critical threshold rejects linearity.

Table 2: Parameter estimation under the two regimes.

Variable	Estimate	St Error
Regime 1: $\text{polcomp} \leq 9$		
Constant	-0.303	0.018
Repression	0.187	0.007
Observations	2,380	
Regime 2: $\text{polcomp} > 9$		
Constant	0	0
Repression	0	0
Observations	660	

that determine both repression and probability of civil war. Finally, Figure 7 shows the confidence interval for the political competition threshold graphically, i. e., where the sequence falls below the critical threshold at 9.

In order to test how the reverse causality issue might affect our results, we exclude country-years where polcomp changed during a civil war. The level of

Figure 7: Confidence interval estimation for threshold level of polcomp.

political competition might have changed because of the war and we do not want to use this variation to explain the non-linear relationship between repression and likelihood of war based on a threshold level of polcomp. Excluding all 49 such cases leads to similar results in Tables 3 and 4 that reject linearity with the same threshold value (equal to 9) for polcomp as before.

Table 3: Test of null of no threshold against alternative of threshold excluding country-years when polcomp changed during civil war.

Under maintained assumption of homoscedastic errors	
Number of bootstrap replications	1,000
Trimming percentage	0.15
Threshold estimate	9
F-test for no threshold	112.411
Bootstrap p-value	0
Threshold estimation	
Threshold variable	Polcomp
Threshold estimate	9
0.95 Confidence interval	[9, 9]

Table 4: Parameter estimation under the two regimes excluding country-years when polcomp changed during civil war.

Variable	Estimate	St Error
Regime 1: polcomp ≤ 9		
Constant	−0.2818174	0.01823907
Repression	0.1743343	0.00774884
Observations	2,331	
Regime 2: polcomp > 9		
Constant	0	0
Repression	0	0
Observations	660	

Finally, we argue that the polcomp variable is relatively stable even during civil wars. This may be because it generally takes a long time to change the level of political competition in a country or because it is highly persistent. In Table 5 we show selected countries that did not have a change in political competition for extended periods of time during a civil war. Moreover, countries on either end of the political spectrum exhibit stability although it appears that totalitarian regimes are more stable during civil wars. For example, Afghanistan and Mozambique both exhibit institutionally closed systems during long periods of civil war. Latin American countries like El Salvador, Guatemala and Peru show factional competition but free elections and limited accommodation across factions for long periods during their respective civil wars. Colombia has close to an open electoral polity during almost a thirty year civil war. This is the variation we are using for the robustness checks in Tables 3 and 4.

4 Conclusion

Civil wars are much more likely to end with peace agreements as opposed to on the ground (Eriksson and Wallensteen 2004). However, little is known about what mix of policy concessions and military power are more likely to work for ending wars. Moreover, this mix is likely to interact with existing institutions and resources in determining the future trajectory of war and peace. There has also been much empirical research on the non-monotonic relationship between democracies and civil wars. However, there is no micro-founded theoretical model that explains why this may be the case in equilibrium. We develop a simple model to allow the government to bargain with the opposition using two

Table 5: Examples of countries with stable polcomp score during civil war.

Country	Years of civil war	Polcomp value	Polcomp value interpretation
Afghanistan	1989–2006	1	Institutionally closed (de facto and de jure)
Chad	1965–1991	1	Institutionally closed (de facto and de jure)
Iraq	1968–2006	1	Institutionally closed (de facto and de jure)
Mozambique	1977–1990	1	Institutionally closed (de facto and de jure)
Sudan	1989–2000	1	Institutionally closed (de facto and de jure)
Vietnam	1955–1964	1	Institutionally closed (de facto and de jure)
Yemen	1962–1970	1	Institutionally closed (de facto and de jure)
Indonesia	1968–1992	2	Institutionally closed (de facto but not de jure)
South Africa	1966–1988	2	Institutionally closed (de facto but not de jure)
Zimbabwe	1972–1978	2	Institutionally closed (de facto but not de jure)
Iraq	1958–1967	3	Very limited and factional political competition
Nepal	1996–1998	5	Gradual transition from unregulated political competition to regulated political competition
Philippines	1946–1971	6	Factional competition/Faction-based restrictions
South Korea	1958–1950	6	Factional competition/Faction-based restrictions
Sri Lanka	1983–2000	6	Factional competition/Faction-based restrictions
El Salvador	1984–1990	7	Factional competition but free elections and limited accommodation across factions
Guatemala	1986–1995	7	Factional competition but free elections and limited accommodation across factions
Myanmar	1948–1961	7	Factional competition but free elections and limited accommodation across factions
Peru	1981–1991	7	Factional competition but free elections and limited accommodation across factions
Turkey	1993–1996	8	Democratic retrenchment with occasional use of military force by government against opposition
Colombia	1966–1994	9	Open electoral politics with transition to/from institutionalized competitive participation
France	1961–1962	10	Institutionalized open electoral participation; stable and enduring political groups compete without use of coercion

