

# The Political Violence Cycle \*

S.P. Harish<sup>†</sup>

Andrew T. Little<sup>‡</sup>

August 2016

## Abstract

Elections are often violent affairs, casting doubt on the canonical claim that democracy makes societies more peaceful by creating non-violent means to contest for power. We develop a formal argument to demonstrate that this conclusion is incorrect. Holding elections has a direct effect of increasing levels of violence close to the voting, as this is when electoral violence can influence political outcomes. Precisely for this reason, elections also have an indirect effect of decreasing levels of violence at all other times, as parties can wait for the election when their efforts are more likely to succeed. The direct and indirect effects generate a “political violence cycle” that peaks at the election. However, when the indirect effect is larger, politics would be more violent without elections. When elections also provide an effective non-violent means to contest for power, they unambiguously make society more peaceful while still generating a political violence cycle.

---

\*Previous versions of paper were presented at the European Political Science Association 2014 Annual Meeting, the International Studies Association 2015 Annual Meeting, the Midwest Political Science Association 2015 Annual Meeting, and the Berkeley Center for Political Economy. Many thanks to audience members at these seminars, Deniz Aksoy, Tiberiu Dragu, Patrick Kuhn, Tom Pepinsky, Mike Miller, Arturas Rozenas, Ignacio Sanchez-Cuenca, and Inken von Borzyskowski, four anonymous referees, and the editors of the *APSR* for helpful comments and discussion. All remaining errors are ours.

<sup>†</sup>PhD Candidate, Department of Politics, New York University. psr245@nyu.edu

<sup>‡</sup>Assistant Professor, Department of Government, Cornell University. andrew.little@cornell.edu.

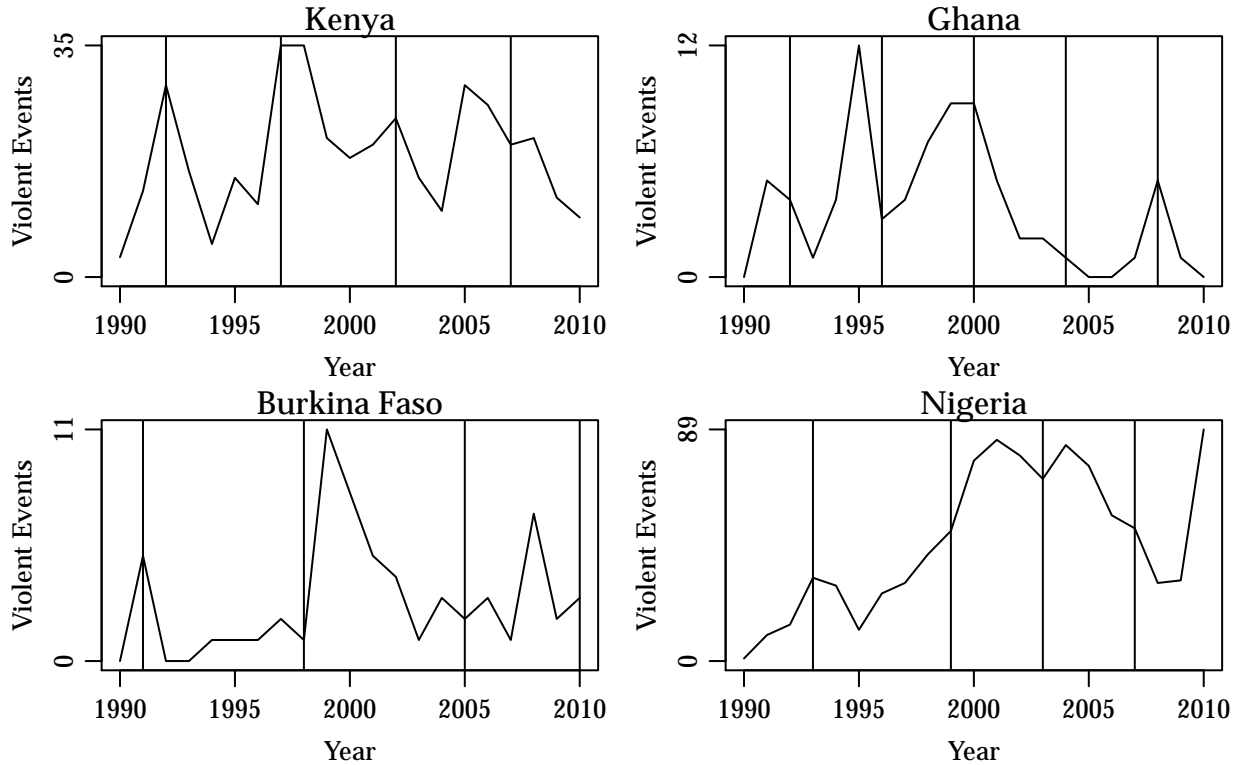
“Sick of elecshun [sic] related violence and terror attacks. Can’t wait for elecshuns to be over and get non-elecshun related violence back.” - A tweet from the satirical and pseudonymous @majorlyp during the 2013 Pakistani elections.

A prominent argument for democracy centers around the fact that elections allow political groups to compete via ballots rather than bullets. Democracies can be more accommodating of their citizens by allowing people to dissent and to vote for alternate political parties in regular elections. However, elections are often violent affairs. Conflict surrounding the 2007 elections in Kenya led to around 1,000 deaths and hundreds of thousands displaced. Similarly, dozens were killed in the May 2013 election-related violence in the Philippines. More generally, electoral violence is not a new phenomenon nor limited to nascent democracies, but a problem “virtually all states have experienced” (Rapoport and Weinberg, 2000, p.42). As many Western governments and NGOs at least nominally encourage other countries to hold elections, the question of whether doing so incites violence is of great practical as well as theoretical importance.

That elections are a necessary condition for electoral violence is tautological; of greater interest is how elections affect patterns of political violence both close to and further from electoral periods. Still, recent empirical studies have found that various forms of political violence sometimes *do* spike around elections (e.g., Hafner-Burton, Hyde and Jablonski, 2014; Newman, 2013; Aksoy, 2014). Figure 1 illustrates this pattern for several African countries in a way that will relate closely to our theoretical model. Each panel shows yearly counts of violent events in a country for 1990-2010, from the Social Conflict Analysis Database (Hendrix and Salehyan, 2015), with vertical lines illustrating years with elections where the chief executive office was at stake (Hyde and Marinov, 2012). Kenya illustrates the pattern we seek to explain starkly: in three out of four years with elections, there were more violent events than the years before and after. Ghana experienced similar spikes in violence around elections in 2000 and 2008, though the most violent year was the

one preceding an election (1995). In Burkina Faso, the largest spike of violence occurred in the year following an election, while in Nigeria patterns in violence seems unrelated to election years.

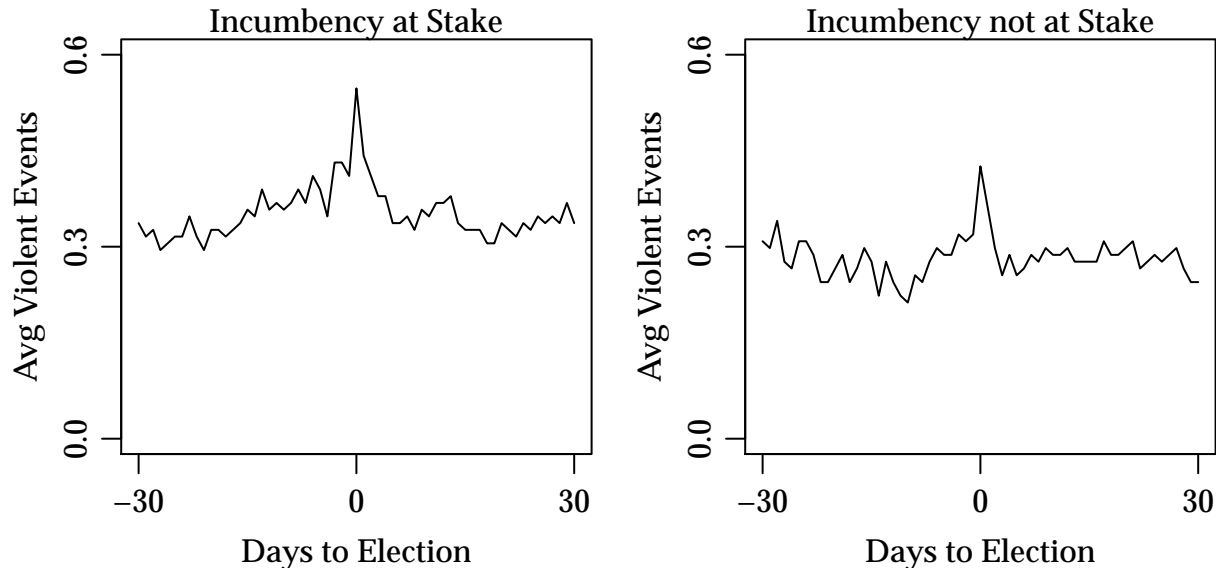
Figure 1: Counts of violent events for select African countries by year, with vertical lines at years with elections where the office of the incumbent was contested.



This pattern can be seen more clearly when aggregating across countries and taking a more fine-grained time window. Figure 2 presents the average daily level of violence from a month before to a month after election day, for elections where the office of the incumbent leader was (left panel) and was not (right panel) at stake, using the full sample of SCAD (which includes Latin America in addition to Africa). Two patterns readily stand out: first, there is a cyclical pattern with a clear spike in violence around the day of the election for both types of elections. Second, there is a higher (average) level of violence around elections when the incumbent leader's office was in contention. (See the Appendix for a complete description of the data and procedures that generate these graphs.)

Motivated by patterns like this and the association between elections and violence more gener-

Figure 2: Average counts of ongoing violent events by the number of days to the closest election for full sample of SCAD.



ally, some have suggested that promoting elections could be dangerous in certain contexts (Collier, 2009), or that elections should not be held too soon in some situations (Brancati and Snyder, 2012; Flores and Nooruddin, 2012). More frequently, scholars of the relationship between elections and violence do not advocate against holding elections, but do express a clear unease that their results could be used to make such an argument.<sup>1</sup> And these fears are not unfounded: those writing for more general audiences have used this association to discourage democracy promotion, e.g., calling elections or democracy more broadly a ‘curse’ (Economist, 2013) or a “among the causes of both the Rwandan and Yugoslavian genocides” (Chua, 2004, p. 12).

We provide a simple and general formal argument which demonstrates that spikes of violence during elections can not be used as evidence that elections make politics more violent overall. The

<sup>1</sup>For example, Chenoweth (2010, p.28) succinctly summarizes this notion in the context of terrorism, noting that “Most studies that establish a positive relationship between terrorism and democracy find themselves in awkward positions because of the implications of their results—namely, that undermining democracy may also undermine terrorism.” Hafner-Burton, Hyde and Jablonski (2014, p.175) note that “scholars and pundits may be tempted to interpret the fact that leaders sometimes use political violence to manipulate elections as confirmation that elections are necessarily ‘bad’ for countries without a history of elections and democracy,” though caution against this conclusion. Even those criticizing a universal push for early elections warn that “our findings justify neither authoritarian leadership in postconflict countries nor the automatic postponement of postconflict elections” (Flores and Nooruddin, 2012, p. 568)

crux of our argument is that elections affect incentives to use violence to further political objectives not only leading up to and directly after the voting, but at all times. In particular, the presence of an election in the future can decrease incentives to commit violence today precisely because violence – as well as non-violent political action – become more effective during electoral periods. That is, making electoral violence a more effective tool to change political outcomes has a *direct effect* of increasing violence surrounding elections, but this can be partially if not fully offset by an *indirect effect* of decreasing violence in the periods between elections. So, we can not conclude from this evidence that elections – or more consequential elections – make politics more violent in general.

Our theoretical argument has important implications for the empirical study of electoral violence. The strategic use of violence around elections and associated temporal dynamics makes empirical assessment of how elections affect total violence levels extremely difficult, since it involves constructing the counterfactual of a world with less consequential elections or not at all. For example, when observing a country where violence increases during elections, it is tempting to conclude that politics would have been more peaceful without the election. However, the increase in violence could be driven by the direct effect or indirect effect described above (or both).

To allow for such counterfactual comparisons (albeit theoretically), we develop a series of formal models which generate dynamics similar to the empirical record with elections, and then ask what would happen were elections to become less consequential or non-existent. In our main model, two parties compete over the spoils from holding office, and the party in opposition commits violence in an attempt to oust the incumbent.<sup>2</sup> To set up a “hard case” for elections to have a pacifying effect, we take it as a given that violence is more effective in electoral periods, in the sense that a marginal increase in the opposition’s violent effort has a higher impact on their chance of taking over office. Consistent with figures 1 and 2, this simple set-up generates a “political violence cycle,” where conflict peaks in electoral periods. However, the presence of elections

---

<sup>2</sup>As discussed below, we only allow the opposition to commit violence in the first model to illustrate our argument in a simple fashion, but later show the conclusions hold when the incumbent commits violence as well.

decreases the amount of violence in non-electoral periods compared to a baseline where elections never happen. When the indirect effect of reducing violence in non-electoral periods outweighs the direct effect of increasing violence during electoral periods, the average level of violence is *lower* in a society with elections than in the counterfactual without elections. So, our first main result is that even when assuming only thing elections do is periodically make violence more effective, the overall impact of elections can be to make politics more peaceful.

Our second main result is that a similar cyclical pattern of violence can arise if elections also provide a non-violent means to contest for power and unambiguously make society more peaceful on average. To demonstrate this, we allow the opposition to also take non-violent actions to increase their chance of taking office during electoral periods (e.g., campaigning). Providing this alternative means of contesting for power lowers the level of violence in electoral periods as well as the periods leading up to elections for a similar reason described above; there is less incentive to commit violence leading up to an electoral period when parties can wait until they are able to contest for power peacefully. If the relative cost of non-violent political activity is sufficiently low, there will *always* be less violence in a political system with elections; in fact, there may be less violence in *every* period compared to a baseline without elections. Further, when the non-violent activity is sufficiently effective, peaks of violence can occur after the election, consistent with the prevalence of post-election protest, particularly in less-than-democratic countries (Daxecker, 2012; Rozenas, 2012; Hyde and Marinov, 2014).

Finally, we conduct two additional extensions to demonstrate that the central arguments of the paper apply to violence committed by different actors and with different goals. First, we allow the incumbent to commit violence, which shows that our model can also capture the (often more empirically relevant) case of violence perpetrated by government forces. Similar results hold even if the incumbent commits the vast majority of violence. Second, we consider violence used to attain more incremental political objectives than taking over office, which also leads to a similar cycle of violence around elections that can make society more or less peaceful on average. In sum,

the models suggest that political violence committed by any actor for any purpose can follow a cyclical pattern peaking at election time without implying that there would be less violence of this form without elections.

## **1 Related Work**

Holding regular elections is central to a democracy since it provides a mechanism through which societal differences are collectively resolved and voters can hold their representatives accountable for their actions (Schumpeter, 1942; Przeworski, 2005; Przeworski, Stokes and Manin, 1999). However, a growing literature on when and why violence is used during elections has challenged this idea by showing the link between the central instrument of democracy and conflict.

The existing theoretical literature on electoral violence primarily analyzes how elites use violence around elections to improve their chances at the polls. For example, Ellman and Wantchekon (2000) present a model on how threats of violence influences policy choices of different parties. Similarly, Chaturvedi (2005) shows how elites use violence to influence both voter turnout and vote choice. In a similar vein, Collier and Vicente (2012) argue that in situations where violence is effective in swaying swing voters, some types of incumbents and challengers will use repression and terrorism, respectively. However, these models do not examine how elections affect incentives to commit violence in non-electoral periods, so they tell us little about how elections affect patterns of political violence more generally.

Other recent game-theoretic work compares levels of violence in a game with and without elections, but only in a single period (Cox, 2009; Little, 2012). In many existing formal models, elections always reduce violence as – loosely speaking – voting or employment act as substitutes for fighting (Fearon, 2011; Przeworski, Rivero and Xi, 2012), the election fully alleviates the uncertainty that can cause bargaining to break down (Cox, 2009), or reducing anti-government violence is the goal of elections (or democratizing) and hence they are only held when serving this end

(Acemoglu and Robinson, 2000; Little, 2012).

A considerable empirical literature supports the more skeptical theoretical models. For instance, Hafner-Burton, Hyde and Jablonski (2014) show that incumbents will use violence during electoral periods when she fears losing power or when there are institutionalized constraints, but that this may also lead to risky post-election violence (Hafner-Burton, Hyde and Jablonski, 2015).<sup>3</sup> Similarly, Aksoy (2014) shows that electoral violence is more likely in places with low ‘electoral permissiveness’. Both Wilkinson (2004) and Brass (2003) describe how Indian elites use violence to increase the turnout of their supporters and decrease that of the challengers. Using data from Africa, Daxecker (2012) argues international monitoring of flawed elections can raise the salience of fraud and consequently the risk of post-election violence, and Kasara (2015) shows how violence may also influence future (and not just upcoming) elections in Kenya. Elections may be particularly dangerous in countries that have recently transitioned from an autocracy to a democracy (Collier, 2009; Cederman, Hug and Krebs, 2010), or that have recently recovered from conflict (Reilly, 2002; Brancati and Snyder, 2012; Flores and Nooruddin, 2012).<sup>4</sup>

Most directly related to our model is a burgeoning empirical literature which focuses specifically on spikes in violence, repression, and terrorism during electoral periods (Norris, Frank and Martinez i Coma, 2015; Staniland, forthcoming; Newman, 2013; Goldsmith, 2014; Bekoe, 2012). The types and perpetrators of violence may also change surrounding elections: e.g., Straus and Taylor (2012) show that incumbents tend to inflict violence before the vote and challengers are more likely to be involved in post-election violence.

While this empirical literature has highlighted potential ways in which elections may incite violence, the research designs employed can not speak directly to the theoretically- and policy-

---

<sup>3</sup>However, violence may sometimes decrease during elections, especially if they are strategic substitutes (Davenport, 1997; Dunning, 2011).

<sup>4</sup>There is a wide literature that examines whether democracy in general is associated with civil conflict and other forms of violence (Hegre et al., 2001; Fearon and Laitin, 2003; Collier and Hoeffler, 2004; Hegre and Sambanis, 2006). Similarly, a large number of studies have focused on the use of political repression in different types of regimes and have generally found that strong democratic institutions are associated with lower levels of repression and human rights violations (Poe and Tate, 1994; Davenport and Armstrong, 2004).



relevant counterfactual of what would happen in the absence of elections, or if elections had lower stakes. Studies that compare levels of violence cross-nationally face the well-known problems of identifying causal effects from observational data. More subtly, studies that compare levels of violence closer and farther from elections within countries could more plausibly identify the causal effect of elections if non-electoral periods can serve as “control” periods for times closer to elections. Our models show this inference is dangerous, since the “treatment” of having (competitive) elections affects incentives to use violence at all times. In fact, we find that in some cases elections lead to less violence overall precisely when the difference between violence in electoral and non-electoral periods is large.

Finally, our argument is also related to models developed to answer how electoral rules can be obeyed in the shadow of force, which argue that the results of elections can be followed and substitute for conflict if losers prefer the potential to contest for power again in future elections to fighting today (Przeworski, 1991, 2005; Przeworski, Rivero and Xi, 2012). On the other hand, Bates (2008) argues that prospect of losing power via competitive elections makes leaders less patient and more apt to act in a predatory manner towards their citizens (see also Bates, Greif and Singh 2002). Both of these approaches focus on conditions under which there is an equilibrium with no conflict or predation, while our model has a unique equilibrium that makes precise predictions about patterns of violence over time. That is, rather than describing a society that is in perpetual conflict or peace, the equilibrium to our model has cycles of violence and peace around elections, as in the empirical record.

## **2 The Baseline Model**

We first present a simple model of political violence in a repeated setting. There are two parties competing for office. The game proceeds over  $T > 1$  time periods.<sup>5</sup> In each period, one party is

---

<sup>5</sup>Picking a finite time horizon allows for a straightforward characterization of a unique equilibrium which holds for any arbitrary large number of periods and set of exogenous parameters, which would not be possible in the analogous

the incumbent the other in opposition. The parties are symmetric, in the sense that the actions and period payoffs assigned to the incumbent and opposition do not depend on which party holds which role. As a result, we refer to decisions made by the incumbent party and opposition party even though the actor in these roles may alternate.<sup>6</sup>

The incumbent takes no actions and earns rents from office  $\psi > 0$ . The party in opposition in time  $t$  chooses violence level  $v_t \geq 0$ , incurring a cost  $c(v_t)$ . Assume  $c$  is increasing and convex, with  $c'(0) = 0$ . That is, the first unit of violence is “free”, and the marginal cost of violence is increasing.<sup>7</sup>

The benefit to committing violence is that it increases the chances of taking over as the incumbent in the next period. In particular, the probability of taking over office is given by  $p(v_t; k_t)$ , where  $v_t \geq 0$  is the level of violence in period  $t$  and  $k_t \in [0, 1]$  is the *effectiveness of violence* in period  $t$ . We assume that  $p$  is continuous, twice-differentiable in both arguments, and strictly increasing and concave in the level of violence  $v_t$ . That is, we assume there are diminishing returns to violence. To formalize the effectiveness of violence, we assume that  $\frac{\partial p}{\partial k_t} > 0$  and  $\frac{\partial^2 p}{\partial v_t \partial k_t} > 0$ , meaning the probability of taking office and the marginal effect of committing more violence are always increasing in  $k_t$ . To preview, when applying the model to cycles of violence around elections we assume that  $k_t$  is higher in electoral periods, but first provide the solution to the general model.

---

infinite horizon model.

<sup>6</sup>To be more precise, we could define the game as between two parties  $A$ , and  $B$ , one of which starts the game as the incumbent. In each period  $v_{J,t}$  is the amount of violence party  $J$  would choose if in the opposition role in period  $t$ , and the probability of taking office when party  $J$  is the opposition is  $p(v_{J,t}; k_t)$ . Since we identify a unique equilibrium and the objective function for the party in opposition does not depend on their label, it must be the case that both sides always choose the same level of violence.

<sup>7</sup>We do not assume there is a budget constraint as this complicates the analysis by raising the possibility of boundary conditions when the opposition spends their entire budget on on violence. If anything, adding budgets would make our results stronger, as it could lead to a “cap” of how much violence can spike during elections. Further, if the budget does not perfectly reset every period there would be intertemporal substitution more directly baked into the model as any unit of violence used during an election would have to come from another period.

Formally, the period payoff to a party is given by:

$$u_t = \begin{cases} \psi & \text{as incumbent} \\ -c(v_t) & \text{as opposition.} \end{cases}$$

The payoff for the entire game is the discounted sum of the period payoffs and a “continuation value” for ending the game in each role. For consistency with later notation, we write the value of ending the game as the incumbent  $\pi_I^*(T + 1)$ , and as the opposition  $\pi_O^*(T + 1)$ .<sup>8</sup> We assume it is better to end the game as the incumbent:  $\pi_I^*(T + 1) > \pi_O^*(T + 1)$ .

Both parties discount future payoffs at rate  $\delta \in (0, 1]$ . So, the total payoff for a party that attains period payoffs  $u_1, \dots, u_T$  and ends the game as party  $J$  is:

$$\sum_{t=1}^T \delta^{t-1} u_t + \delta^T \pi_J^*(T + 1)$$

This setup is deliberately simple to highlight our core argument in a clear fashion.<sup>9</sup> An inevitable drawback to this simplification is that some aspects of the model are *prima facie* at odds with how much violence unfolds in actual elections. For example, we assume that the only opposition uses violence despite the fact that much if not most electoral violence is committed by or on behalf of the incumbent regime. We choose to have only one actor commit violence in the baseline model as this greatly streamlines the presentation. Further, assuming the actor committing violence is trying to change rather than maintain the status quo leads to cleaner intuitions, and in this context that is the opposition. Importantly for connecting our model to the empirical literature, we later extend the model (in section 4) to allow violence by both actors, and find our central

---

<sup>8</sup>While the specific values chosen for  $\pi_O^*(T + 1)$  and  $\pi_I^*(T + 1)$  can have a large impact on the equilibrium levels of violence in the final periods, when the game is long (i.e.,  $T$  is large), the continuation values at the end have little affect on the behavior for most of the game. In our illustrations we set the continuation values to avoid changes in behavior due to the game ending, see the appendix for a derivation of this stationary value.

<sup>9</sup>See Little and Pepinsky 2016 for a more general discussion of the role of simplification in models of comparative politics.

results hold.

Two other particularly consequential assumptions are that violence is the only tool to affect political outcomes and holding office is the only outcome parties care about. Again, we later present extensions to the model which loosen these assumptions without changing our core conclusions. Before getting to these more realistic models, we illustrate our core point about the intertemporal substitution of violence in our simple baseline model.

## Solution

Our solution concept (formally defined below) requires that the level of violence chosen in each period maximizes the opposition expected payoff for the rest of the game given the future equilibrium violence choices.<sup>10</sup> To compute the optimal violence choice in period  $t$ , the party in opposition has to compare the expected payoff for the remainder of the game entering the next period as incumbent or opposition. In the last period, this is relatively straightforward, as the values of ending the game in either role are the exogenously given  $\pi_O^*(T + 1)$  and  $\pi_I^*(T + 1)$ . So, the payoff for the party that is the opposition in final period as a function of their violence choice is:

$$\underbrace{\sum_{t=1}^{T-1} \delta^{t-1} u_t}_{\text{past payoffs}} - \underbrace{\delta^{T-1} c(v_T)}_{\text{period } T \text{ payoff}} + \underbrace{\delta^T (p(v_T; k_T) \pi_I^*(T + 1) + (1 - p(v_T; k_T)) \pi_O^*(T + 1))}_{\text{continuation value}}$$

Since the past payoffs are fixed, when characterizing the optimal level of violence it is simpler to work with the *net present value* of the game starting in period  $t$ , which only considers the payoffs

---

<sup>10</sup>The probabilistic nature of who enters each period as the incumbent means this is a game with incomplete information, so subgame perfection does not apply. We do not introduce extra notation for the beliefs held by the parties since the uncertainty is symmetric and the probability of taking office function is a primitive of the model.

beginning in period  $t$  and normalizes by the discount rate. So, for the last period this is given by:<sup>11</sup>

$$\pi_O(T, v_T) = -c(v_T) + \delta(p(v_T; k_T)\pi_I^*(T+1) + (1 - p(v_T; k_T))\pi_O^*(T+1))$$

To be sequentially rational, the violence level in the last period must maximize  $\pi_O(T, v_T)$ . Taking the first order condition, an interior optimal violence choice is the  $v_T$  solves:

$$\underbrace{\frac{\partial p(v_T; k_T)}{\partial v_T}}_{\text{Pr(take over)}} \underbrace{\delta(\pi_I^*(T+1) - \pi_O^*(T+1))}_{\text{discounted value of taking over}} = c'(v_T). \quad (1)$$

The left-hand side of equation 1 is the marginal benefit to committing more violence in period  $T$ , which is equal to the change in the probability of ending the game as the incumbent times the discounted difference between ending the game as the incumbent versus as opposition. The right-hand side of this equation is the marginal cost to committing more violence. Since there are diminishing returns to committing more violence and an increasing marginal cost, this equation has a unique solution  $v_T^*$  where the marginal benefit equals the marginal cost.<sup>12</sup>

The optimal violence choice in every period has this general form: the opposition commits the level of violence where the marginal cost of committing more violence equals the marginal benefit via increasing the chance of taking over office in the next period. The only complication – which will drive the intertemporal substitution effects we aim to model – is that the benefit of taking over office in the next period depends on the future effectiveness of violence. However, once we know the violence level in period  $T$  (derived above), we can compute the net present value of entering period  $T$  as incumbent versus opposition, which gives the optimal level of violence in period  $T - 1$ . This gives the net present value of entering the next to last period in each role, and

<sup>11</sup>That is, the payoff for the entire game for the party in opposition for any time  $t$  given the future violence choices can be written  $\sum_{i=1}^{t-1} \delta^{i-1} u_i + \delta^{t-1} \pi_O(t, v_t)$ . Since the past payoffs are not a function of  $v_t$ , optimizing this equation is equivalent to optimizing  $\pi_O(t, v_t)$ .

<sup>12</sup>More precisely, since  $p$  is concave and bounded above by 1, the left-hand side is positive, decreasing, and approaches 0 as  $v_T \rightarrow \infty$ . Since  $c$  is convex and equal to zero at  $v_T = 0$ , this ensures a unique intersection, which by the concavity of the objective function is the unique global maximizer.

hence the optimal violence level in period  $T - 2$ , etc.

Formally, the opposition objective function ( $\pi_O(t, v_t)$ ), optimal violence choice ( $v_t^*$ ), and the net present values for entering period  $t$  in each role ( $\pi_O^*(t)$  and  $\pi_I^*(t)$ ) can be defined recursively as:

$$\pi_O(t, v_t) = c(v_t) + \delta(p(v_t; k_t)\pi_I^*(t+1) + (1 - p(v_t; k_t))\pi_O^*(t+1)) \quad (2)$$

$$v_t^* \in \arg \max_{v_t} \pi_O(t, v_t) \quad (3)$$

$$\pi_O^*(t) = \pi_O(t, v_t^*) \quad (4)$$

$$\pi_I^*(t) = \psi + \delta(p(v_t^*; k_t)\pi_O^*(t+1) + (1 - p(v_t^*; k_t))\pi_I^*(t+1)) \quad (5)$$

An equilibrium to the model is a characterized by sequences  $v_t^*$ ,  $\pi_O^*(t)$ , and  $\pi_I^*(t)$  that solve equations 2-5 for  $t = 1, \dots, T$ . It is also convenient to write the difference between the net present value of entering period as the incumbent versus the as the opposition as  $\Delta_t^* \equiv \pi_I^*(t) - \pi_O^*(t)$ . So, the first order condition for an interior level of violence  $v_t$  is:

$$\delta \frac{\partial p(v_t; k_t)}{\partial v_t} \Delta_{t+1}^* = c'(v_t) \quad (6)$$

As long as  $\Delta_{t+1}^* > 0$  – which means it is better to enter the next period as the incumbent rather than opposition – this optimization problem has a unique interior solution  $v_t^*$ . If it is better to enter period  $t+1$  as the opposition rather than as the incumbent, there is no benefit to violence and hence it is optimal to pick  $v_t^* = 0$ .<sup>13</sup> So:

**Proposition 1.** *The model has a unique equilibrium where  $v_t^*$  solves equation 6 when  $\Delta_{t+1}^* > 0$  and  $v_t^* = 0$  otherwise.*

**Proof** Follows from the above analysis, see the appendix for details. ■

<sup>13</sup>One way this can happen is if violence is extremely effective in period  $t+1$  but less effective after that, meaning is better to enter period  $t+1$  as the opposition in order to take control before violence becomes less effective again.

Next we analyze how changing the effectiveness of violence in a given period affects the pattern of violence throughout the game. For simplicity we only consider the plausibly realistic case where it is better to enter as the incumbent in every period (i.e., when  $\Delta_t^* > 0$  for all  $t$ ), see the appendix for discussion of how loosening this restriction affects the results.

The direct effect of increasing the effectiveness violence in period  $t$  is that by increasing the marginal effect of  $v_t$  on taking over office, the marginal benefit to violence increases, leading to a higher choice in period  $t$ . Formally, implicitly differentiating equation 6 gives that  $\frac{\partial v_t^*}{\partial k_t} > 0$ .

To formalize the indirect effect, consider how making violence more effective in future periods (i.e.,  $t' > t$ ) affects behavior in period  $t$ . (By sequential rationality, violence levels in previous periods  $t' < t$  do not affect the choice in period  $t$ .) Referring back to equation 6, this will depend on how the future effectiveness of violence changes the relative value of entering the next period as the incumbent ( $\Delta_{t+1}^*$ ). When  $t' = t + 1$ , the result is straightforward: making violence more effective in the next period unambiguously makes the opposition better off and the incumbent worse off entering this period. This reduces the relative value of entering the next period as the incumbent, so there is less violence in period  $t$ . For periods  $t' > t + 1$  the technical analysis is more subtle, but for all of the examples we present in our illustrations, reducing the effectiveness of violence at *any* future period decreases the level of violence today (see the Appendix). Intuitively, as long as it is better to enter each period as the incumbent, and taking control of the government by force is rare, anything that makes doing so easier in the future reduces incentives to commit violence today. Formally:

**Proposition 2.** *The equilibrium level of violence in time period  $t_1$  is:*

*i) increasing in  $k_{t_1}$ ,*

*ii) decreasing in  $k_{t_1+1}$ , and*

*iii) provided  $\delta(1 - 2p(v_t^*; k_t)) > -\frac{\partial v_t^*}{\partial \Delta_{t+1}^*} c'(v_t^*)$  for  $t \in \{t_1, \dots, t_2 - 1\}$ , decreasing in  $k_{t_2}$  for  $t_2 > t_1 + 1$ .*

**Proof** See the Appendix.

While the model has not yet explicitly addressed elections, this result formalizes the central intuition about the direct and indirect effects of making violence more effective in a given period. The obvious direct effect is that there is more violence in this period. However, making violence more effective in period  $t$  has an indirect effect of *decreasing* violence in periods  $t - 1$ , and potentially in all periods prior to period  $t$ .

The idea that political actors time their actions is fairly well documented, especially in the terrorism literature. For instance, the Boston Marathon bombers had initially planned their attack for the July 4th festivities (Boston, 2013), and the so-called ‘underwear bomber’ had timed his attack for Christmas Day (Hudson, 2013). Such violent actors are also known to specifically wait for elections so that their attacks would have a greater impact. A recent prominent example of such an approach is the the 2004 train bombings in Madrid that took place three days before the Spanish voters went to the ballot, and is now known to have been timed specifically to influence the election outcome (Richburg, 2004). Other similar instances include the Kurdistan Workers’ Party (PKK) attacking Turkish security forces to sway the electorate in April 2015 (Aksoy, 2015), and intelligence reports indicating that Pakistani terrorists planning suicide attacks timed for the Indian elections (Shukla, 2014). Violence (including but not limited to terrorism) may also be more prevalent during seasons when it is easier to recruit fighters, for example because wages are lower outside of harvest seasons (Guardado and Pennings, 2015).<sup>14</sup>

Proposition 2 indicates that this intuition can apply to the incentives to commit violence to gain political power. While some of these examples are from groups with no stated aspiration to actually take control of the government, in section 4 we further argue that the logic applies to a wide class of political violence committed by various actors and various aims.

---

<sup>14</sup>As these examples indicate, elections are not the only times when violence could become more effective.



### 3 Elections in the Baseline Model

With this general solution in place we now examine how periodic elections change aggregate levels of violence under the assumption that violence is more effective in electoral periods. For simplicity, we begin with a stark comparison between patterns of violence in a society with *no* elections versus one with periodic elections. We then turn to the question of how making elections more consequential and other more fine-grained changes affect patterns and aggregate levels of political violence.

#### A Simple Example

Suppose in a society without elections, the effectiveness of violence is  $k_t = k_n$  for all periods. In a society with elections, the effectiveness of violence is  $k_e > k_n$  in electoral periods and  $k_n$  for other periods.

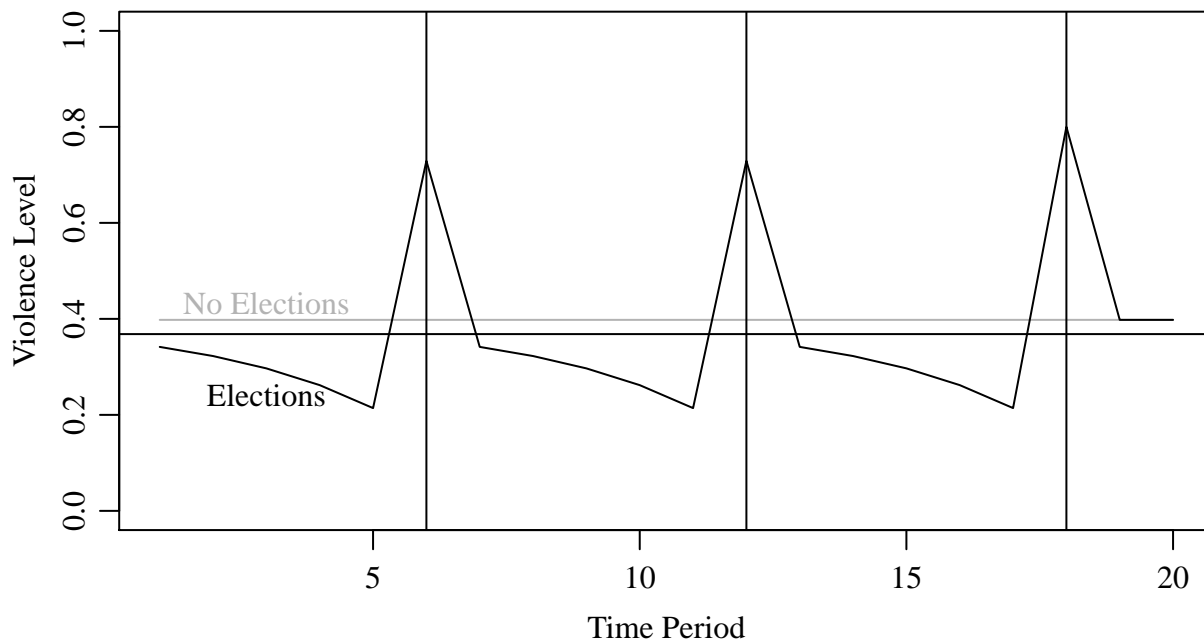
A simple microfoundation for this assumption is that the opposition can commit “non-electoral” violence in any period, but electoral violence is only possible (or only useful) in electoral periods. So, in electoral periods, the opposition – and, as formalized in section 4, other actors – have multiple ways to influence political outcomes with violence during elections. While electoral violence can look much different than other forms of violence, for our purposes adding a new violent technology during elections is equivalent to assuming that violence is more effective in electoral periods (see the appendix for a formal statement of this point). More broadly, we make this seemingly unusual assumption because our primary goal is to show how elections can reduce violence even if fighting peaks around elections. So this assumption constitutes a “hard case” for our aims.<sup>15</sup>

As demonstrated by proposition 2, introducing elections has a direct effect of increasing the level of violence in electoral periods but also an indirect effect of decreasing violence in the periods before elections, and potentially all non-electoral periods. To show that either effect can be larger,

---

<sup>15</sup>In terms of arguing whether elections are “good” or not, we are also setting aside other positive benefits of democracy such as giving citizens a voice in how they are governed.