Note: No country had a civil war with a polcomp value of 4 or Uninstitutionalized competition.

different types of instruments: concessions and repression. The equilibrium has only one of the following characteristics: either civil wars can happen or there is always peace. When civil wars can happen, repression is higher as compared to the peace equilibrium.

The choice between relenting to the demands of an opposition group and imposing repressive measures is often not mutually exclusive. Our model with complete information predicts that in order to prevent a civil war, the

government should focus on either concessions or repression depending on political constraints. When degree of political competition is lower, the incumbent government resorts to greater military power for maintaining peace. If polity becomes more competitive, government's discretion on military power wilts and greater resources must be redistributed to the opposition group. This makes repressive peace less attractive for the government and, as a result, the state achieves peace through high concessions. With asymmetric information, the equilibrium is either a state of perpetual peace where there are concessions but no repression or a state of repressive equilibrium that can lead to civil wars. The degree of political competition has a non-monotonic impact on the prevalence of civil war. Specifically, when degree of the electoral political competition is sufficiently low, political development may have a negative impact on peace since it may restrict the use of military investment for keeping peace. When competition is high enough, the government emphasizes concessions for maintaining peace. Once this threshold of political competition is crossed, repression should no longer be correlated with civil war.

The correlations from data bear out the comparative statics from the theoretical model. This threshold is estimated to be just below open institutionalized electoral participation using a Hansen test. This implies that the road to completely free and fair elections as well as open electoral participation is paved with conflict. In particular, we are likely to see repressive regimes and higher conflict in countries that do not achieve institutionalized open political participation. Recent examples of countries undergoing unsuccessful political development include conflict-prone nations in both Asia and Africa. Another implication of our model is that imposing a middling level of political competition is likely to lead to a repressive equilibrium and may stir greater conflict. Examples include efforts by the United States to establish greater democracy in Iraq and Afghanistan.

The theoretical model offers new insights into the microfoundations of why civil wars take place along with repression in closed polities. The result point towards further study of political institutions in the context of weakly institutionalized states or states undergoing a process of political development.

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A Proofs

A.1 Proof of Proposition 1

Suppose that the equilibrium does not satisfy eq. [1]. Note that since $t \geq \underline{t}(K)$, it is the case only if $(1 - \pi(p, \theta))(R - g - p) > \underline{t}(K)$. Since $\underline{t}(K) \geq 0$, it is satisfied if and only if $p < \min\{\theta, R - g - \underline{t}(K)\}$. Since (1) is not satisfied and $p < \theta$, the opposition chooses to start war and wins. Then the opposition wins and the payoff for the government is 0.

Suppose that the equilibrium satisfies eq. [1]. Then the opposition does not attempt war, which yields payoff $R - t - p$ for the government. Since it is decreasing in t , the government optimally chooses $t = \max\{(1 - \pi(p, \theta))(R - g - p), \underline{t}(K)\}$. If $p < \theta$, then the government's payoff is $\min\{g, R - \underline{t}(K) - p\}$, which is maximized at $p = 0$. Note that since $R > \underline{t}(K) + g$, we obtain $\min\{g, R - \underline{t}(K)\} = g > 0$. It follows that when eq. [1] is satisfied, the payoff can be higher than when eq. [1] is violated. Thus the equilibrium must satisfy eq. [1].

If $\bar{p}(K) < \theta$, then the equilibrium payoff for the government is g , which is achieved for any $p \in [0, \bar{p}(K)]$. Note that for any $p \in [0, \bar{p}(K)]$, the aggregate payoff for the government and the opposition is $R - p$, implying that the socially optimal outcome is achieved when $p = 0$. Thus the equilibrium satisfies that $p = 0$ and $t = R - g$.