Figure 3: Comparison of levels of violence with no elections (grey line) and elections (black line).



we present several illustrative cases. For all of these examples,  $c(v_t) = -v_t^2$  and  $p(v_t; k_t) = k_t(1 - (1 + v_t)^{-1})$ .

Figure 3 presents a comparison of violence levels in two societies that only vary in the presence of elections. In both societies, there are 20 periods, and the effectiveness of violence in non-electoral periods is  $k_n = 0.3$ . Without elections (the grey line), all periods are non-electoral, and the equilibrium violence choice is constant.<sup>16</sup> In the second society (black curve), there are elections in periods 6 and 12, and 18 (the vertical lines), where the effectiveness of violence increases to  $k_e = 1$ . The horizontal black line the average violence level with elections.

The black curve presents a similar (if tidier) pattern as shown in the cases of Kenya and Ghana in figure 1 with spikes in levels of violence in electoral periods (or years). While we can not directly know what the counterfactual level of violence would be without elections using observational

<sup>16</sup>The requires setting the continuation values at the end of the game such that the different between the expected payoff for entering each period in each role is stationary, see the appendix.

data, with the theoretical model we can make this comparison by looking at violence levels with in an otherwise identical society with no elections. In this case, the black line is below the grey line, indicating that the spikes of in electoral periods are more than offset by the decrease in violence in non-electoral periods, leading to less fighting on average.<sup>17</sup> This example illustrates the first main result of the paper in a simple fashion: the clumping of violence around elections does not imply societies would become more peaceful without elections.<sup>18</sup>

Next, we consider how general this example is by examining how changing various parameters of the model affects patterns and aggregate levels of violence. Unfortunately, analytic results on this relationship in the baseline model prove very difficult (stronger results along these lines emerge in the model with non-violent actions in the next section). However, it is straightforward to simulate the model for a wide range of parameters and functional forms for the  $c$  and  $p$  functions to explore how this affects average levels of violence. The appendix contains an extensive analysis of how changing individual parameters affects violence levels for randomly drawn values of the other parameters. In the main text we focus on several results from this exercise that are of substantive interest and are generally robust to varying other parameters.

### **Consequential/Competitive Elections**

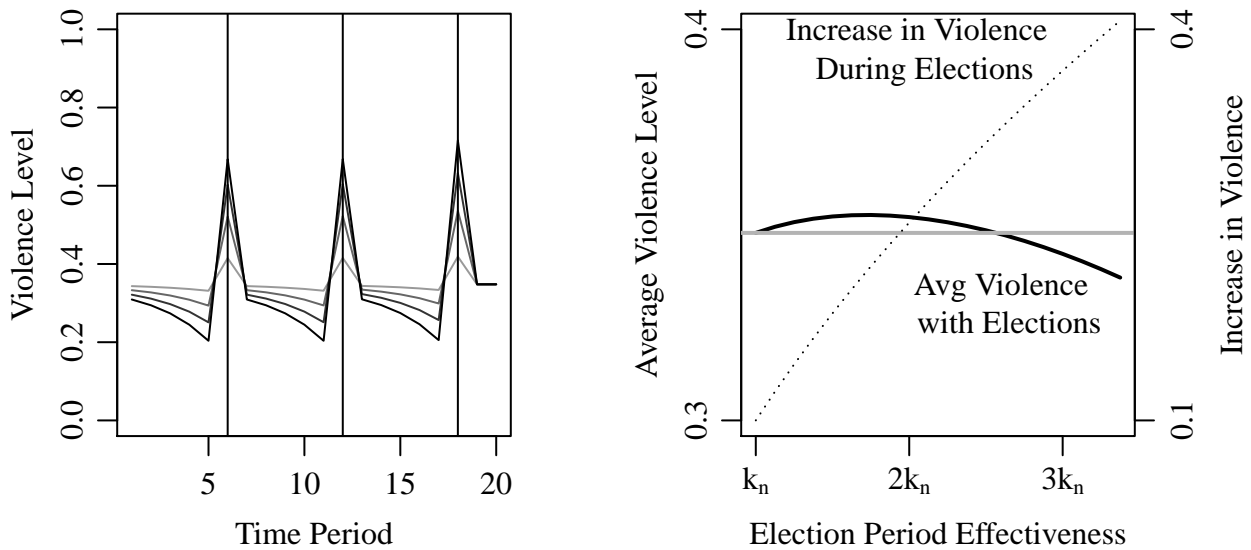
First, figure 4 shows a counterintuitive and empirically relevant example of how the degree to which violence is more effective during elections affects the average level of violence. The

---

<sup>17</sup>A subtle difference between the pattern of violence from the theoretical model and the empirical evidence is that in figure 3 violence is decreasing throughout the non-electoral period, reaching it's lowest points right before the electoral periods. This is because the violence-detering effect of future elections is strongest when the election is near. That is, there is less incentive to wait for the election when it is far away. However, this disconnect is not inherent to the model itself, but to the fact that electoral violence is only available in the electoral period itself, while some electoral violence occurs in the months leading up to the election. As shown in the appendix, when assuming that violence is also somewhat more effective in the period before the election, a more smoothly cyclical pattern of violence arises.

<sup>18</sup>We always use the average level of violence as our metric of how peaceful society is. This is the natural statistic when thinking about levels of violence as measuring things like the number of people killed. However, it is possible that higher volatility in violence is itself bad. This could be formalized by specifying a society welfare function that sums up some convex function of the period violence choices. In general this will make elections less beneficial from a welfare perspctive, though in the model with substitution elections can lead to less violence in every period.

Figure 4: The effect of making elections more consequential on average levels of violence.



left panel illustrates the per period violence levels with increasingly dark lines as  $k_e$  increases. Increasing the effectiveness of violence in the electoral periods leads to bigger spikes of violence during the election, but also larger decreases in violence in non-electoral periods.

The right panel shows how this affects the average levels of violence (solid line) and the difference between the average level of violence in electoral periods versus non-electoral periods (dotted line). While making violence slightly more effective in electoral periods increases the average amount of violence, making violence much more effective leads to less violence overall. However, increasing the effectiveness of violence unambiguously increases the difference between violence levels in electoral versus non-electoral periods. So, for part of the parameter space, making electoral period violence more effective leads to bigger spikes of violence in electoral periods but less violence overall.

While this effect is just from one set of simulations (again, see the appendix for an illustration of how this relationship changes for random draws of the other parameters) and the changes in the average violence level are not large, this illustration has important empirical and policy conse-

quences. First, it is interesting in light of empirical findings that competitive elections outside of consolidated democracies tend to be particularly violent (Straus and Taylor, 2012; Hafner-Burton, Hyde and Jablonski, 2014), as well as the sharper spike of violence in elections where the chief executive is at stake shown in figure 2.

Elections with higher stakes can be directly interpreted as ones where  $k_e$  is higher.<sup>19</sup> Connecting the competitiveness of elections to this parameter is less straightforward. However, when elections are close there can be a higher marginal return to any political activity that will lead to more votes, including violence.<sup>20</sup> So, in that sense, we might expect competitive elections are ones where the marginal returns to violence are high, which is precisely what we mean by  $k_e$  being high. Under this interpretation, it is the competitiveness of the election that depresses violence before the election: there is less of an incentive to commit violence today if the opposition has a real chance to take office in an upcoming election.

On the policy end, given nearly every country holds some kind of election and few argue they should be abolished entirely, the comparison between more or less consequential elections may be more relevant than the contrast between elections and no elections at all. Interestingly, this simulation suggests that to reap the benefits of elections in terms of peace it may not be enough to have elections that are only slightly consequential. Conversely, this example raises the possibility that making elections less consequential will lead to smaller spikes in violence during elections but also more violence overall.

## Other Simulations

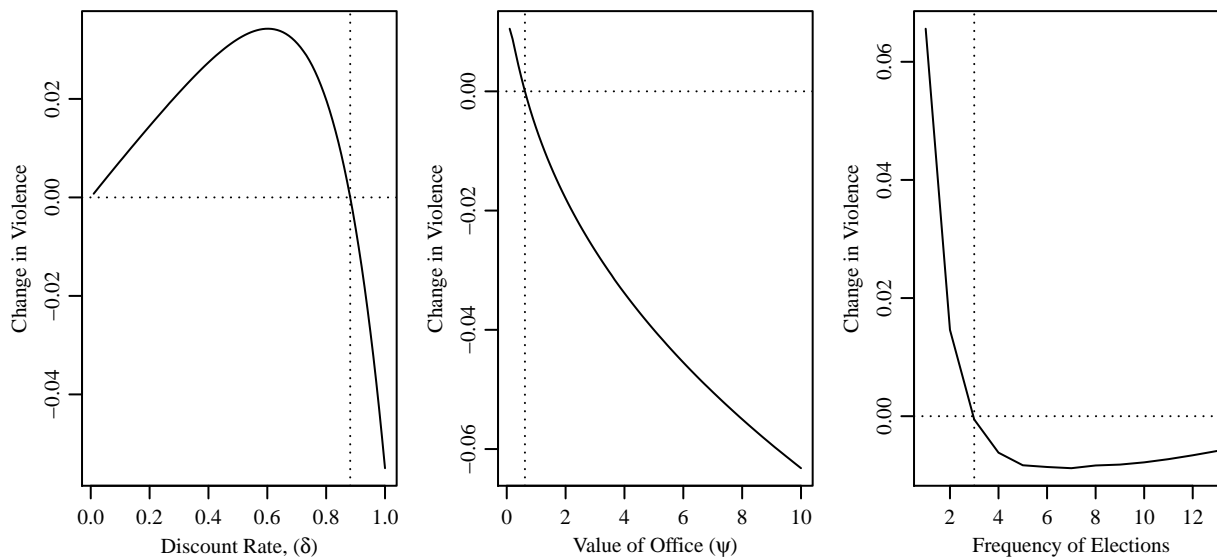
Figure 5 shows how changing several other parameters affects the difference in average levels of violence with and without elections. The left panel examines the effect of the discount rate.

---

<sup>19</sup>See Durant and Weintraub (2014) for a discussion on how to reduce the stakes in post-conflict elections.

<sup>20</sup>For example, if a party only cares about winning the majority of votes, and their vote share is equal to a normally distributed variable with mean  $m$  and standard deviation  $\sigma$  plus some costly action  $a$ , then the marginal return to  $a$  is  $\frac{\partial}{\partial a}[\Phi((a + m - .5)/\sigma)] = \sigma^{-1}\phi((a + m - .5)/\sigma)$  where  $\Phi$  and  $\phi$  are the CDF and PDF of a standardized normal random variable. For the first marginal unit of  $a$ , this is maximized at  $m = .5$ , i.e., a perfectly competitive election.

Figure 5: Comparative statics on change in violence with elections by the discount rate (left panel), value of office (middle panel), and frequency of elections (right panel)



Changing  $\delta$  has a non-monotone effect. When the parties are extremely impatient ( $\delta \rightarrow 0$ ) the optimal violence choice is always zero since the benefits of taking over office do not accrue right away. So if parties are completely impatient, there is no violence at all regardless of whether elections are held (or any other parameters). For moderate levels of patience there can be more violence with elections, and the parties are patient enough to get a benefit from using violence but not patient enough for the prospect of future elections to outweigh the direct effect. When  $\delta$  gets large, the indirect effect becomes stronger and elections lead to less violence overall.<sup>21</sup> For this particular parameterization, a discount rate of 0.88 is where elections go from promoting to preventing violence.

The middle panel examines the value of holding office ( $\psi$ ). For this parameterization (and, as shown in the appendix, the majority but not all of our simulations), increasing  $\psi$  *always* leads to elections having a more pacifying effect. A potential explanation for this is that there will be more

<sup>21</sup>The requirement that actors be patient in order to accept peaceful allocation of power also shows up in Przeworski (1991, 2005); Przeworski, Rivero and Xi (2012).

violence in general when there are more spoils to fight over. When there is already a high level of violence in the non-electoral baseline, the marginal effect of making violence more effective in electoral periods is relatively low compared to potential to decrease violence by making it more effective in the future.

Finally, the right panel examines the frequency of elections. When elections are extremely frequent, they lead to more violence, as there is not enough time between elections for the indirect effect of making non-electoral periods more peaceful to outweigh the direct effect. When elections are very rare, they lead to slightly less violence since it takes a long time to wait until the next election, weakening the indirect effect. So, the optimal election timing is intermediate, where non-electoral periods are short enough that the indirect effect matters for the entire time between elections, but long enough that the indirect effect adds up to matter more than the direct effect.

## **4 Extensions**

Several simplifying assumptions utilized so far raise doubts about the scope conditions for the model. First, by assuming that elections only increase the effectiveness of violence, it can not demonstrate how providing non-violent means to contest for power affects the patterns we describe. Second, it allows only the opposition to commit violence, while much if not most political violence is perpetrated by the government and their agents. Third, it only captures violence committed to take over the government, while political violence often has more incremental goals. As our goal is to assess how elections affect broad patterns of political violence, it is important to check that similar results can come out of models with more realistic and general assumptions.

Fortunately, the results are robust and often even stronger when extending the model in several ways. In particular, we address these concerns with three modifications to the model that allow for non-violent political technology, multiple actors committing violence, and violence to obtain goals other than taking over office. Doing so also provides more detailed empirical insights about when

certain political actors are more or less apt to commit violence.

## **Bullets and Ballots**

A central idea in the literature on democracy is that elections allow parties to compete for power with non-violent means as a substitute to violence. Further, there are a number of empirical examples where armed groups have either delayed or renounced violence in the presence of non-violent alternatives. For example, the Irish Republican Army (IRA) agreed to give up arms in Northern Ireland in 2005 when its political arm, Sinn Fein, made inroads in Northern Ireland and in the Irish Republic (Lavery and Cowell, 2005). Similarly, the Free Aceh Movement (GAM) in Indonesia give up violence as part of an agreement that included Indonesia allowing regional political parties to participate in national elections (Simanjuntak, 2008).

To combine our argument with the canonical claim that elections reduce violence by providing an alternative means to contest for power, we first present an extension where the opposition can also use non-violent actions. In short, we find that this leads to a substitution away from violence that can make society substantially more peaceful even though there is still cycle of violence around elections.

To formalize this, suppose that in an electoral period, the opposition party can also choose to take nonviolent actions to increase their probability of becoming the incumbent following the election. Let  $x_t$  represent the amount of non-violent activity in period  $t$ , which could represent campaigning, mobilizing voters on election day, or other less desirable but non-violent tactics like vote-buying. Let the probability of taking office in an electoral period be  $p(x_t + v_t; k_t)$  with the same functional form assumptions as above.<sup>22</sup> So, now the  $k_t$  parameter reflects the increased effectiveness of political activity in general. To simplify the analysis, we assume that nonviolent political action is not available or ineffective in non-electoral periods.

---

<sup>22</sup>That is,  $p$  is increasing and concave in its first argument, and the cross partial with respect to the two arguments is positive.



In addition to the cost  $c(v_t)$  paid to take violent actions, the opposition also pays a partial cost  $c(x_t)/\beta$  for the nonviolent actions, for some  $\beta > 0$ . So,  $\beta$  reflects the relative cost of violent political activity: when  $\beta > 1$  violent activity is more efficient and when  $\beta < 1$  nonviolent action is more efficient.<sup>23</sup>

Our solution concept (formalized in the appendix) is analogous to the main model, except now the joint choice of violent and non-violent action must be sequentially rational. Following standard optimization procedures, the first order condition for the opposition's choice in period  $t$  is now the  $(v_t, x_t)$  that jointly solve

$$\frac{\partial p(x_t + v_t; k_t)}{\partial v_t} \delta \Delta_{t+1}^* = c'(v_t) \quad (7)$$

$$\frac{\partial p(x_t + v_t; k_t)}{\partial x_t} \delta \Delta_{t+1}^* = c'(x_t)/\beta \quad (8)$$

where  $\Delta_{t+1}^*$  is again the difference between the net present value of entering period  $t + 1$  as the incumbent versus opposition. This implies  $c'(v_t^*) = c'(x_t^*)/\beta$ , which by the convexity of  $c$  ensures a unique pair  $(x_t^*, v_t^*)$  meeting these conditions. So, by an identical argument to the baseline model, there is a unique equilibrium level of violence and non-violent activity  $(v_t^*, x_t^*)$  in each period characterized by equations 7-8 when  $\Delta_t^* > 0$  and  $v_t^* = x_t^* = 0$  when  $\Delta_t^* < 0$ .

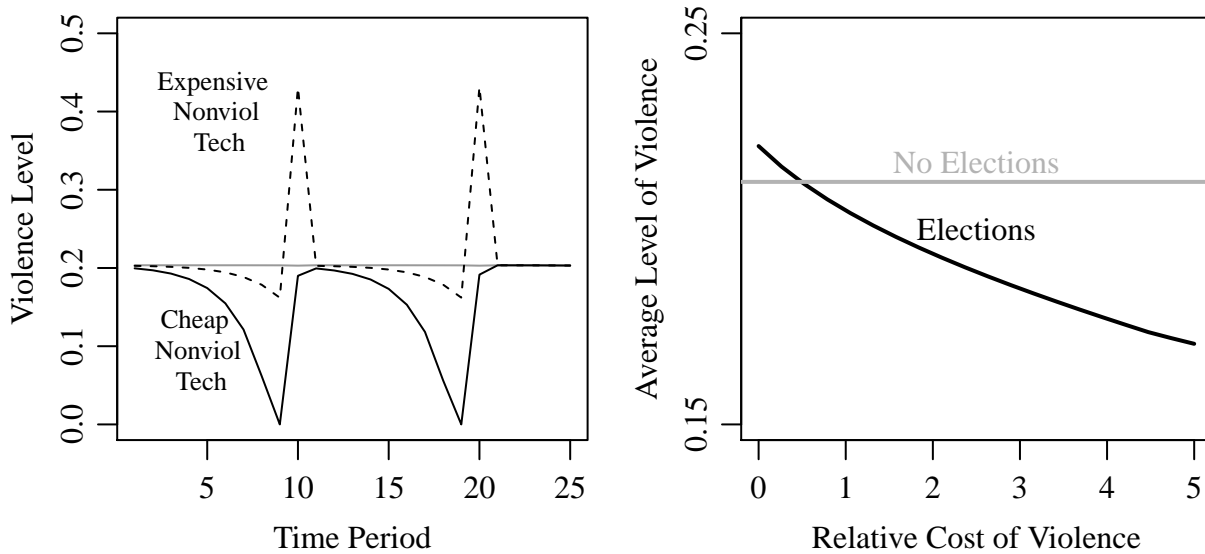
Figure 6 illustrates the impact of nonviolent activity on how much violence is chosen in equilibrium, with  $c(v_t) = -v_t^2$  and  $p(v_t + x_t; k_t) = k_t(1 - (1 + v_t + x_t)^{-1})$ . As before, the flat line in the left panel is the level of violence with no elections. The dotted curve represents the level of violence chosen where non-violent technology is very expensive, and the spike in violence during the election is large relative to the dip in violence in no-electoral periods, resulting in more violence on average with elections despite some substitution to non-violent activity.

In the solid curve, the non-violent technology is cheaper (high  $\beta$ ), leading to a stronger substitution away from using violence during electoral periods. The availability of effective non-violent

---

<sup>23</sup>This parameter could also reflect how easy it is to attain political power through normal institutional channels.

Figure 6: The effect of introducing nonviolent technologies on the level of violence.



technology also augments the intertemporal effects of the baseline model, as there is less reason to commit violence when it is possible to contest for power peacefully in future electoral periods. As a result, the level of violence is not only lower on average, but lower in *every* period than it would be without elections. The substitution effect is so large that violence peaks after the election, when (1) the non-violent technology is not available, but (2) the next election is far enough away that it is worth committing violence to try and take over office. This pattern matches the case of Burkina Faso in figure 1; we revisit the relationship between this example and several theoretical and empirical papers on post-election protest in the discussion. Still, the presence of elections induces a cyclical pattern of violence that, without thinking of the proper counterfactual, could erroneously lead to conclusions that elections encourage violence.

The right panel of figure 6 plots the average level of violence as a function of the relative cost of violent actions ( $\beta$ ). Unlike the previous graphs, making the nonviolent action cheaper (higher  $\beta$ ) has an unambiguous and large effect in decreasing the average levels of violence. In this parameterization, elections would lead to more violence in the absence of a nonviolent technology

( $\beta \rightarrow 0$ ), but as long as the nonviolent technology is less than twice as expensive as violence the presence of elections will decrease the average level of violence.

Formalizing these observations:

**Proposition 3.** *The model with non-violent technology has a unique equilibrium, where:*

- i. the level of violence in the last electoral period and every period before this is strictly decreasing in the relative cheapness of nonviolent technology ( $\beta$ ),*
- ii. if the average level of violence is higher with elections and no nonviolent technology (i.e., as  $\beta \rightarrow 0$ ), then there exists a  $\bar{\beta}$  such that the average level of violence is lower with elections if and only if  $\beta > \bar{\beta}$ , and*
- iii. There exists a  $\bar{\bar{\beta}}$  such that if  $\beta > \bar{\bar{\beta}}$  then there is less violence in every period when there are elections.*

**Proof** See the appendix.

### Incumbent and Opposition Violence

Next we analyze a case where both the incumbent and opposition can commit violence. In this section, we assume the probability that the opposition becomes the incumbent in period  $t + 1$  as a function of their violence choice (now  $v_{O,t}$ ) and the incumbent violence choice ( $v_{I,t}$ ) is:

$$p(v_{O,t}, v_{I,t}; k_t) = \begin{cases} k_t \frac{v_{O,t}}{v_{O,t} + v_{I,t}} & v_{O,t} + v_{I,t} > 0 \\ p_0 & v_{O,t} + v_{I,t} = 0 \end{cases}$$

for some  $k_t \in [0, 1]$  and  $p_0 \in (0, 1)$ . (The  $v_{O,t} + v_{I,t} = 0$  case is to avoid division by zero, and the exact value of  $p_0$  has no impact on the analysis). This functional form meets all of the assumptions with respect to  $v_{O,t}$  and  $k_t$  in the baseline model as long as  $v_{I,t} > 0$  (which will always be true in equilibrium).

Let the opposition cost for committing violence level  $v_{O,t}$  be exactly  $v_{O,t}$ , and let the cost of committing violence for the incumbent be  $\gamma v_{I,t}$  for some  $0 < \gamma < 1$ . That is, we assume that violence is “cheaper” for the incumbent, or, equivalently, the incumbent gets a higher return to violence.<sup>24</sup>

The rents for being the incumbent are again  $\psi$ . So, actor  $J$ 's net present value of committing violence level  $v_{J,t}$  in period  $t$  (given the future violence choices) is:

$$\pi_O(t, v_{O,t}; v_{I,t}) = -v_{O,t} + \delta(p(v_{O,t}, v_{I,t}; k_t)\pi_I^*(t+1) + (1 - p(v_{O,t}, v_{I,t}; k_t))\pi_O^*(t+1))$$

$$\pi_I(t, v_{O,t}; v_{I,t}) = \psi - \gamma v_{I,t} + \delta(p(v_{O,t}, v_{I,t}; k_t)\pi_O^*(t+1) + (1 - p(v_{O,t}, v_{I,t}; k_t))\pi_I^*(t+1)).$$

Our solution concept now requires that the violence choices are mutual best responses given future violence choices (see the appendix for a formal statement) By a standard analysis, whenever  $\pi_I^*(t+1) > \pi_O^*(t+1)$  the equilibrium violence choices are given by:

$$v_{O,t}^* = \frac{k_t \delta (\pi_I^*(t+1) - \pi_O^*(t+1))}{(1 + \gamma^{-1})^2} \quad (9)$$

$$v_{I,t}^* = \frac{\gamma^{-1} k_t \delta (\pi_I^*(t+1) - \pi_O^*(t+1))}{(1 + \gamma^{-1})^2} \quad (10)$$

and if  $\pi_I^*(t+1) < \pi_O^*(t+1)$  both actors choose no violence (see the appendix for detail). Since  $\pi_I^*(T+1) > \pi_O^*(T+1)$ , the level of violence chosen in the last period is positive for both actors:  $v_{J,T}^* > 0$ .

It immediately follows from equations 9-10 that the level of violence chosen by both actors in period  $t$  (when strictly positive) is increasing in the effectiveness in period  $t$ . Further, since  $\gamma < 1$ , the incumbent always chooses more violence than the opposition, and hence always remains the incumbent with a probability greater than 1/2. As  $\gamma \rightarrow 0$ , the incumbent commits far more

---

<sup>24</sup>Some of the results require more caveats analogous to those in part iii proposition 2 without this assumption. In this section the cost function is not convex (and  $c'(0) > 0$ ) as this is not necessary to ensure interior solutions when both actors choose violence.

violence than the incumbent, indicating this extension can capture cases where the vast majority is committed by government forces.

Using these violence levels to compute the net present value for entering period  $t$  as each party, the difference between these payoffs is:

$$\Delta_t^* = \pi_I^*(t) - \pi_O^*(t) = \psi + \delta \left( 1 - 2 \frac{k_t}{1 + \gamma^{-1}} \right) \Delta_{t+1}^* \quad (11)$$

Since  $\gamma < 1$ , whenever  $\Delta_{t+1}^*$  is positive  $\Delta_t^*$  is positive as well, so by induction  $\Delta_t^*$  is positive for all  $t$  and hence both actors choose a strictly positive level of violence in each period. Further,  $\Delta_t^*$  is decreasing in  $k_t$ : when violence is more effective in period  $t$ , the difference between entering this period as the incumbent versus opposition decreases. So, there will be less violence committed in period  $t - 1$  as  $k_t$  increases.

The same inductive argument then implies that  $\Delta_{t-1}^*$  is decreasing in  $k_t$ , as is  $\Delta_{t'}^*$  for any  $t' < t$ , and hence  $v_{J,t-1}^*$  is decreasing in  $k_t$  for both  $J = I$  and  $J = O$ . Combined with the fact that the violence levels in period  $t$  are increasing in  $k_t$ :

**Proposition 4.** *In the two actor model, the level of violence committed by both actors in period  $t$  is increasing in  $k_t$  and decreasing in  $k_{t'}$  for all  $t > t'$*

**Proof** See the appendix

The intuition for the opposition violence choice is similar to the main model: if violence will be more effective in the future (e.g., because of an election), the opposition invests less in violence anticipating it will be more effective later. The fact that violence will be more effective in the future also leads the incumbent to choose less, as even if they are ousted they will have an opportunity to take power back during the election.

Another intuition for the incumbent violence choice is that they are reacting to anticipated violence choices by the opposition, and increasing the violence choice by the opposition gives the

incumbent an incentive to commit more violence to counteract this. Formally, the marginal benefit for the incumbent violence choice is increasing in  $v_{O,t}$  as long as  $v_{O,t} < v_{I,t}$ , which is always true in equilibrium. That is, making violence more effective for the opposition during elections can lead to more incumbent violence. During elections, this can lead to a spiral effect where the incumbent reacts to opposition violence with even more of their own. However, there is a similar but peaceful spiral effect in non-electoral periods: since the opposition would rather wait to use violence, the government has less reason to repress them.

### Continuous Policy Outcomes

Finally, a drawback of the models so far is that they only consider violence committed to take control of the government, while much political violence has more incremental goals. To show that the logic of our model applies to this more general class of political violence, we briefly present a variant of the model where a single political actor chooses a level of violence to affect a continuous policy outcome. Unlike before, there is only one actor and no “incumbency”; i.e., the same actor chooses a violence level in each period to influence the policy in their preferred direction.

Formally, the actor chooses violence level  $v_t$  in each of  $T > 1$  periods. The policy in period  $t + 1$  is:

$$y_{t+1} = (1 - k_t)y_t + k_tv_t$$

where  $k_t \in [0, 1]$ . That is, the policy in each period is a weighted average of the past policy and the efforts of the political actor. When  $k_t$  is higher, violence will be more effective in period  $t$ , or, equivalently, the status quo is “less sticky”. The period utility as a function of the policy and violence choice is:

$$u_t = y_t - cv_t^2$$

and the payoff for the entire game is:

$$\sum_{i=1}^T \delta^{i-1} u_i + a \delta^T y_{T+1}$$

where  $a > 0$  represents the relative importance of the policy at the end of the game.

The main insight from this model is that violence committed in period  $t$  increases the policy in every future period. However, the impact on periods beyond the next one is diminished by the fact that future policies are also shaped by future violence choices. In particular, a marginal increase in violence in period  $t$  increases  $y_{t+1}$  by  $k_t$ ,  $y_{t+2}$  by  $k_t(1 - k_{t+1})$ , and for any  $\tau > t + 1$ ,  $y_\tau$  by  $k_t \prod_{i=t+1}^{\tau-1} (1 - k_i)$ . So, the total return to violence today is increasing in  $k_t$  and decreasing in the effectiveness of violence in every future period:

**Proposition 5.** *In the continuous policy model, the amount of violence committed in period  $t$  is:*

*i) increasing in  $k_t$ ,*

*ii) decreasing in  $k_{t'}$  for all  $t' > t$ .*

In addition to demonstrating that the results in the baseline model extend to “policies” other than who controls the government, this model provides an alternative intuition for why elections may reduce violence overall. When committing violence today, political actors are not just attempting to change the status quo for the “next period”, whether that be a day, year, or electoral cycle. Since policy tends to be sticky, the marginal benefit to violence today is a discounted sum of how violence today affects policy for every future period. The effective discount rate for the future is not just a function of patience, but whether whatever political gains made today could be reversed in the future. So, if elections increase the chance that any political gains may be reversed, there is less reason to commit violence in non-electoral periods.

## 5 Discussion

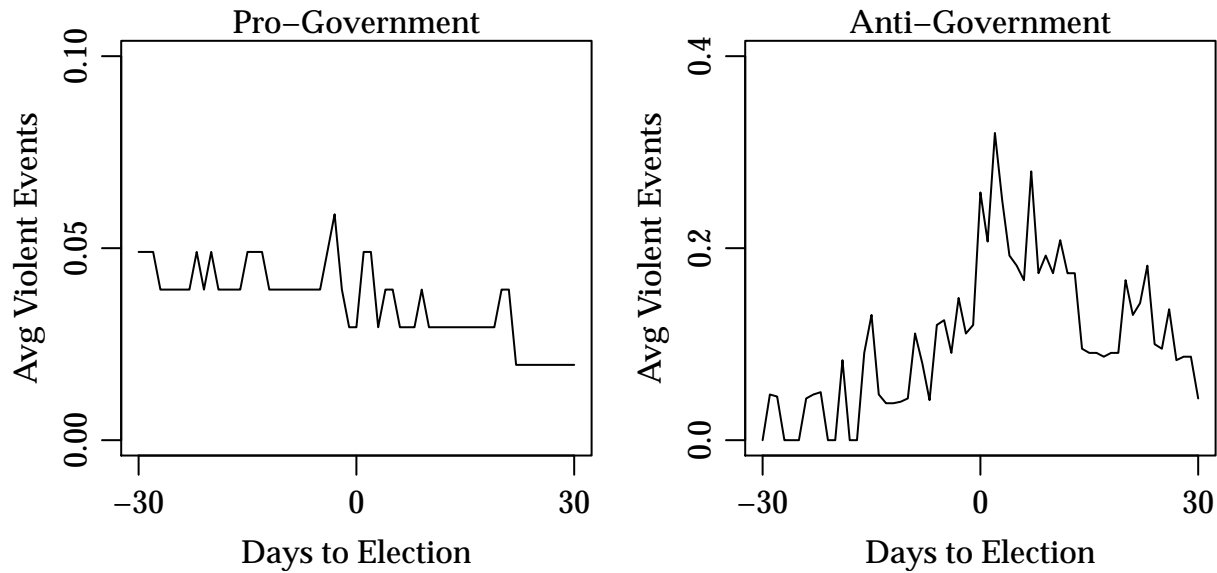
The central conclusion from all of the models is that comparisons between levels of violence in electoral versus non-electoral periods using observational data can lead to misleading conclusions about the efficacy of elections for reducing overall amount of violence in society. Put another way, that elections are violent is theoretically consistent with the general result that societies with more meaningful elections generally have lower levels of conflict (Poe and Tate, 1994; Gleditsch and Ruggeri, 2010; Hegre et al., 2001; Cheibub and Hays, 2016).

More specifically, the models also provide insight into several recent empirical studies of when certain types of elections in certain contexts are particularly violent. First, several recent studies examine the prevalence of post-election protests (Rozenas, 2012; Daxecker, 2012; Hyde and Marinov, 2014), and Straus and Taylor (2012) find that in Africa most violence is perpetrated by regimes, but the relative share of violence perpetrated by opposition groups is higher after elections. Figure 7 shows this differential pattern from the SCAD data used before for pro-government and anti-government violence. While pro-government violence tends to be higher leading up to and during election day, anti-government violence is highest just after the election. (Of course the regime may respond to these protests with violence of their own, see e.g., Arriola 2014)

Most theorizing about post-election protest is backward looking, in the sense that groups are motivated to protest the process or outcome of the election (Daxecker, 2012; Rozenas, 2012; Hyde and Marinov, 2014). This idea can be incorporated in our model by interpreting the time immediately after the voting as part of the electoral period, and post-election protest contributing to violence being more effective in electoral periods. Our approach also highlights a more nuanced and forward looking explanation for why opposition groups turn to violence after elections. While (violently) protesting the election outcome may look quite different than the kinds of violence used before elections or when there are no consequential elections, it can still be classified by violence used with the ultimate goal of affecting political outcomes.



Figure 7: Patterns of Pro- and Anti-Government Violence Around Elections.



So, violence is particularly attractive to electoral losers in times just after defeat for several reasons. First, if parties are more apt to use violence when the status quo is unfavorable, parties losing elections will have more to gain by turning to violence. Second, as demonstrated in the extension with substitution, violence can peak after elections because this is a time when non-violent political activity is relatively ineffective (compared to electoral periods) and it is the time when the opposition has the longest to wait until non-violent technologies become available (and violent actions more effective) at the next election. That is, when a party has to wait a long time to affect policy via elections they are more apt to turn to violence to affect the status quo in the short term.

Our argument also provides insight into studies about what institutional contexts are most prone to spikes of violence around elections. Aksoy (2014) finds that terrorism in democracies tends to cluster around elections in systems with lower “electoral permissiveness”, meaning it is harder for small parties to have a formal role in politics. This can be interpreted in light of the model with violent and non-violent technology. If low electoral permissiveness means that non-violent technologies are not effective, marginalized groups resort to violence during the election as that is

their only choice and the most effective time to do so.

What does our model have to say in terms of novel predictions for future empirical work? We view the generality and small number of parameters in the model as a feature which provides confidence that the core of our argument holds across many political settings. However, this also means there are few comparative static predictions about how different institutions or other political and economic variables affect how much violence will be used during elections or the difference between violence levels in electoral versus non-electoral periods. So, one way to push the literature forward both theoretically and then empirically would be to write models that combine the forces we introduce here with political institutions to generate comparative static predictions on variables which we could map to data.

Perhaps more importantly, future empirical work could aim to examine our more general contention that the ability to attain political goals during elections, whether with violence (parts ii-iii of proposition 2) or other nonviolent tactics (part i of proposition 3) makes politics more peaceful in non-electoral periods. Isolating variables that only change the effectiveness in electoral periods (but not elsewhere) could prove difficult. One potential avenue for doing so would be to examine how (preferably exogenous) changes to expectations about how competitive future elections will be affects violence in time periods after this revelation but before the election. Another potential empirical avenue would be to examine the effect of elections in places that hold both scheduled and early elections, and analyze whether it leads to a political violence cycle similar to the available evidence on budget cycles (Khemani, 2004).