If $\bar{p}(K) \geq \theta$, then the government can choose $p \geq \theta$ as well as $p < \theta$. If $p \geq \theta$, then the payoff for the government becomes $\min\{R - p, R - \underline{t}(K) - p\} = R - \underline{t}(K) - p$. With constraint $p \geq \theta$, $R - \underline{t}(K) - p$ is optimized at $p = \theta$ (and $t = \underline{t}(K)$), which implies that the payoff for the government is $R - \underline{t}(K) - \theta$. Note that in this case the aggregate payoff for the government and the opposition is $R - \theta \leq R$ where equality holds if and only if $\theta = \underline{\theta} = 0$. Recall that the assumption on political equilibria implies that the government chooses the socially optimal strategy if it has multiple best responses. Then when $\theta > 0$, the government chooses $(p, t) = (\theta, \underline{t}(K))$ in order to gain the payoff $R - \underline{t}(K) - \theta$ rather than $(p, t) = (0, R - g)$ if $R - \underline{t}(K) - \theta > g$. When $\theta = 0$, since $R - \underline{t}(K) > g$, the government strictly prefers $(p, t) = (\theta, \underline{t}(K))$ to $(p, t) = (0, R - g)$. In summary, the government chooses $(p, t) = (\theta, \underline{t}(K))$ if and only if $\bar{p}(K) \geq \theta$ and $R - \underline{t}(K) - \theta > g$.

A.2 Proof of Proposition 2

First, suppose that the equilibrium satisfies that $t \geq R - g - p$. Since $\pi(p, \theta) \geq 0$ for any p and θ , no matter what θ is, (1) is satisfied and the opposition chooses peace. Then the *ex ante* payoff for the government is given by $R - t - p$. Thus if it is the equilibrium, then the government chooses (p, t) to solve the following optimization problem:

$$\begin{aligned} \text{Problem (C)} \quad & \max_{p, t} R - t - p \\ \text{subject to} \quad & t \geq \max\{R - g - p, \underline{t}(K)\}, p \in [0, \bar{p}(K)]. \end{aligned}$$

It is obvious that $t = \max\{R - g - p, \underline{t}(K)\}$ and then the government chooses $p \in [0, \bar{p}(K)]$ to maximize $\min\{g, R - p - \underline{t}(K)\}$. Note that the payoff for the government is g for $p \in [0, R - \underline{t}(K) - g]$ and $R - \underline{t}(K) - p$ for $p \in [R - \underline{t}(K) - g, \bar{p}(K)]$, implying that the payoff for the government is maximized at any p in $[0, R - \underline{t}(K) - g]$ and the socially optimal military investment is $p = 0$. Then the government chooses $p = 0$ and the equilibrium transfer is $t = R - g$. Let us call the solution of Problem (C) the concessive strategy.

Next suppose that the equilibrium satisfies $t < R - g - p$. Then due to the assumption on $\pi(p, \theta)$, (1) is satisfied if and only if $\theta \leq p$. It implies that from the government perspective, peace is achieved with probability $F(p)$ and a war breaks out with probability $1 - F(p)$. Since $\pi(p, \theta) = 0$ for $p < \theta$, the government can never win in a war if it happens. Hence given (p, t) , the government's expected payoff is $F(p)[R - t - p]$. Then the government chooses (p, t) to solve the following optimization problem:

$$\begin{aligned} \text{Problem (R)} \quad & \max_{p, t} F(p)[R - t - p] \\ \text{subject to} \quad & R - g - p > t \geq \underline{t}(K) \text{ and } p \in [0, \bar{p}(K)]. \end{aligned}$$

It is obvious that $t = \underline{t}(K)$ and then the problem is simplified to the following:

$$\begin{aligned} \text{Problem (R')} \quad & \max_p F(p)[R - \underline{t}(K) - p] \\ \text{subject to} \quad & p \in [0, \bar{p}(K)], p < R - g - \underline{t}(K). \end{aligned}$$

We call the solution of Problem (R') the repressive strategy. Now consider the following relaxed problem:

$$\begin{aligned} \text{Problem (R'')} \quad & \max_p F(p)[R - \underline{t}(K) - p] \\ \text{subject to} \quad & p \in [0, \min\{\bar{p}(K), R - g - \underline{t}(K)\}]. \end{aligned}$$

In the relaxed problem, we allow $p = R - g - \underline{t}(K)$ while it is not feasible in Problem (R').