## **6 Conclusion**

Elections play an important role in democracies but they are often accompanied by violence against both candidates and voters. We have shown that the spike in conflict levels around elections does not necessarily imply that elections cause more political violence in general. When elections

are the central means to contest for political power, they may also become the most effective times to use political violence. It is precisely the expectation of the ability to use violence effectively in a future electoral period that results in relatively lower levels of violence in non-electoral periods. When elections also provide a non-violent means to contest for power, there is even less reason to commit violence both during electoral and non-electoral periods. Elections can be peaceful for two reasons: either they are not a serious means to contest for power, or they provide such an effective non-violent means to contest for power that violence is no longer a useful tool.

More generally, the model highlights cycles of any political activity surrounding elections, whether fiscal policy, repression, or special interests attempts to influence policy do not mean these activities would be more or less prevalent if elections were less consequential. When the actions spiking around elections are “bad” it is easy to associate elections with negative consequences, but concentrating the time window in which these bad actions are most effective may leave citizens better off in the long term. So, empirical work examining how elections affect patterns of any political activity must keep in mind the effects of intertemporal substitution when thinking through the broader implications of their findings.

## References

- Acemoglu, Daron and James A. Robinson. 2000. "Why Did the West Extend the Franchise? Democracy, Inequality, and Growth in Historical Perspective." *The Quarterly Journal of Economics* 115(4):1167–1199.
- Aksoy, Deniz. 2014. "Elections and the Timing of Terrorist Attacks." *The Journal of Politics* 76(4):899–913.
- Aksoy, Deniz. 2015. "Terrorist attacks are linked to the timing of elections, but only in states where it is difficult to influence the political process.". accessed 24 Sep 2015.  
**URL:** <http://blogs.lse.ac.uk/euoppblog/2015/05/19/terrorist-attacks-are-linked-to-the-timing-of-elections-but-only-in-states-where-it-is-difficult-to-influence-the-political-process/>
- Arriola, Leonardo R. 2014. "Suppressing Protests During Electoral Crises: The Geographic Logic of Mass Arrests in Ethiopia." Manuscript.
- Bates, Robert, Avner Greif and Smita Singh. 2002. "Organizing Violence." *Journal of Conflict Resolution* 46(5):599–628.
- Bates, Robert H. 2008. *When Things Fell Apart: State Failure in Late-century Africa*. Cambridge University Press.
- Bekoe, Dorina, ed. 2012. *Voting in Fear: Electoral Violence in Sub-Saharan Africa*. United States Institute of Peace.
- Boston, CBS. 2013. "Boston Bombing Suspects Originally Planned 4th Of July Attack.". accessed 28 Sep 2015.  
**URL:** <http://boston.cbslocal.com/2013/05/02/bostonbombingsuspectsoriginallyplanned4thofjulyattack/>
- Brancati, Dawn and Jack L Snyder. 2012. "Time to Kill: The Impact of Election Timing on Postconflict Stability." *Journal of Conflict Resolution* .

- Brass, Paul R. 2003. *The Production of Hindu-Muslim Violence in Contemporary India*. University of Washington Press.
- Cederman, Lars-Erik, Simon Hug and Lutz F. Krebs. 2010. "Democratization and Civil War: Empirical evidence." *Journal of Peace Research* 47(4):377–394.
- Chaturvedi, Ashish. 2005. "Rigging Elections with Violence." *Public Choice* 125(1/2):189–202.
- Cheibub, José A. and Jude C. Hays. 2016. "Elections and Civil War in Africa." *Political Science Research and Methods* FirstView:1–22.
- Chenoweth, Erica. 2010. "Democratic Competition and Terrorist Activity." *Journal of Politics* 72(1):16–30.
- Chua, Amy. 2004. *World on fire: How exporting free market democracy breeds ethnic hatred and global instability*. Anchor.
- Collier, Paul. 2009. *Wars, Guns, and Votes: Democracy in Dangerous Places*. Harper Perennial.
- Collier, Paul and Anke Hoeffler. 2004. "Greed and Grievance in Civil War." *Oxford Economic Papers* 56(4):563+.
- Collier, Paul and Pedro C Vicente. 2012. "Violence, Bribery, and Fraud: The Political Economy of Elections in Sub-Saharan Africa." *Public Choice* 153(1-2):117–147.
- Cox, Gary W. 2009. "Authoritarian Elections and Leadership Succession, 1975-2004." Manuscript.
- Davenport, Christian. 1997. "From Ballots to Bullets: An Empirical Assessment of how National Elections Influence State Uses of Political Repression." *Electoral Studies* 16(4):517–540.
- Davenport, Christian and David A. Armstrong. 2004. "Democracy and the Violation of Human Rights: A Statistical Analysis from 1976 to 1996." *American Journal of Political Science* 48(3):538–554.

- Daxecker, Ursula E. 2012. "The Cost of Exposing Cheating International Election Monitoring, Fraud, and Post-election Violence in Africa." *Journal of Peace Research* 49(4):503–516.
- Dunning, Thad. 2011. "Fighting and Voting: Violent Conflict and Electoral Politics." *Journal of Conflict Resolution* 55(3):327–339.
- Durant, Clark and Michael Weintraub. 2014. "How to Make Democracy Self-enforcing after Civil War: Enabling Credible yet Adaptable Elite Pacts." *Conflict Management and Peace Science* 31(5):521–540.
- Economist. 2013. "An Old Curse Returns." accessed 13 October 2013.
- Ellman, Matthew and Leonard Wantchekon. 2000. "Electoral Competition under the Threat of Political Unrest." *The Quarterly Journal of Economics* 115(2):499–531.
- Fearon, James D. 2011. "Self-Enforcing Democracy." *Quarterly Journal of Economics* 126(4).
- Fearon, James D. and David D. Laitin. 2003. "Ethnicity, Insurgency, and Civil War." *The American Political Science Review* 97(1):75–90.
- Flores, Thomas Edward and Irfan Nooruddin. 2012. "The Effect of Elections on Postconflict Peace and Reconstruction." *The Journal of Politics* 1(1):1–13.
- Gleditsch, Kristian Skrede and Andrea Ruggeri. 2010. "Political Opportunity Structures, Democracy, and Civil War." *Journal of Peace Research* 47(3):299–310.
- Goldsmith, Arthur A. 2014. "Electoral Violence in Africa Revisited." *Terrorism and Political Violence* 27(5):818–837.
- Guardado, Jenny and Steven Pennings. 2015. "The Seasonality of Conflict." *Working Paper* .
- Hafner-Burton, Emilie M., Susan D. Hyde and Ryan S. Jablonski. 2014. "When Governments use Election Violence to Stay in Power." *British Journal of Political Science* 44(1):149–179.

- Hafner-Burton, Emilie M., Susan D. Hyde and Ryan S. Jablonski. 2015. "Surviving Elections: Election Violence, Incumbent Victory, and Post-Election Repercussions." *Working Paper* .
- Hegre, Håvard and Nicholas Sambanis. 2006. "Sensitivity Analysis of Empirical Results on Civil War Onset." *Journal of Conflict Resolution* pp. 508–535.
- Hegre, Håvard, Tanja Ellingsen, Scott Gates and Nils P. Gleditsch. 2001. "Toward a Democratic Civil Peace? Democracy, Political Change, and Civil War, 1816-1992." *The American Political Science Review* 95(1):33–48.
- Hendrix, Cullen S. and Idean Salehyan. 2015. "Social Conflict in Africa Database (SCAD)". accessed on 1 Jan 2015.  
**URL:** <http://www.scadata.org>
- Hudson, John. 2013. "How jihadists schedule terrorist attacks.". accessed 28 Sep 2015.  
**URL:** <http://foreignpolicy.com/2013/05/03/howjihadistsscheduleterroristattacks/>
- Hyde, Susan D. and Nikolay Marinov. 2012. "Which Elections can be Lost?" *Political Analysis* 20(2):191–210.
- Hyde, Susan D and Nikolay Marinov. 2014. "Information and self-enforcing democracy: The role of international election observation." *International Organization* 68(02):329–359.
- Kasara, Kimuli. 2015. "Electoral Geography and Conflict: Examining the Redistricting through Violence in Kenya." *Working Paper* .
- Khemani, Stuti. 2004. "Political Cycles in a Developing Economy: Effect of Elections in the Indian States." *Journal of Development Economics* 73(1):125–154.
- Lavery, Brian and Alan Cowell. 2005. "I.R.A Renounces Use of Violence, Vows to Disarm.". accessed 24 Sep 2015.  
**URL:** <http://www.nytimes.com/2005/07/29/world/europe/irarenouncesuseofviolencevowstodisarm.html>

- Little, Andrew T. 2012. "Elections, Fraud, and Election Monitoring in the Shadow of Revolution." *Quarterly Journal of Political Science* 7(3):249–283.
- Little, Andrew T. and Thomas B. Pepinsky. 2016. "Simple and Formal Models in Comparative Politics." *Chinese Political Science Review* 1(3):425–447.  
**URL:** <http://dx.doi.org/10.1007/s41111-016-0032-0>
- Newman, Lindsay Shorr. 2013. "Do Terrorist Attacks Increase Closer to Elections?" *Terrorism and Political Violence* 25(1):8–28.
- Norris, Pippa, Richard W. Frank and Ferran Martinez i Coma, eds. 2015. *Contentious Elections: From Ballots to Barricades*. Routledge.
- Poe, Steven C. and C. Neal Tate. 1994. "Repression of Human Rights to Personal Integrity in the 1980s: A Global Analysis." *American Political Science Review* 88(4):853–872.
- Przeworski, Adam. 1991. *Democracy and the Market*. Cambridge University Press.
- Przeworski, Adam. 2005. "Democracy as an equilibrium." *Public Choice* 123(3-4):253–273.
- Przeworski, Adam, Gonzalo Rivero and Tianyang Xi. 2012. "Force and Elections: A General Framework for the Analysis of Political Regimes and their Dynamics." Manuscript.
- Przeworski, Adam, Susan C. Stokes and Bernard Manin, eds. 1999. *Democracy, Accountability, and Representation*. Cambridge University Press.
- Rapoport, David C and Leonard Weinberg. 2000. "Elections and Violence." *Terrorism and Political Violence* 12(3-4):15–50.
- Reilly, Benjamin. 2002. "Post-Conflict Elections: Constraints and Dangers." *International Peacekeeping* 9(2):118–139.



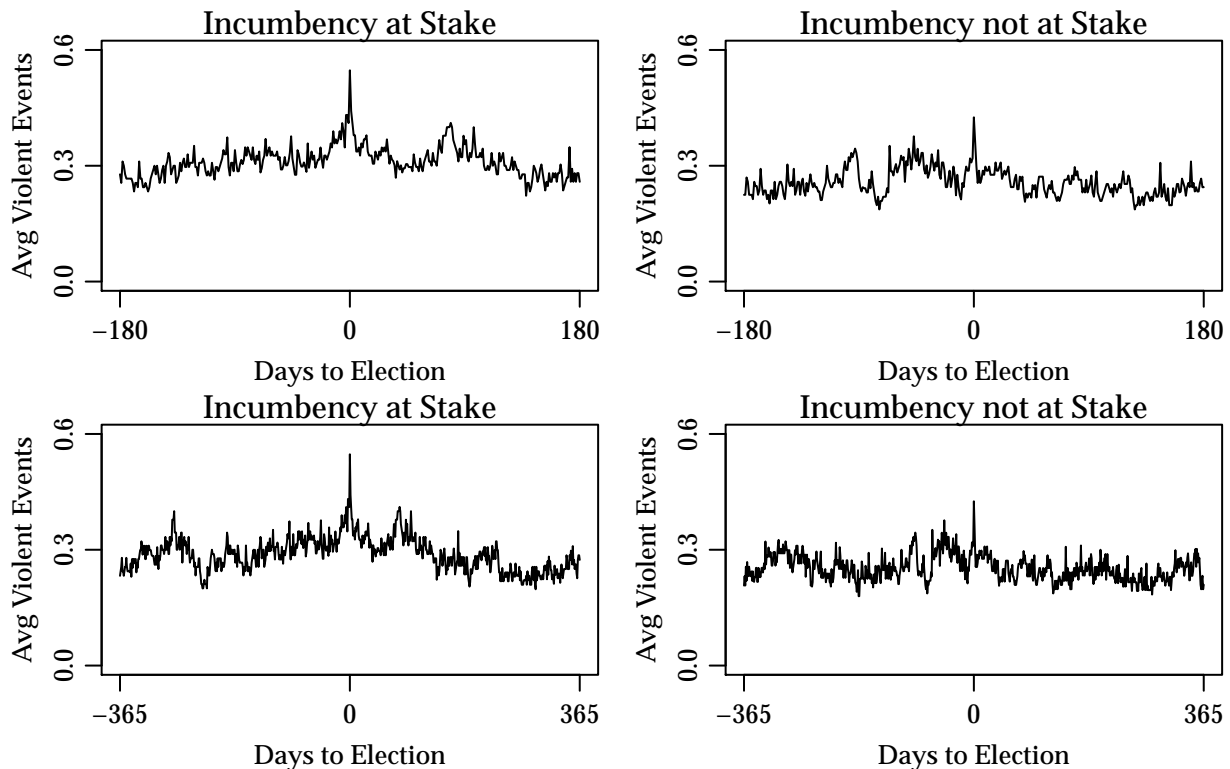
- Richburg, Keith B. 2004. "Madrid Attacks May Have Targeted Election.". accessed 24 Sep 2015.  
**URL:** <http://www.washingtonpost.com/wpdyn/articles/A388172004Oct16.html>
- Rozenas, Arturas. 2012. "The Calculus of Dissent: Rigged Elections, Information, and Post-Election Stability." Manuscript.
- Schumpeter, Joseph A. 1942. *Capitalism, Socialism, and Democracy*. New York: Harper & Row.
- Shukla, Saurabh. 2014. "Lok Sabha polls: Pakistan terrorist planning suicide attacks at election rallies.". accessed 24 Sep 2015.  
**URL:** <http://indiatoday.intoday.in/story/masood-azhar-planning-suicide-attacks-at-election-rallies/1/344288.html>
- Simanjuntak, Hotli. 2008. "Finally, Aceh local parties to take part in general election.". accessed 24 Sep 2015.  
**URL:** <http://www.thejakartapost.com/news/2008/08/18/finallyacehlocalpartiestakepartgeneralelection.html>
- Staniland, Paul. forthcoming. "Armed Groups and Militarized Elections." *International Studies Quarterly* .
- Straus, Scott and Charlie Taylor. 2012. Democratization and Electoral Violence in Sub-Saharan Africa, 1990-2008. In *Voting in Fear: Electoral Violence in Sub-Saharan Africa*, ed. Dorina Bekoe. United States Institute of Peace pp. 15–38.
- Wilkinson, Steven I. 2004. *Votes and Violence: Electoral Competition and Ethnic Riots in India*. Cambridge University Press.

## Appendix

### Data

Figure 8 shows how the patterns we identify are less stark but still clear when looking at wider time windows around elections.

Figure 8: Violence around elections for wider time windows.



We use two main data sources to examine the empirical patterns of violence around elections. Violence data is obtained from the Social Conflict in Africa Database, Version 3.0 (Hendrix and Salehyan, 2015). This dataset provides information on different types of violent events (protests, riots, strikes and other social disturbances) in Africa and Latin America from 1990-2012. The main source of these events are based on the Associated Press and *Agence France Presse* news wires,

indexed by the Lexis-Nexis news service.<sup>25</sup> Election dates and characteristics are from the National Elections Across Democracy and Autocracy (NELDA) Dataset (Hyde and Marinov, 2012). This dataset provides information on election events for all countries during the period 1945-2010.<sup>26</sup>

To generate these figures, we first reshape the SCAD data into a ‘country code - day’ unit of analysis. Second, for each country and each day we determined the distance to the nearest election using the NELDA data. For example, if the previous election in a country was 200 days ago and the next is in 201 days, the distance to election variable is -200. In the next day when the previous election was 201 days ago and the next is in 200 days, the distance variable becomes 200. Figures 2, 7, and 8 plot the average levels of violence levels by this distance to election variable, sometimes for subsets of the data identified by other characteristics.

For figure 2, we distinguish between elections when the incumbent leader’s office was in contention versus when it was not contesting the election. This was done use the variable in the NELDA dataset that captured whether the office of the incumbent leader contested in a given election.

For figure 7, distinguished between pro- and anti- government violence around elections. Pro-government violence was identified using the variable in the SCAD dataset that captures “distinct violent events waged primarily by government authorities, or by groups acting in explicit support of government authority, targeting individual, or ‘collective individual,’ members of an alleged opposition group or movement.” Anti-government violence was identified using whether the “central government the target of the event”, and whether any of the issue areas involved elections.<sup>27</sup>

---

<sup>25</sup>For more information on the search methodology and the coding procedure, see the Social Conflict in Africa Database, Version 3.0 codebook.

<sup>26</sup>For more information on what constitutes an election, see the NELDA codebook.

<sup>27</sup>For more information on these variables, see the SCAD codebook.

## Proof of proposition 1

Equation 3 has a unique solution for  $t = T$ , which gives unique values of  $\pi_O^*(T)$  and  $\pi_I^*(T)$ , which then implies the optimal  $v_{T-1}^*$  by equation 6. Further, if there is a unique  $\pi_O^*(t)$  and  $\pi_I^*(t)$ , this leads to a unique  $v_{t-1}^*$ , which is given by equation 6 and equal to zero otherwise. So, by induction there is a unique triple of sequences  $(\pi_I^*(t), \pi_O^*(t), v_t^*)$  which solve equations 2-5 for all  $t$ . ■

## Microfoundation of the Effectiveness of Violence During Elections

One way to microfound the assumption that violence is more effective during elections is to let the opposition choose two different types of violence, one of which is only effective during electoral periods. Formally, let  $v_t^n \geq 0$  be the amount of violence not related to elections chosen in each period, and  $v_t^e \geq 0$  be the amount of electoral violence. Let  $E_t = 1$  be an indicator for period  $t$  being an election period, where  $E_t = 0$  in non-electoral periods. Suppose the probability of taking office is given by  $p(v_{n,t} + E_t v_{e,t})$ , where  $p' > 0$  and  $p'' < 0$ . (We drop the  $k_t$  parameter for reasons which will become apparent.) The cost to choosing  $v_{n,t}$  is given by  $c(v_{n,t})$  as in the main model and the cost to choosing  $v_{e,t}$  is  $\beta_e^{-1} c(v_{e,t})$  for some  $\beta_e > 0$  (i.e.,  $\beta_e$  is the relative cost of electoral violence). Let  $v_t = v_{n,t} + v_{e,t}$ .

To make the connection to the baseline model more clear, it is useful to interpret the opposition action not as picking violence levels, but first deciding what cost to pay for violence and then deciding how to allocate between electoral and non-electoral violence for that cost. In non-electoral periods this is straightforward: when paying cost  $c_t$  the resulting level of violence is  $v_t(c_t) = c^{-1}(v_t)$ . So in non-electoral periods the opposition picks  $c_t$  that meets:

$$\delta \frac{\partial p(v_{n,t})}{\partial c_t} \Delta_{t+1}^* = \delta \frac{\partial p(v_{n,t})}{\partial v_t} \frac{\partial v_t}{\partial c_t} \Delta_{t+1}^* = 1 \quad (12)$$

By the assumptions placed on  $c$ , it must be the case that  $v_t'$  is continuous and decreasing with

$v'_t(0) = \infty$ , so there is a unique solution to this equation. This is also the solution to electoral periods as  $\beta_e \rightarrow 0$ . In electoral periods:

$$v_t(c_t) = \max_{v_{n,t}, v_{e,t}: c(v_{n,t}) + \beta_e^{-1} c(v_{e,t}) = c_t} v_{n,t} + v_{e,t}$$

The allocations must be at a point where the marginal return to each level of violence is equal. So the increase in the sum amount of violence with the optimal allocation as the cost paid increases is:

$$\frac{\partial v_t}{\partial c_t} = c'(v_{n,t})$$

And so:

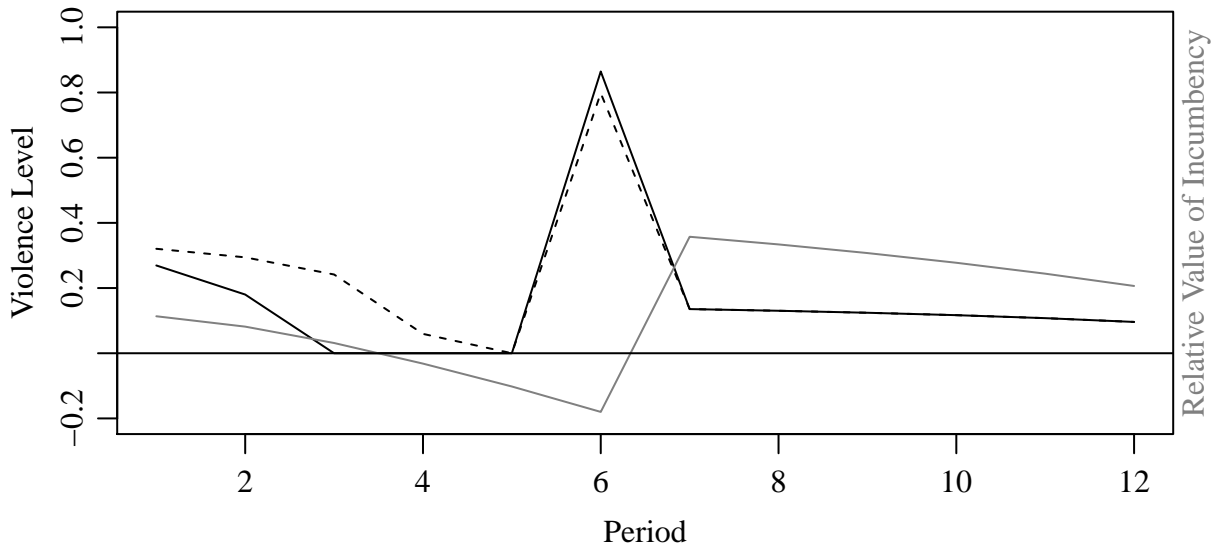
$$\frac{\partial^2 v_t}{\partial c_t \partial \beta} = c'(v_{n,t}) \frac{\partial v_{n,t}}{\partial \beta} > 0$$

This implies that  $\frac{\partial^2 p(v_{n,t})}{\partial c_t \partial \beta} > 0$ , i.e., when electoral violence becomes cheaper (or available at all) violence becomes more effective in the sense that increasing the cost paid (when choosing the optimal allocation between electoral and non-electoral violence) has a larger marginal impact on the chance of taking over the incumbency. So, introducing a new technology has the exact effect we assume of increasing the marginal effect of violence on the probability of taking over office.

### **Discussion of case where $\Delta_t^* < 0$ for some $t$**

Recall that if  $\Delta_t^* < 0$ , then there will be no violence in period  $t - 1$  as the opposition would rather remain the opposition in period  $t$ . Intuitively, this can occur if the probability of taking over the government in period  $t$  is very high but then violence becomes very ineffective. Figure 9 illustrates such a case, where violence becomes extremely effective in period 6 and is nearly ineffective for all periods after that. The solid black line plots the violence level in each period,

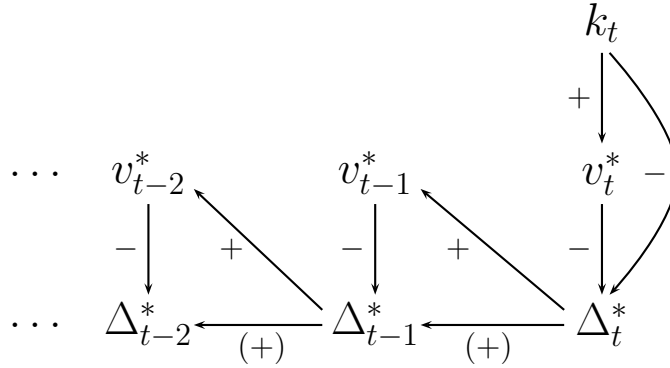
Figure 9: Example with no violence in some periods



and the grey line plots  $\Delta_t^*$ . Since  $\Delta_t^* < 0$  for periods 4-6, there is no violence in periods 3-5. However, moving back to period 3,  $\Delta_t^*$  is positive again, and there is a positive level of violence in period 2. This is because for each period with no violence the incumbent collects  $\psi$  with no chance of being removed from office. So, in effect the tradeoff in period 3 is between capturing the incumbency for two periods followed by nearly surely losing office, while in period 2 the opposition can capture the incumbency for three periods before being ousted. For these sets of parameters, it is worth committing violence in period 2 but not period 3.

The dashed line shows what happens when violence becomes slightly less effective in period 6. This has no effect on the level of violence in period 5, as the opposition would rather remain as opposition in either case. However, when violence is less effective in period 6, there is only one period where it is better to enter as opposition, and hence there is a positive violence level in period 4, and a higher level in all periods prior to period 6. So, in this case, making violence more effective in period  $t$  only *weakly* increases violence in period  $t - 1$ , as it may be zero no matter what. However, when this is the case the effect of violence on periods before  $t - 1$  appears to

Figure 10: Illustration of proposition 2



be larger than in the main examples we consider. So, it does not appear that allowing for periods where it is better to be the opposition affects the overall conclusions (and the simulations with random parameter draws allow this).

### Proof of proposition 2

Figure 10 illustrates the logic how changing  $k_t$  affects the violence choices and relative value of incumbency for periods up to  $t$ .

The most direct effect of increasing  $k_t$  is increase the level of violence in period  $t$ , which can be demonstrated by implicitly differentiating 6 with respect to  $k_t$ :

$$\frac{\partial v_t^*}{\partial k_t} = \frac{-\frac{\partial^2 p(v_t; k_t)}{\partial v_t \partial k_t} \Delta_{t+1}^*}{\frac{\partial^2 p(v_t; k_t)}{\partial^2 v_t} \Delta_{t+1}^* - c''(v_t^*)} > 0.$$

where the inequality is true because the numerator is negative the the denominator is negative at  $v_t^*$  since it is at a local maximum.

The effect of increasing  $k_t$  on  $v_{t-1}^*$  is determined by how increasing  $k_t$  affects  $\Delta_t^*$ , which in turn

affects  $v_{t-1}^*$ . Formally:

$$\frac{\partial \Delta_t^*}{k_t} = \frac{\partial \pi_I^*(t)}{k_t} - \frac{\partial \pi_O^*(t)}{k_t}$$

The effect of increasing  $k_t$  on  $\pi_I^*(t)$  is entirely through the fact that doing so increases  $p(v_t^*; k_t)$  both directly by increasing  $k_t$  and indirectly by increasing  $v_t^*$ . So:

$$\frac{\partial \pi_I^*(t)}{\partial k_t} = -\delta \Delta_{t+1}^* \frac{dp(v_t^*; k_t)}{dk_t} < 0$$

For the change in the value of entering as the opposition the analogous calculation has more terms as they incur a higher cost to commit more violence, but by the envelope theorem this effect drops out, giving:

$$\begin{aligned} \frac{\partial \pi_O^*(t)}{\partial k_t} &= -\frac{\partial v_t^*}{\partial k_t} c'(v_t^*) + \delta \Delta_{t+1}^* \frac{dp(v_t^*; k_t)}{dk_t} \\ &= -\frac{\partial v_t^*}{\partial k_t} \left( -c'(v_t^*) + \delta \Delta_{t+1}^* \frac{\partial p(v_t^*; k_t)}{\partial v_t^*} \right) + \delta \Delta_{t+1}^* \frac{\partial p(v_t^*; k_t)}{\partial k_t} \\ &= \delta \Delta_{t+1}^* \frac{\partial p(v_t^*; k_t)}{\partial k_t} > 0 \end{aligned}$$

Since  $\frac{\partial \pi_O^*(t)}{\partial k_t} > 0$  and  $\frac{\partial \pi_I^*(t)}{\partial k_t} < 0$ ,  $\frac{\partial \Delta_t^*}{k_t} < 0$ . Since there is less benefit to entering period  $t$  as the incumbent, this decreases the incentives to commit violence in period  $t - 1$ :

$$\frac{\partial v_{t-1}^*}{\partial k_t} = -\frac{\frac{\partial p(v_t; k_t)}{\partial v_t} \frac{\partial \Delta_t^*}{\partial k_t}}{\frac{\partial^2 p(v_t; k_t)}{\partial^2 v_t} \Delta_{t+1}^* - c''(v_t)} < 0$$

The effect on even earlier periods is more nuanced. As shown in figure 10, how  $k_t$  affects violence in  $t' < t - 1$ , depends on how  $k_t$  affects  $\Delta_{t'}$ , which in turn depends on how  $k_t$  affects



$\Delta_{t'+1}^*$ . This is given by

$$\frac{\partial v_{t'}^*}{\partial k_t} = -\frac{\frac{\partial p(v_{t'}; k_{t'})}{\partial v_{t'}} \frac{\partial \Delta_{t'+1}^*}{\partial k_t}}{\frac{\partial^2 p(v_t; k_t)}{\partial^2 v_t} \Delta_{t'+1}^* - c''(v_t)}$$

which has the same sign as  $\frac{\partial \Delta_{t'+1}^*}{\partial k_t}$ . To sign this, first write  $\Delta_t^*$  as:

$$\Delta_t^* = \psi - c(v_t^*) + \delta(1 - 2p(v_t^*; k_t))\Delta_{t+1}^*$$

So:

$$\begin{aligned} \frac{\partial \Delta_t^*}{\partial \Delta_{t+1}^*} &= \frac{\partial v_t^*}{\partial \Delta_{t+1}^*} c'(v_t^*) + \delta \left( (1 - 2p(v_t^*; k_t)) - 2\Delta_{t+1}^* \frac{\partial p(v_t^*; k_t)}{\partial v_t^*} \frac{\partial v_t^*}{\partial \Delta_{t+1}^*} \right) \\ &= \frac{\partial v_t^*}{\partial \Delta_{t+1}^*} \left( c'(v_t^*) - 2\Delta_{t+1}^* \frac{\partial p(v_t^*; k_t)}{\partial v_t^*} \right) + \delta(1 - 2p(v_t^*; k_t)) \\ &= -\frac{\partial v_t^*}{\partial \Delta_{t+1}^*} c'(v_t^*) + \delta(1 - 2p(v_t^*; k_t)) \end{aligned} \quad (13)$$

where the last line follows from the period  $t$  equilibrium condition (equation 6). Rearranging,

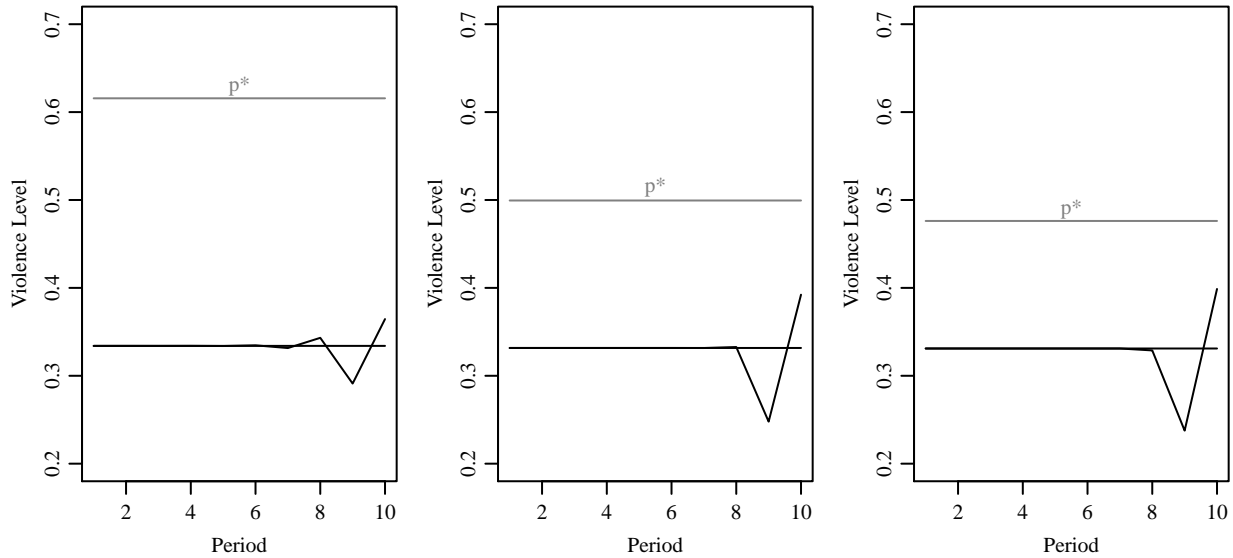
$\frac{\partial \Delta_t^*}{\partial \Delta_{t+1}^*} > 0$  if and only if:

$$\delta(1 - 2p(v_t^*; k_t)) > -\frac{\partial v_t^*}{\partial \Delta_{t+1}^*} c'(v_t^*) \quad (14)$$

From part ii we know that  $\frac{\partial \Delta_t^*}{\partial k_t} < 0$ , and if equation 14 holds for all  $t', \dots, t-1$  then  $\frac{\partial \Delta_{t-1}^*}{\partial \Delta_t^*} > 0$  each of these periods, and hence by induction  $\frac{\partial v_{t'}^*}{\partial k_t} < 0$ .

When does equation 14 hold? The left hand side of this equation is equation is positive if and only if  $p(v_t^*; k_t) < 1/2$ . Intuitively, if the opposition is likely to remain the opposition in the future, anything that increases the relative value of incumbency tomorrow also increases the relative likelihood of incumbency today. The right hand side represents the indirect effect that increasing the relative value of incumbency tomorrow leads to more violence today, which in turn

Figure 11: Examples where equation 14 does not hold.



lowers the relative value of incumbency today. In all of our simulations this indirect effect is quite small, so as long as  $p(v_t^*; k_t)$  is generally low, increasing the effectiveness of violence in period  $t$  reduces violence in *every* previous period.

The left two panels of figure 11 shows cases where condition 14 does not hold. In the left panel, the probability of the opposition taking control of the government is above 0.6, and the black curve shows the effect of making violence even more effective in the final period. Compared to the horizontal line (where the effectiveness of violence is constant), there is more violence in the last period, less in the second to last, but more in the last to last. Iterating back, the level of violence alternates between being above and below the constant effectiveness benchmark. The intuition behind this is that when the incumbency is likely to switch hands every period, making violence more effective in period 10 helps the opposition in period 8 as they expect to lose the incumbency in period 9 and regain it in period 10. Similarly, this helps the opposition in every even period.

The center panel shows this “bouncing” pattern can hold – if almost imperceptibly – when  $p^*(v_t^*, k_t)$  is at  $1/2$ , as the right-hand side of equation 14 is negative. However, as long as  $p^*(v_t^*; k_t)$

is below around .48 (right panel), making violence more effective in the last period reduces violence in every previous period. In the context of our examples with elections, as long as the probability of taking over the incumbency in non-electoral periods is not too high, increasing the effectiveness of violence in an electoral period will decrease the levels of violence for each period of the preceding non-electoral spell as long as the chance of taking office by force is not too high without an election.

### Stationary continuation values

In all of our simulations, we set the continuation value at the end of the game such that with no elections (and hence a constant  $k_t$ ) the violence level is stationary. This is found by finding the level of  $\Delta_{T+1}^*$  which makes  $\Delta_T^* = \Delta_{T+1}^*$ , which by induction means that when  $k_t$  is constant  $\Delta_t^*$  is constant and hence the level of violence is constant. Referring back to the proof of proposition 2, this is given by the solution to:

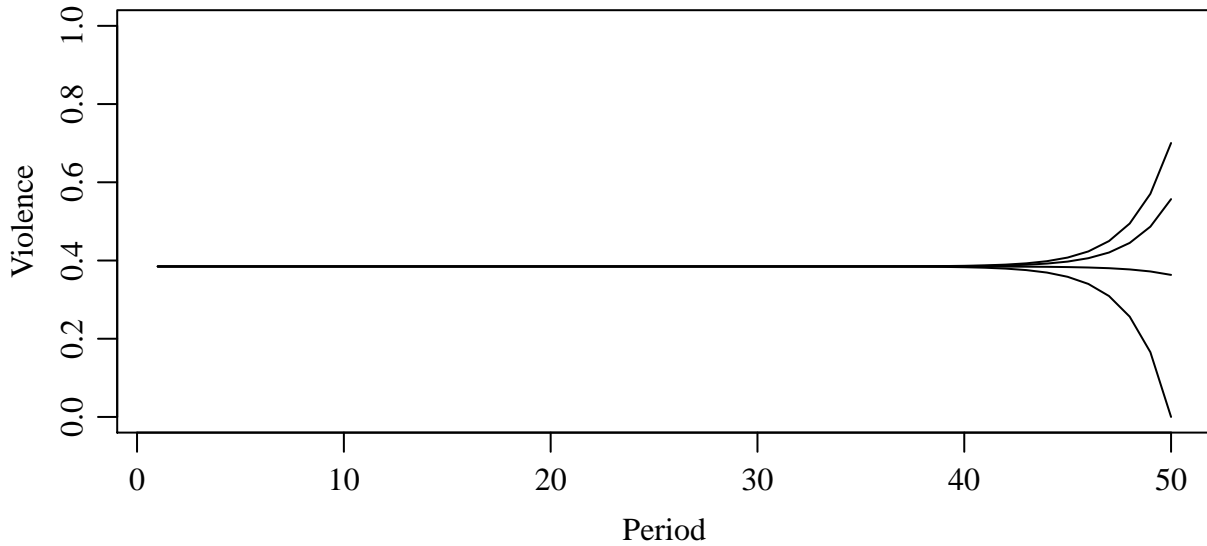
$$\begin{aligned}\Delta^* &= \psi - c(v_t^*) + \delta(1 - 2p(v_t^*; k_t))\Delta^* \\ \Delta^* &= \frac{\psi - c(v_t^*)}{(1 - \delta(1 - 2p(v_t^*; k_t)))}\end{aligned}$$

Figure 12 shows how changing  $\Delta^*$  affects violence throughout a 50 period model. Changing the continuation value has a large effect on violence choices in the last period, and some effect for the preceding periods. However, by period 40 the differences are undetectable.