In problem (R''), if $p > \bar{\theta}$, then we see $F(p)[R - \underline{t}(K) - p] = R - \underline{t}(K) - p < R - \underline{t}(K) - \bar{\theta} = F(\bar{\theta})[R - \underline{t}(K) - \bar{\theta}]$, which means that choosing is strictly better for the government than $p > \bar{\theta}$. Furthermore, if $p \leq \underline{\theta}$, then $F(p)[R - \underline{t}(K) - p] = 0$. Since Assumption 1 implies $R - \underline{t}(K) - \underline{\theta} > R - \underline{t}(K) - \bar{\theta} > 0$, the payoff for the government is guaranteed to be positive for some $p > \underline{\theta}$. Then the optimal level of p in Problem (R'') must be between $\underline{\theta}$ and $\bar{\theta}$.

By assumption on $F(\cdot)$, the log transformation of the objective function in (R'') is concave in $p \in [\underline{\theta}, \bar{\theta}]$. When the constraint is ignored, the optimal military strength can be characterized by the first order condition. Let

$$\xi(p, K) \equiv \frac{f(p)}{F(p)} - \frac{1}{R - \underline{t}(K) - p}.$$

Then the first-order condition is equivalent to $\xi(p, K) = 0$, or

$$\Delta(p, K) = f(p)[R - \underline{t}(K) - p] - F(p) = 0,$$

which implies $p = \hat{p}(K)$. Note that since $\xi(p, K)$ is decreasing in $p \in [\underline{\theta}, \bar{\theta}]$ and $\lim_{p \rightarrow \underline{\theta} + 0} \xi(p, K) > 0$, we see that $\hat{p}(K)$ uniquely exists in $(\underline{\theta}, \bar{\theta}]$.²¹ If $\hat{p}(K) > \min\{\bar{p}(K), R - g - \underline{t}(K)\}$, the concavity of the objective function in Problem (R'') implies that the optimal military investment must be $\min\{\hat{p}(K), \bar{p}(K), R - g - \underline{t}(K)\}$.

If $\hat{p}(K) < R - g - \underline{t}(K)$, then the optimal level of p in Problem (R'') is written by $p = \bar{p}(K)$ and it is also feasible in Problem (R'). Then provided $t < R - g - p$, the payoff for the government is $V^r(K)$. On the other hand, if $\bar{p}(K) \geq R - g - \underline{t}(K)$, then the optimal level of p in Problem (R'') is $p = R - g - \underline{t}(K)$, which violates $t < R - g - p$. It implies that provided $t < R - g - p$, the payoff for the government must be strictly less than $F(R - g - \underline{t}(K))[R - \underline{t}(K) - (R - g - \underline{t}(K))] = F(R - g - \underline{t}(K))g \leq g$.

We now compare the payoff for the government under the concessive and repressive strategy. First suppose $\bar{p}(K) < R - g - \underline{t}(K)$. We have already seen that the payoff is g under the concessive strategy and $V^r(K)$ under the repressive strategy. Thus if $g > F(\bar{p}(K))[R - \underline{t}(K) - \bar{p}(K)]$, then the government chooses the concessive strategy such that $t = R - g$ and $p = 0$. If $g < F(\bar{p}(K))[R - \underline{t}(K) - \bar{p}(K)]$, then the government chooses the repressive strategy such that $t = \underline{t}(K)$ and $p = \bar{p}(K)$. If $g = F(\bar{p}(K))[R - \underline{t}(K) - \bar{p}(K)]$, then the government is indifferent between the concessive and the repressive strategy. Since the concessive strategy is more socially efficient, the government chooses $t = R - g$ and $p = 0$. Second suppose

²¹ Note that if $\xi(p, K) \neq 0$, then $\Delta(p, K) \neq 0$.

$\bar{p}(K) \geq R - g - \underline{t}(K)$. We have already seen that the payoff is g under the concessive strategy strictly less than g under the repressive strategy. Therefore the government chooses the concessive strategy such that $t = R - g$ and $p = 0$. Note that if $\bar{p}(K) \geq R - g - \underline{t}(K)$, then we see $V^r(K) = F(\bar{p}(K))[R - \underline{t}(K) - \bar{p}(K)] \leq F(\bar{p}(K))g \leq g$. It means that whether $\bar{p}(K) \geq R - g - \underline{t}(K)$ or $\bar{p}(K) < R - g - \underline{t}(K)$, the government chooses $t = R - g$ and $p = 0$ if and only if $g \geq V^r(K)$.

A.3 Proof of Proposition 3

Let $\hat{K} \equiv \inf\{K \in \mathbb{R} | V^r(K) \leq g\}$. The payoff for the government is given by $V^r(K)$ when the equilibrium is repressive and g when the equilibrium is concessive. Given K fixed, the equilibrium is repressive if and only if $V^r(K) > g$. Given K and $K' > K$, we see

$$\begin{aligned} V^r(K) &= F(\bar{p}(K))[R - \underline{t}(K) - \bar{p}(K)] \\ &\geq F(\bar{p}(K'))[R - \underline{t}(K) - \bar{p}(K')] \\ &\geq F(\bar{p}(K'))[R - \underline{t}(K') - \bar{p}(K')] = V^r(K') \end{aligned}$$

where the first inequality is satisfied since $\bar{p}(K) \in \arg \max_{p \in [0, \bar{p}(K)]} F(p)[R - \underline{t}(K) - p]$ and $\bar{p}(K') \leq \bar{p}(K) \leq \bar{p}(K)$ and the second inequality is satisfied since $\underline{t}(K)$ is non-decreasing. Thus $V^r(K)$ is non-increasing in K . Since g is obviously independent of K , $\hat{K}$ satisfies that for all $K < \hat{K}$, $g > V^r(K)$ and for all $K > \hat{K}$, $g \leq V^r(K)$.

Suppose $\hat{K} \in \mathbb{R}$. Note that since $\hat{p}(K)$, $\bar{p}(K)$, and $\underline{t}(K)$ are all continuous in K , $V^r(K)$ is also continuous in K . Then we obtain $V^r(\hat{K}) = g$ by definition of $\hat{K}$. Therefore Proposition 2 implies that the equilibrium is concessive if $K = \hat{K}$.

Note that $\hat{p}(K)$ is non-increasing in K since $\xi_p(p, K)$ is non-increasing in K . Moreover $\bar{p}(K)$ is non-increasing in K by Assumption 1. Therefore $\bar{p}(K) = \min\{\hat{p}(K), \bar{p}(K)\}$ is non-increasing in K . Since the probability of peace is $F(\bar{p}(K))$ given $K < \hat{K}$, it is obviously non-increasing in K . Furthermore suppose that $\hat{p}(K)$ is decreasing. Then, since $\bar{p}(K) \leq \bar{\theta}$ for all $K \in \mathbb{R}$, $F(\bar{p}(K))$ is strictly decreasing in K . Therefore, if $\hat{K} > -\infty$, then for $K < \hat{K}$, the equilibrium is repressive and the probability of peace is strictly decreasing while for $K > \hat{K}$, the equilibrium is concessive and the probability of peace is one.

A.4 Formal Analysis of Piecewise-Linear Contest Function

In this section, we assume that the contest function $\pi(p, \theta)$ takes a form of (2) satisfying the following assumption:

Assumption 2: 1. $\bar{\theta} + 1/2\rho < R - g$.
 2. $\rho > 1/2\bar{\theta}$

Assumption 2 basically implies that parameter ρ is sufficiently high.

A.4.1 Complete Information

When the government knows the opposition's strength θ exactly, the government always achieves peace. To state the result, let

$$\hat{p}^I(\theta, K) \equiv \frac{\rho(R - g + \theta) + 1/2 - \sqrt{[\rho(R - g - \theta) - 1/2]^2 + 4\rho t(K)}}{2\rho}$$

and $\bar{p}^I(\theta, K) \equiv \min\{\hat{p}^I(\theta, K), \bar{p}(K)\}$.

Proposition 4: Suppose that the contest function $\pi(p, \theta)$ takes a form of (2). In case of complete information where the government knows the type of the opposition group, the government always chooses t such that peace is necessarily achieved in political equilibria. The equilibrium military strength and transfer (p^I, t^I) are characterized as follows:

$$(p^I, t^I) = \begin{cases} (0, R - g) & \text{if } \theta - 1/2\rho \geq \bar{p}^I(\theta, K) \\ (\bar{p}^I(\theta, K), (1 - \pi(\bar{p}^I(\theta, K), \theta))(R - g - \bar{p}^I(\theta, K))) & \text{if } \theta - 1/2\rho < \bar{p}^I(\theta, K). \end{cases}$$