### Smoother Cycles of Violence

The dip in violence leading up to elections results from the fact that when violence is only more effective in the electoral period itself, the incentives to commit violence are weakest right before the election. However, pre-electoral violence can begin weeks or months before the actual election date, leading to a smoother cycle as shown in figure 8. One way to generate such a pattern with the

Figure 12: Illustration of the effect of changing  $\Delta^*$  from 0 to 9 when  $\psi = 1$ .



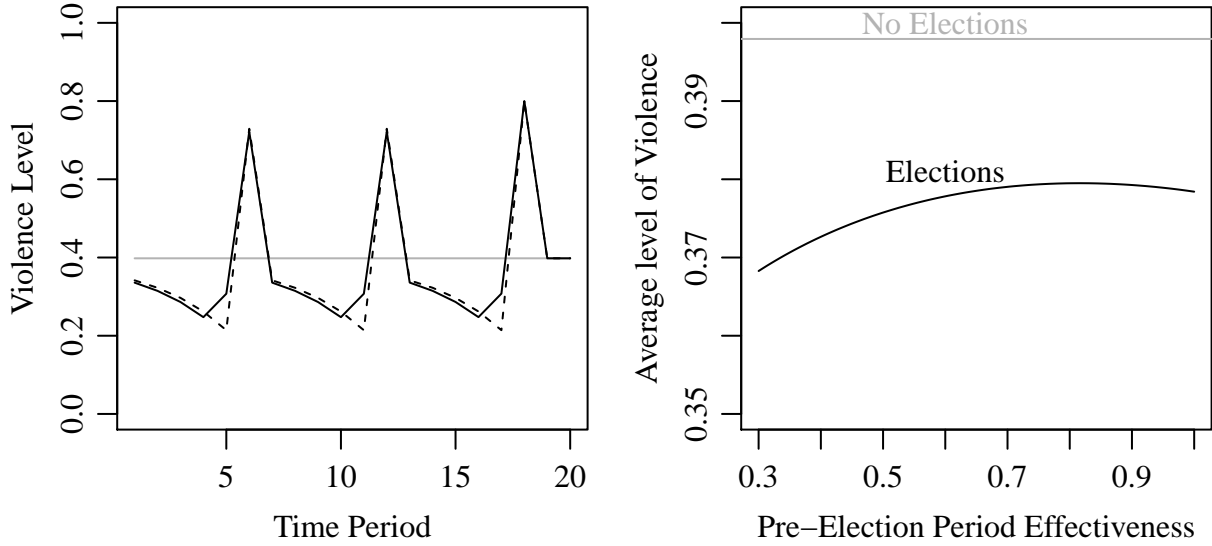
model is to assume that violence is also somewhat more effective in the period prior to elections.

Figure 13 illustrates this claim, with the solid curve in the left panel showing how the parameterization in figure 3 changes if the effectiveness of violence is equal to  $k_t = 0.6$  in pre-election periods (it is equal to 0.3 in other non-electoral periods and 1 in electoral periods). Compared to the case where the pre-election period is the same as other non-electoral periods (the dashed curve), there is more violence in the pre-election period but less violence in other non-electoral periods. The right panel shows that making violence more effective in the pre-election period increases the average level of violence until it becomes nearly as effective as in electoral periods, but the average is still below that which it would be with no elections (the grey curve).

### Simulated Comparative Statics

To test the robustness of the conclusions from the numerical examples in the main text and generate suggesting results about when elections lead to more or less violence, we conduct a simulation exercise for a range of (randomly generated) parameterizations of the model. In these

Figure 13: The effect of allowing violence to be moderately more effective in the pre-election period.



simulations, we vary the exogenous parameters  $\psi$ ,  $\delta$ ,  $k_t$ ,  $k_n$ ,  $\Delta_{T+1}^*$ , and the frequency of elections. We also consider more general cost functions of the form

$$c(v_t) = v_t^\alpha$$

where  $\alpha > 1$  affects the convexity of the cost function, i.e., how strongly the marginal cost increases. Finally, we also vary the probability of taking over office by considering functions of the form:

$$p(v_t; k_t, v_0) = k_t \frac{v_t}{v_0 + v_t}$$

When  $v_0 > 0$  is low, it is generally “easier” to take over office, as the returns to violence are very high for low levels. When  $v_0$  is higher low levels of violence have a lower marginal return and it is generally hard to take over office.

By proposition 2, since  $c$  is convex with  $c'(0) = 0$  and  $p$  is concave, there is a unique solution to each period's equilibrium condition, which is strictly positive if  $\Delta_t^* > 0$ .

In particular, the equilibrium condition for an interior solution is:

$$\alpha v_t^{\alpha-1} = k_t \frac{v_0}{(v_0 + v_t)^2} \delta (\pi_I^*(T+1) - \pi_O^*(T+1))$$

We now explore how varying the exogenous parameters of the model affects average violence levels for these classes of cost and  $p$  functions. For each parameter, we first plot the change in the average violence level in a 100 period model when keeping the other parameters fixed at the following values:  $k_e = 0.9, k_n = 0.3, \delta = 0.9, \psi = 1, v_0 = 1, \alpha = 2$ , elections occur every 4 periods, and  $\Delta_{T+1}^*$  is set such that the level of violence is stationary without elections.

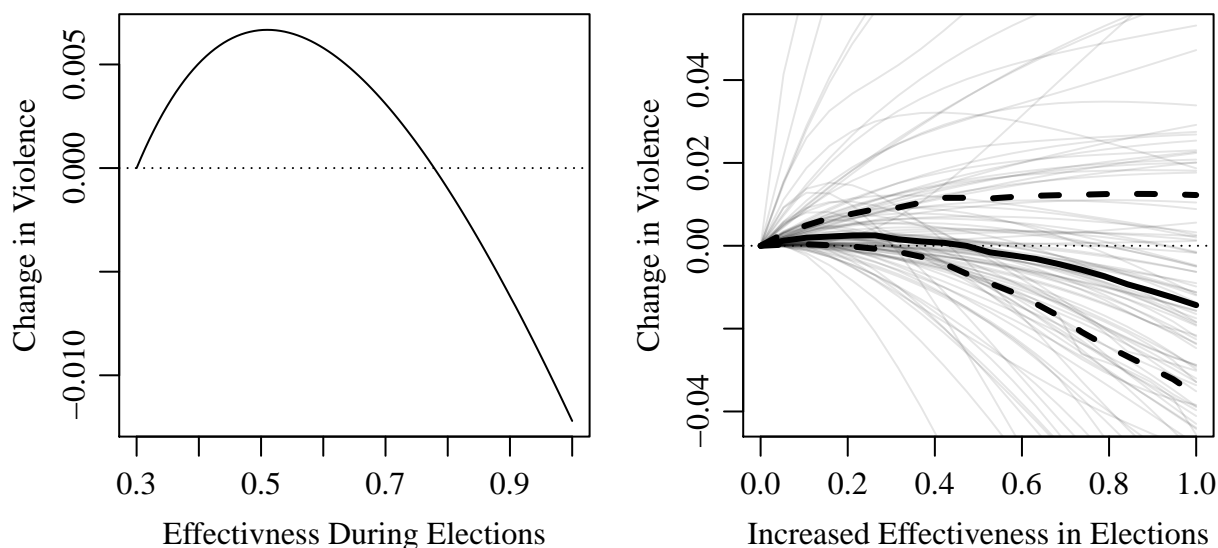
Next, we run plot the effect of these variables for 100 simulations where each of the “control” parameters is randomly drawn from a distribution generally centered around the values of the main parameterization:

- $k_e$  is uniform on  $[.1, .6]$  and  $k_n$  is uniform on  $[.6, 1]$ . When looking at the effect of changing  $k_e$ , we first drawn  $k_n$  and then plot over the range  $[0, k_n]$ . When looking at the effect of changing  $k_e$ , we first draw  $k_n$  and then plot the range  $[k_n, 1]$ ,
- $\delta$  is drawn from a beta distribution with shape parameters  $a = 9$  and  $b = 1$ ,<sup>28</sup>
- $v_0$  is drawn from an exponential distribution with mean 1,
- $\alpha$  is equal to 1.1 plus an exponential distribution with mean 0.9.<sup>29</sup>,
- $\psi$  is equal to 0.5 plus an exponential random variable with mean 0.5,
- the periodicity of elections is uniform between every 1 and every 10 periods, and

<sup>28</sup>I.e., the density is proportional to  $\delta^{a-1}(1 - \delta)^{b-1}$ .

<sup>29</sup>When  $\alpha$  is very close to 1 some of the optimization procedures fail for some draws of the other parameters, so putting a lower bound at 1.1 avoids this issue.

Figure 14: Simulations for the effect of  $k_e$ .



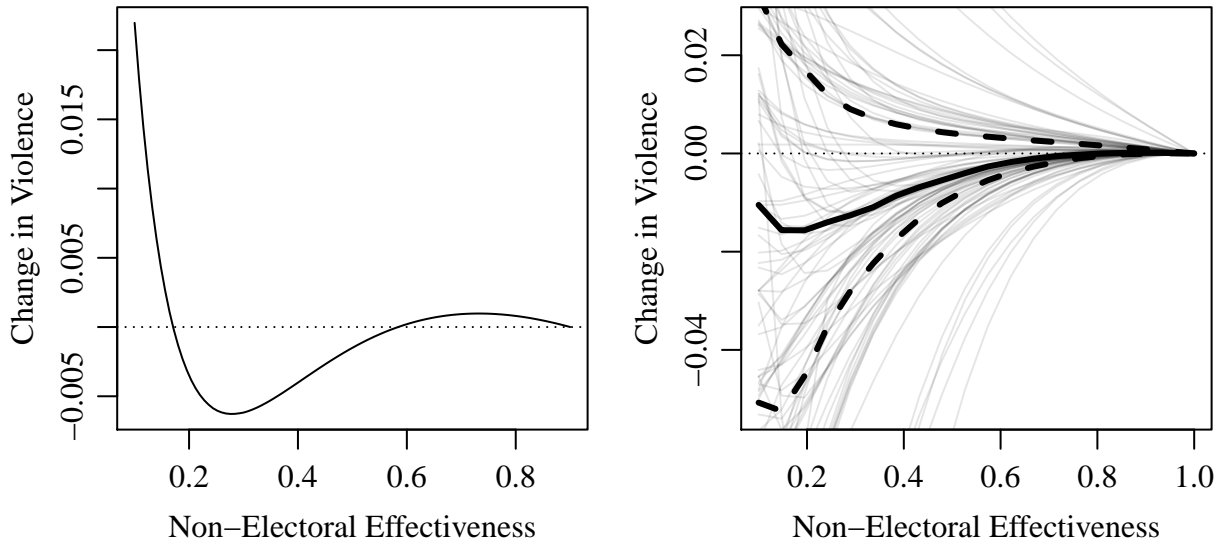
- $\Delta_{T+1}^*$  is set so the level if violence is stationary without elections.

Figure 14 shows the effect of changing  $k_e$ . For this and later parameters, left panel plots the effect of changing  $k_e$  on the absolute change in average violence when going from no elections to elections. The right panel plots the change in average violence when introducing elections for 100 simulations in translucent lines, with the median effect in a solid black curve and the 25th and 75th percentile effects in dashed black curves.

The results for  $k_e$  largely reinforce the conclusion in the main text. As  $k_e \rightarrow k_n$ , introducing elections has no effect on violence and electoral periods are no different than non-electoral periods. When  $k_e$  is slightly higher than  $k_n$  there is generally more violence, but as violence gets much more effective during electoral periods there is usually less violence on average with elections.

Figure 15 looks at varying the effectiveness of violence in *non-electoral* periods. The left panel indicates that for the main parameterization, when  $k_n$  is very small introducing elections leads to a substantial increase in violence. This is not too surprising: if society is very peaceful without elections, the indirect effect of introducing elections will be small since there is little

Figure 15: Simulations for the effect of  $k_n$ .



violence to prevent in the non-electoral baseline. So, the direct effect of increasing violence in elections dominates. On the other extreme, the effect of introducing elections when society is already very violent ( $k_n$  close to  $k_e$ ) is close to zero, as there is little difference in electoral and non-electoral periods. However, when the effectiveness of violence is intermediate, so the indirect effect is meaningful and there is a sufficient difference between non-electoral and electoral periods, introducing elections decreases the average violence levels.

The right panel shows that this pattern holds generally for a wide variety of simulations, though for some (e.g., following the 75th percentile curve) there is always more violence with elections. Even when this is true, though increasing  $k_n$  generally makes introducing elections less bad (i.e., the change is less positive).

Figure 16 examines the effect of increasing the stakes of office  $\psi$ . As discussed in the main text, for the the main parameterization increasing  $\psi$  *always* leads to elections having a more (if always modest) pacifying effect. This also holds for most of the simulations: the 75th percentile line hugs zero and is slightly decreasing, while the median and 25th percentile are negative for all



Figure 16: Simulations for the effect of  $\psi$ .

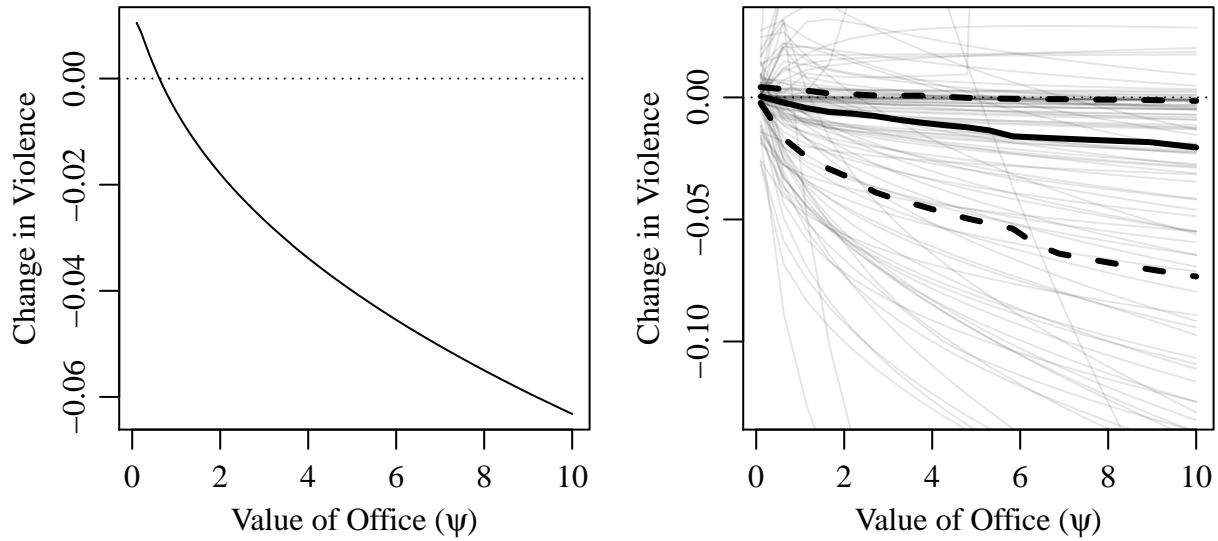
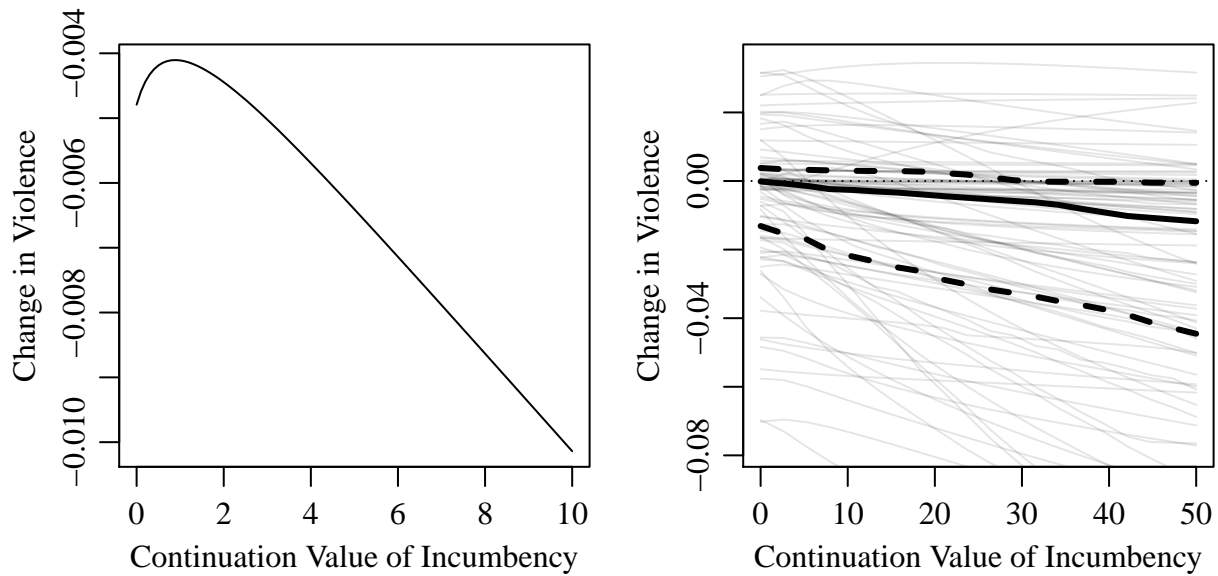


Figure 17: Simulations for the effect of  $\Delta_{T+1}^*$ .



but tiny values of  $\psi$  and decreasing. So, it seems elections have a pacifying effect not only when elections are consequential, but when officeholding is consequential.

Figure 18: Simulations for the effect of  $\delta$ .

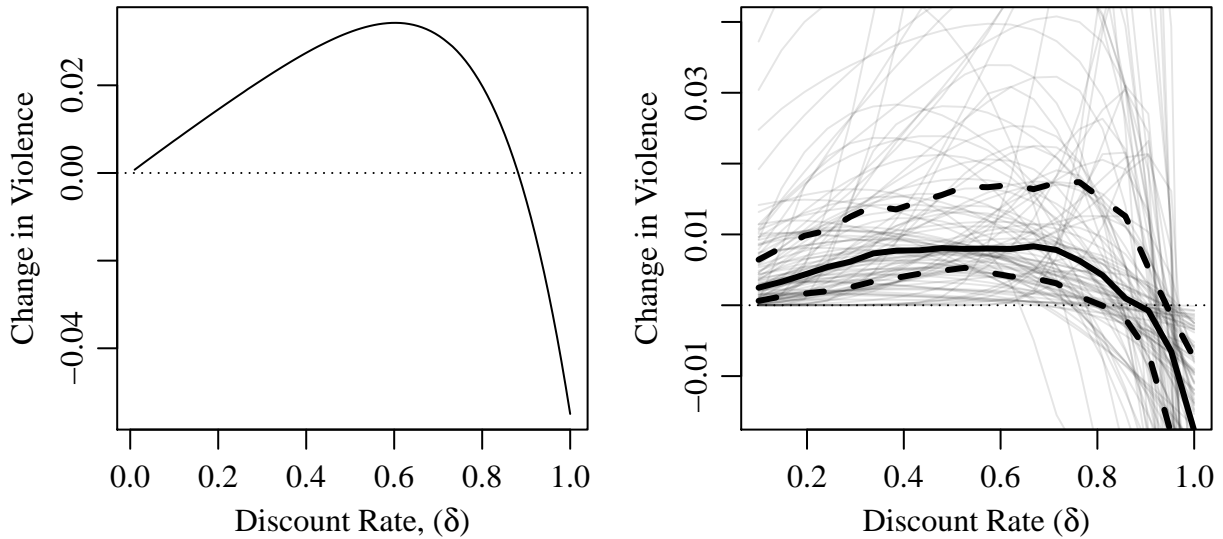


Figure 17 shows similar results when changing the value of holding office at the end of the game  $\Delta_{T+1}^*$ . This likely follows from a similar logic, as increasing the value of holding office at the end of the game increase the value of holding office earlier, though this effect tends to be smaller compared to increasing the value of holding office in every period. This also demonstrates that setting this parameter to the stationary value is unlikely to have large consequences on the conclusions reached.

Figure 18 examines the effect of increasing the discount rate. As discussed in the main text in the main parameterization Changing  $\delta$  has a non-monotone effect, and elections lead to less violence when the actors are sufficiently patient. The shape of this effect is similar for the vast majority of the simulations.

Next we plot the effect of making the cost function more convex (increasing  $\alpha$ ). For most of the range of  $\alpha$  (particularly greater than 2) the effect of changing  $\alpha$  is modest on average, though as the individual simulations show the effect of elections can become very positive or negative as  $\alpha \rightarrow 1$  depending on the other parameters. On average for the distributions used here, elections

Figure 19: Simulations for the effect of  $\alpha$ .

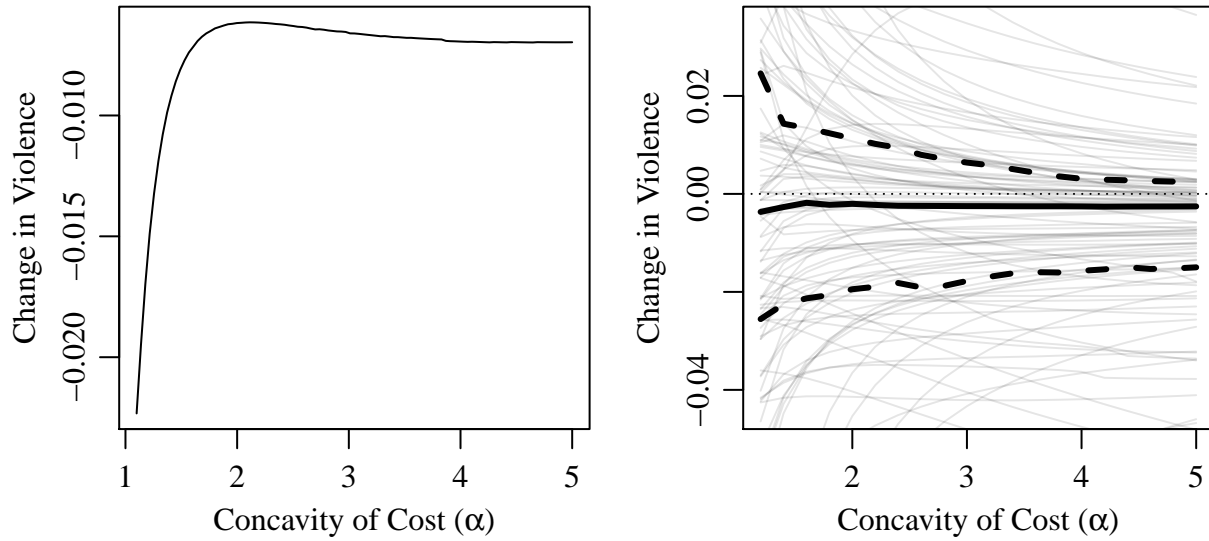
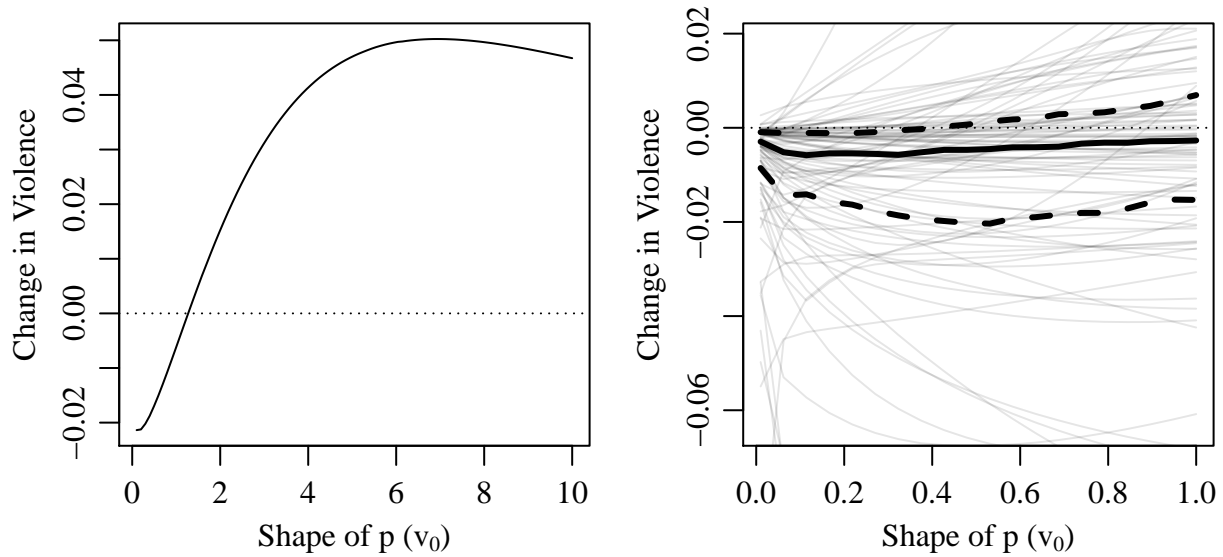


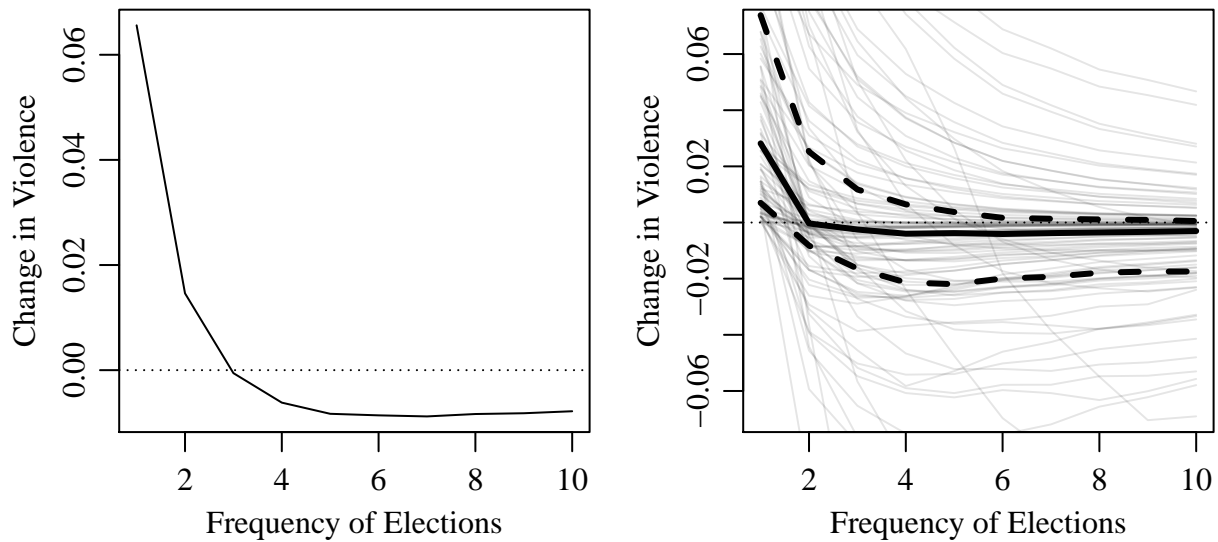
Figure 20: Simulations for the effect of  $v_0$ .



always have a modest but negative impact on violence for any  $\alpha$ .

Figure 20 looks at how changing the shape of the function capturing the probability of taking

Figure 21: Simulations for the effect of the frequency of elections.



office changes the effect of holding elections. In general, when  $v_0$  is small, the effect of committing violence is larger for small values of  $v_t$  but smaller for large values of  $v_t$ , i.e., when  $v_0$  is bigger the returns to violence are lower at first but diminish more slowly. For the fixed parameter values, elections tend to have a pacifying effect when  $v_0$  is low but lead to more violence when  $v_0$  is high. This could be related to the fact that when  $v_0$  gets very high there will tend to be less violence in equilibrium, so by a similar logic discussed when considering changes in  $\psi$  it may be the case that the direct effect matters more when violence tends to be low while the indirect effect is stronger when violence is already high.

However, it also seems that the effect of elections is always increasing or always decreasing in  $v_0$  for some simulations, so drawing strong conclusions on this parameter is likely unwarranted.

Finally, we examine the effect of making elections more or less frequent (figure 21). The general pattern where elections lead to more violence when very frequent and generally lead to a reduction in violence for moderate frequency holds for the majority of the simulations.

### Equilibrium Definition for Extension with Non-violent action

An equilibrium to the model with non-violent action is a  $x_t^*$ ,  $v_t^*$ ,  $\pi_O^*(t)$ , and  $\pi_I^*(t)$  that solve:

$$\pi_O(t, v_t, x_t) = c(v_t) - c(x_t)/\beta + \delta p(v_t + x_t; k_t)\pi_I^*(t+1) + (1 - p(v_t + x_t; k_t))\pi_O^*(t+1)$$

$$(v_t^*, x_t^*) \in \arg \max_{(v_t, x_t)} \pi_O(t, v_t, x_t)$$

$$\pi_O^*(t) = \pi_O(t, v_t^*, x_t^*)$$

$$\pi_I^*(t) = \psi + \delta(p(v_t^*, x_t^*; k_t)\pi_O^*(t+1) + (1 - p(v_t^*, x_t^*; k_t))\pi_I^*(t+1))$$

for  $t = 1, \dots, T$ . The main difference between this and the main model is that there are two optimizing choices  $v_t^*$  and  $x_t^*$ .

### Proof of proposition 3

Part i follows from implicitly differentiating the equilibrium condition. For parts ii-iii, note that for any  $p(\cdot)$ ,  $\delta$ , and  $x_t$ , if  $\pi_I^*(t+1) > \pi_O^*(t+1)$  (defined analogously to the baseline model), then there exists a  $\beta > 0$  such that:

$$\frac{\partial p(x_t + v_t; k_t)}{\partial x_t} \delta (\pi_I^*(t+1) - \pi_O^*(t+1)) < c'(x_t)/\beta$$

So, either there is no violence committed in round  $t$ , or as  $\beta \rightarrow 0$   $x_t \rightarrow \infty$ , which implies  $\frac{\partial p(x_t + v_t; k_t)}{\partial v_t} \rightarrow 0$  and hence  $v_t \rightarrow 0$ . So, the violence level in each period and hence the average level of violence throughout the game approaches 0 as  $\beta \rightarrow 0$ , which combined with parts i and the intermediate value theorem implies parts ii and iii.

## Equilibrium Definition for Extension with Incumbent Violence

An equilibrium to the model with incumbent and opposition violence is a  $v_{O,t}^*$ ,  $v_{I,t}^*$ ,  $\pi_O^*(t)$ , and  $\pi_I^*(t)$  that solve:

$$\pi_O(t, v_{I,t}, v_{O,t}) = c(v_{O,t}) + \delta p(v_{I,t}, v_{O,t}; k_t) \pi_I^*(t+1) + (1 - p(v_{I,t}, v_{O,t}; k_t)) \pi_O^*(t+1)$$

$$\pi_I(t, v_{I,t}, v_{O,t}) = c(v_{I,t}) + \delta p(v_{I,t}, v_{O,t}; k_t) \pi_O^*(t+1) + (1 - p(v_{I,t}, v_{O,t}; k_t)) \pi_I^*(t+1)$$

$$v_{I,t}^* \in \arg \max_{v_{I,t}} \pi_I(t, v_{I,t}, v_{O,t}^*)$$

$$v_{O,t}^* \in \arg \max_{v_{O,t}} \pi_O(t, v_{I,t}^*, v_{O,t})$$

$$\pi_O^*(t) = \pi_O(t, v_{O,t}^*, v_{I,t}^*)$$

$$\pi_I^*(t) = \psi + \delta (p(v_{I,t}^*, v_{O,t}^*; k_t) \pi_O^*(t+1) + (1 - p(v_{I,t}^*, v_{O,t}^*; k_t)) \pi_I^*(t+1))$$

for  $t = 1, \dots, T$ . The main difference between this and the main model is that the incumbent and opposition choices must be mutual best responses, rather than the opposition violence choice being optimal in isolation.

## Derivation of equations 9-10 and proof of proposition 4

The first order conditions if both actors choose a strictly positive level of violence are:

$$1 = k_t \delta (\pi_I^*(t+1) - \pi_O^*(t+1)) \frac{v_{I,t}^*}{(v_{O,t} + v_{I,t}^*)^2}$$

$$\gamma = k_t \delta (\pi_I^*(t+1) - \pi_O^*(t+1)) \frac{v_{O,t}^*}{(v_{O,t}^* + v_{I,t}^*)^2}$$

If  $\pi_I^*(t+1) < \pi_O^*(t+1)$  there can be no solution to these equations: the objective functions are always decreasing in  $v_{J,t}$ , so in any equilibrium both actors choose  $v_{J,t}^* = 0$ .

If  $\pi_I^*(t+1) > \pi_O^*(t+1)$  and both actors chose no violence, there is an upward discontinuity in the probability of taking over office at  $v_{J,t} = 0$ , so it is always better to choose an incrementally

small level of violence to no violence. If only one actor chose a strictly positive level of violence, the other actor could always deviate to a lower violence level and have the same probability of being the incumbent in the next period. So, when  $\pi_I^*(t+1) > \pi_O^*(t+1)$  both violence levels must be interior, and by the preceding system of equation, this implies  $v_{I,t}^* = \gamma^{-1}v_{O,t}^*$ . Since violence is cheaper for the incumbent, they choose more in equilibrium. This also implies that in equilibrium the probability of a transition of power in each period is  $\frac{k_t}{1+\gamma^{-1}}$ .

The net present values for entering in each role in period  $t$  when choosing the equilibrium level of violence is:

$$\pi_O^*(t) = -v_{O,t}^* + \delta \left( \frac{k_t}{1+\gamma^{-1}} \pi_I^*(t+1) + \left(1 - \frac{k_t}{1+\gamma^{-1}}\right) \pi_O^*(t+1) \right) \quad (15)$$

$$\pi_I^*(t) = \psi - \gamma v_{I,t}^* + \delta \left( \frac{k_t}{1+\gamma^{-1}} \pi_O^*(t+1) + \left(1 - \frac{k_t}{1+\gamma^{-1}}\right) \pi_I^*(t+1) \right) \quad (16)$$

and the formula for  $\Delta_t^*$  follows from subtracting these.

For the proposition, part i follows immediately from equations 9-10. For part ii, consider what happens when violence becomes more effective in some period  $t'$ . By equation 11,  $\Delta_{t'}^*$  is decreasing in  $k_{t'}$ , which then implies  $v_{J,t'-1}^*$  and  $\Delta_{t'-1}^*$  are both decreasing in  $k_{t'}$ . This in turn implies that  $v_{J,t'-2}^*$  and  $\Delta_{t'-2}^*$  are decreasing in  $k_{t'}$ . More generally,  $v_{J,t'-j}^*$  and  $\Delta_{t'-j}^*$  decreasing implies  $v_{J,t'-j-1}^*$  and  $\Delta_{t'-j-1}^*$  are decreasing. The result then follows by induction ■

### Proof of Proposition 5

An equilibrium to the continuous policy outcome model is a sequence of violence choices where each  $v_t^*$  to maximizes the expected payoff for the remainder of the game given the future violence choices.

So, in period  $T$ , the actor chooses  $v_T$  to maximize

$$y_T - \delta^{T-1} c v_T^2 + a \delta^T ((1 - k_T) y_T + k_T v_T),$$

giving first order condition:

$$2cv_T = \delta ak_T,$$

and hence  $v_T^* = \delta ak_T/2c$

In period  $T - 1$ , the actor picks  $v_{T-1}$  to maximize:

$$\delta^{T-2}cv_{T-1}^2 + \delta^{T-1}((1 - k_{T-1})y_{T-1} + k_{T-1}v_{T-1}) + a\delta^T((1 - k_T)((1 - k_{T-1})y_{T-1} + k_{T-1}v_{T-1}) + k_Tv_T^*)$$

Giving first order condition:

$$2cv_{T-1} = \delta k_{T-1} + a\delta^2(k_{T-1}(1 - k_T))$$