The equilibrium payoff for the government is

$$\begin{cases} g & \text{if } \theta - 1/2\rho \geq \bar{p}^I(\theta, K) \\ \pi(\bar{p}^I(\theta, K), \theta)(R - g - \bar{p}^I(\theta, K)) + g & \text{if } \theta - 1/2\rho < \bar{p}^I(\theta, K). \end{cases}$$

As in the basic model, the former $(p^I, t^I) = (0, R - g)$ is interpreted as a “concessive” equilibrium, whereas the latter $((\bar{p}^I(\theta, K), (1 - \pi(\bar{p}^I(\theta, K), \theta))(R - g - \bar{p}^I(\theta, K)))$ is a “repressive” equilibrium. Since $\partial \hat{p}^I(\theta, K)/\partial \theta < 1$, the condition of concessive or repressive equilibrium implies that the equilibrium is likely to be concessive as K increases and/or θ increases. It is possible to check that $\lim_{\rho \rightarrow +\infty} \hat{p}^I(\theta, K) = \theta$, which is corresponding to the military power of the repressive equilibrium in the basic model. Then the piecewise-linear contest function can be interpreted as generalization of the contest function adopted in the basic model.

Proof of Proposition 4: Similar to the basic model, given θ , p , and t , the opposition keeps peace if and only if (1) is satisfied. If the equilibrium does not satisfy (1), then the government's expected payoff is $\pi(p, \theta)(R - g - p)$. Note that $t \geq \underline{t}(K)$, the constraint to induce war must satisfy $(1 - \pi(p, \theta))(R - g - p) > t \geq \underline{t}(K)$. Since t does not affect the government's expected payoff, without loss of generality the constraint is simplified into $(1 - \pi(p, \theta))(R - g - p) > \underline{t}(K)$ and the equilibrium military power must be a solution to the following optimization problem:

$$\max_p \pi(p, \theta)(R - g - p) \text{ subject to } (1 - \pi(p, \theta))(R - g - p) > \underline{t}(K).$$

Note that there may not exist a solution to this problem. In this case, it is straightforward that war never happens on the equilibrium. If there is a solution, let p^W be the solution to this problem. We later check that war never happens even if such p^W exists.

We next consider an equilibrium when (1) is satisfied. The government's payoff is $R - t - p$. Then the pair of the equilibrium military power and transfer is a solution to the following problem:

$$\max_{p, t} R - t - p \text{ subject to } t \geq \max\{(1 - \pi(p, \theta))(R - g - p), \underline{t}(K)\}.$$

We now show that the solution satisfies $t = (1 - \pi(p, \theta))(R - g - p)$. Suppose to the contrary $t > (1 - \pi(p, \theta))(R - g - p)$. If $t > \underline{t}(K)$, then the government's payoff can be strictly improved by slightly decreasing t without violating the constraints. Then since $t = \underline{t}(K)$, the military power at the solution is a solution to the following simplified optimization problem:

$$\max_p R - \underline{t}(K) - p \text{ subject to } \underline{t}(K) > (1 - \pi(p, \theta))(R - g - p).$$

Note that the right hand side of the constraint is decreasing in p . If $p > 0$, then the government's payoff can be strictly improved by slightly reducing p without violating the constraints, a contradiction. If $p = 0$, then the constraint implies

$$(1 - \pi(0, \theta))(R - g) = R - g < \underline{t}(K),$$

which contradicts Assumption 1.

Then the solution satisfies $t = (1 - \pi(p, \theta))(R - g - p)$. Given such t , the optimization problem is transformed into

$$\max_p \pi(p, \theta)(R - g - p) + g \text{ subject to } (1 - \pi(p, \theta))(R - g - p) \geq \underline{t}(K).$$

Note that p^W satisfies the constraint. When p^W is chosen, the government's payoff $\pi(p^W, \theta)(R - g - p^W) + g$ is strictly higher than when war happens and p^W is chosen. Then eq. (1) must be satisfied on the equilibrium.

We now derive the equilibrium p . First when $p > \theta + 1/2\rho$, the government's payoff is $R - g - p$, which is decreasing in p . Since the constraint is relaxed as p decreases, if the equilibrium satisfies $p > \theta + 1/2\rho$, then the government can improve the payoff by reducing p . Then it is never the equilibrium.

Suppose that the equilibrium satisfies $p \in [0, \theta - 1/2\rho]$. Then the government's payoff is g and the constraint becomes $R - g - p \geq \underline{t}(K)$ since $\pi(p, \theta) = 0$. Since the government's payoff is invariant in p and the opposition's payoff is decreasing in p , the equilibrium satisfies $p = 0$ and $t = R - g$.

When $p \in [\theta - 1/2\rho, \theta + 1/2\rho]$, the government's payoff is

$$\left[\frac{1}{2} + \rho(p - \theta) \right] (R - g - p) + g,$$

which is increasing in $p \in (\theta - 1/2\rho, \theta + 1/2\rho]$, and the constraint becomes

$$\left[\frac{1}{2} - \rho(p - \theta) \right] (R - g - p) \geq \underline{t}(K),$$

the left-hand side of which is decreasing in p . Solving the quadratic equation implies that the constraint is satisfied with equality at

$$p = \frac{\rho(R - g + \theta) + 1/2 \pm \sqrt{[\rho(R - g - \theta) - 1/2]^2 + 4\rho\underline{t}(K)}}{2\rho}.$$

Note that the higher root is above $R - g > \theta + 1/2\rho$, whereas the lower root, which is actually equal to $\hat{p}^I(\theta, K)$, is below $\theta + 1/2\rho$. Since the left-hand side of the constraint is convex in p , by taking into account $p \leq \bar{p}(K)$, p satisfies the constraint if and only if $[\theta - 1/2\rho, \theta + 1/2\rho] \cap [0, \bar{p}^I(\theta, K)]$. Since $\hat{p}^I(\theta, K) \leq \theta + 1/2\rho$, the set is not empty if and only if $\theta - 1/2\rho \leq \bar{p}^I(\theta, K)$. Given this inequality, since the objective is increasing in p , the solution satisfies $p = \bar{p}^I(\theta, K)$ and $t = (1 - \pi(\bar{p}^I(\theta, K), \theta))(R - g - \bar{p}^I(\theta, K)) \geq \underline{t}(K)$. The government's payoff is then $\pi(\bar{p}^I(\theta, K), \theta)(R - g - \bar{p}^I(\theta, K)) + g$ which is strictly larger than g , namely, the payoff when $p = 0$, if $\theta - 1/2\rho < \bar{p}^I(\theta, K)$.

A.4.2 Asymmetric Information

Similar to the complete information case, peace is achieved if and only if eq. [1] is satisfied.

Suppose that the equilibrium satisfies $t \geq (1 - \pi(p, \bar{\theta}))(R - g - p)$. Then, since $(1 - \pi(p, \theta))(R - g - p)$ is non-decreasing in θ , all the opposite types choose

peace. Given the government aims to achieve peace certainly, the payoff is $R - t - p$. Then, in equilibrium the government chooses (p, t) that solves the following optimization problem:

$$\max_{p, t} R - t - p \text{ subject to } t \geq \max\{(1 - \pi(p, \bar{\theta}))(R - g - p), \underline{t}(K)\}.$$

This is the same problem as the complete information with $\theta = \bar{\theta}$: the equilibrium can be characterized as (p^I, t^I) for $\theta = \bar{\theta}$.

Now suppose that $\underline{t}(K) \leq t < (1 - \pi(p, \bar{\theta}))(R - g - p)$. Let

$$\hat{\theta}(p, t) = \begin{cases} p + \frac{1}{\rho} \left(\frac{t}{R - g - p} - \frac{1}{2} \right) & \text{if } t \geq (1 - \pi(p, \underline{\theta}))(R - g - p) \\ \underline{\theta} & \text{if } t < (1 - \pi(p, \underline{\theta}))(R - g - p). \end{cases}$$

By construction, the opposition group chooses peace if and only if $\theta \leq \hat{\theta}(p, t)$. When $\theta \leq \hat{\theta}(p, t)$, the government receives $R - t - p$ whereas the payoff is $\pi(p, \theta)(R - g - p)$ when the opposition with type θ attempts war. Then the government's expected payoff is described as

$$F(\hat{\theta}(p, t))(R - p - t) + \int_{\hat{\theta}(p, t)}^{\bar{\theta}} \pi(p, \theta)(R - g - p)f(\theta)d\theta.$$

The government chooses $p \in [0, \bar{p}(K)]$ and $t \in [\underline{t}(K), (1 - \pi(p, \bar{\theta}))(R - g - p)]$ to maximize the payoff.

Suppose that the optimal p and t satisfy $t \geq (1 - \pi(p, \underline{\theta}))(R - g - p)$. The first derivative of the government's payoff with respect to t is

$$\begin{aligned} & \frac{f(\hat{\theta}(p, t))}{\rho(R - g - p)} \left[(R - p - t) - \pi(\hat{\theta}(p, t), p)(R - g - p) \right] - F(\hat{\theta}(p, t)) \\ &= f(\hat{\theta}(p, t)) \left[\frac{g}{\rho(R - g - p)} - \frac{F(\hat{\theta}(p, t))}{f(\hat{\theta}(p, t))} \right]. \end{aligned}$$

Note that p is bounded between 0 and $\bar{p}(K)$. If $F(\theta)/f(\theta)$ is bounded, then the first derivative is negative for sufficiently large ρ .²² It means that t should be lower as much as possible, i. e., $t = \underline{t}(K)$.

We admit that in general it is hard to derive a characterization of the optimal level of p . Nevertheless, as ρ becomes higher again, the optimal p would converge to that of the repressive equilibrium in our main model with the

²² For instance, $F(\theta)/f(\theta)$ is bounded if θ is uniformly distributed.

discontinuous contest function. To see it, note that given $t = \underline{t}(K)$, $\hat{\theta}(p, t)$ satisfies $\underline{t}(K) = (1 - \pi(p, \hat{\theta}(p, \underline{t}(K))))(R - p - g)$. If $\pi(p, \hat{\theta}(p, \underline{t}(K))) \in (0, 1)$, then solving the quadratic equation yields $p = \hat{p}^I(\hat{\theta}(p, \underline{t}(K)), K)$. Recall that $\hat{p}^I(\hat{\theta}(p, \underline{t}(K)), K)$ converges to $\hat{\theta}(p, \underline{t}(K))$ as ρ goes to infinity. Then as ρ is higher, for $\theta > \hat{\theta}(p, \underline{t}(K))$, $\pi(\hat{p}^I(\hat{\theta}(p, \underline{t}(K)), K), \theta)$ approaches zero, which implies that the second term of the government payoff, $\int_{\hat{\theta}(p, t)}^{\hat{\theta}} \pi(p, \theta)(R - g - p)f(\theta)d\theta$, also converges to zero. Recall that the first term of the government payoff takes essentially the same form as the objective function in Problem (R). Therefore the characterized solution would converge to the same equilibrium as in our main model with the discontinuous contest function.

B Data Appendix

The variable “polcomp” from Marshall and Jaggers (2007) takes the following values:

- (1) Repressed Competition – the polity is institutionally closed and the regime bans all organized opposition groups
- (2) Restricted Competition – the polity is institutionally closed and the regime systematically restricts major opposition groups
- (3) Deepening of Hegemonic Control – concerted effort on the part of hegemonic regimes to open up their political systems to limited political competition
- (4) Uninstitutionalized Competition – political participation is decentralized and fluid in character
- (5) Gradual Transition from Uninstitutionalized Competition – transition from (4) to more regulated forms of political competition
- (6) Factional/Restricted Competition – when one faction secures power it promotes its exclusive interests and favors group members while restricting the political access and activities of other, excluded groups, until it is displaced in turn.
- (7) Factional Competition – Relatively stable and enduring political groups which compete for political influence at the national level – parties, regional groups, or ethnic groups – but particularist/parochial agendas tend to be exclusive and uncompromising with limited social integration or accommodation across identity boundaries
- (8) Democratic Retrenchment: Persistent Overt Coercion – reflects the unconsolidated nature of liberal political participation in otherwise procedurally democratic polities

- (9) Democratic Retrenchment: Decreasing Overt Coercion – reflects relatively peaceful transitions either to or from institutionalized competitive participation
- (10) Institutionalized Open Electoral Participation – Relatively stable and enduring political groups regularly compete for political influence with little use of coercion. No significant or substantial groups, issues, or types of conventional political action are regularly excluded from the political process.

B.1 Data Sources

Political Terror Scale 1976–2008, 2008.

URL: <http://www.politicalterror scale.org/>

Polity IV Project, Data set User's Manual, 2010.

URL: <http://www.systemicpeace.org/>

Uppsala Conflict Data Program, Codebook Uppsala Conflict Database, 2006.

URL: <http://www.pcr.uu.se/>

World Bank Data, 2011.

URL: <http://data.worldbank.org/data-catalog/world-development-indicators>

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