# Economic Grievances and Civil War: An Application to the Resource Curse

Jack Paine*

April 20, 2018

**Abstract**

Although rebel groups frequently fight in response to perceived economic grievances, we have limited understanding of two foundational questions. Which types of economic production tend to trigger grievances and civil war, and why? Why would a strategic government not limit economic grievances to prevent fighting? This paper offers two contributions: (1) It analyzes an infinite-horizon bargaining game between a government and regional challenger, which can protect its economic production by exiting the formal economy or by coercively seceding. Economic activities that limit the value of the challenger's economic exit option exacerbate the adverse consequences of the government's commitment inability by incentivizing high tax rates. This strategic behavior creates redistributive grievances in equilibrium and increases civil war likelihood. (2) Applying the logic explains a core empirical finding about natural resources and conflict: oil-rich regions fight separatist civil wars relatively frequently. The capital-intense and immobile nature of oil production corresponds with model conditions predicting war by creating economic grievances. Finally, extending the model highlights shortcomings of alternative greed-based explanations for the oil-conflict relationship.

**Keywords:** Civil war, greed, grievances, natural resources, oil, resource curse, secession

*Assistant Professor, Department of Political Science, University of Rochester, jackpaine@rochester.edu.

A common explanation for civil war is that residents take up arms because they harbor grievances over economic exploitation. Influential scholarship on oil, for example, argues that governments often indiscriminately redistribute wealth away from oil-rich territories, creating incentives for aggrieved oil-rich regions to secede and eliminate government exploitation (Sorens 2011, 574-5; Ross 2012, 151-2). More broadly, building on classic arguments such as Gurr (1970) and Horowitz (1985), more recent statistical evidence (Boix, 2008; Cederman, Weidmann and Gleditsch, 2011) and case-based evidence (Wood 2003, Sambanis 2005, 323-4) highlights the importance of economic grievances and of other grievance sources (Cederman, Gleditsch and Buhaug, 2013) amid broader debates in the civil war literature (Collier and Hoeffler, 1998, 2004; Fearon and Laitin, 2003).

Despite considerable analysis of economic and other sources of grievances, we have limited understanding of two foundational questions. Which types of economic production tend to trigger grievances and civil war, and why? Why would a government not strategically reduce economic grievances to prevent fighting? The broader conflict literature provides insight into rationalist reasons—such as the inability to commit to future deals—that actors would engage in costly fighting rather than strike Pareto-improving bargains.[1] However, these insights are not consistently applied to many purported civil war risk factors that have received considerable empirical attention, such as natural resources and broader economic grievances.

This article offers two contributions to understanding the relationship between economic grievances (especially oil) and civil war. First, it studies a game theoretic model that addresses the two motivating questions. A government and regional challenger interact in an infinite-horizon game in which the challenger exogenously fluctuates between having strong and weak capacity for rebellion. In each period, the government sets a tax rate on oil and other economic production from the challenger's formal economy, but cannot commit to future offers. The challenger responds by deciding how much labor to supply to the formal economy, which corresponds to an economic exit option. It also chooses whether or not to fight a civil war—which would prevent future government taxation if successful.[2] The setup builds on many formal bargaining mod-

[1] Fearon (1995) and Powell (2004) provide foundational results. Walter (2009) overviews the bargaining framework for studying civil war.

[2] The specific war option in the model is separatist, in which rebels seek to create an independent territory. Although some of the logic should generalize beyond this type of civil war, the model setup section defends the separatist focus.

els that study dynamic commitment problems, although most existing models do not include endogenous economic production.

The model explains features of economic production that trigger grievances and war by exacerbating the adverse consequences of the government's commitment inability. If the mode of production makes the challenger's economic exit threat ineffective, then the government will levy high taxes on the region's production in periods the challenger has weak capacity for rebellion. This strategic behavior creates *redistributive grievances* in equilibrium. High taxation reduces the challenger's lifetime expected utility from accepting a deal and increases its incentives to fight when temporarily strong. Therefore, economic activities that undermine the challenger's economic exit option create incentives to use its outside option—fighting—to prevent government exploitation, explaining why strategically generated economic grievances cause war. By contrast, the government's inability to *commit* to a favorable weak-period bargain does not incentivize the challenger to fight in a strong period if economic properties of its production provide *incentives* for the government to offer a low tax rate even in weak periods.

The baseline model shows that redistributive grievances arise endogenously from strategic government taxation choices. The analysis then moves beyond this institution-free environment in which the government can never commit to tax relief in periods the challenger does not pose a coercive threat by assessing the incentive compatibility of a strategy profile in which the government offers the same tax rate to the challenger in all periods, conceived as a regional autonomy deal. A strategic government may choose not to limit the challenger's redistributive grievances—even if this results in civil war along the equilibrium path—because forgoing rents creates an opportunity cost. Economic activities that yield low-valued economic exit options encourage the government to tax at exploitative levels to reap high short-term gains before eventually paying long-term costs from triggering war. Therefore, the logic of the first theoretical result also explains why governments may strategically choose not to limit redistributive grievances.

The second contribution is to apply the model insights to study the widely debated relationship between natural resources and civil war. Specifically, it seeks to explain one of the few robust statistical findings in the vast conflict resource curse literature: oil-producing regions fight separatist civil wars relatively frequently.[3]

[3] Sorens (2011), Morelli and Rohner (2015), Hunziker and Cederman (2017), and Paine (2017) find evidence for this relationship using different samples and data sources. The analysis below discusses this empirical relationship in more depth.

Many have advanced an argument that resembles the present focus on economic grievances by arguing that governments often indiscriminately redistribute wealth away from oil-rich territories, which creates incentives for aggrieved oil-rich regions to secede and eliminate government exploitation (Sorens 2011, 574-5; Ross 2012, 151-2). However, they do not address the motivating questions: (1) What aspects of oil production generate this behavior? (2) What prevents a government from strategically lessening grievances? Applying the logic of the model to studying oil production shows why capital-intense and immobile oil production undermines a region's economic exit option, and therefore should make civil war more likely. Similarly, these easy revenue properties of oil production increase a government's incentives to renege on regional autonomy deals, as South Sudan exemplifies.

The model also provides a productive framework for evaluating leading alternative explanations for the oil-separatism pattern focused on "greedy" rebels. These arguments focus on how oil production provides opportunities for rebels to *loot* and otherwise finance an insurgency during an ongoing civil war, to finance the *build-up* of an insurgent organization, to *disrupt* production and earn revenues during peacetime, and to create a lucrative *prize* of predation (Collier and Hoeffler 2005, 44; Collier et al. 2009, 13; Lujala 2010).[4] Strikingly, most of these arguments assume that rebels routinely access or can influence the distribution of oil revenues, compared to the core premise of grievance theories that governments easily control oil revenues. Formalizing greed mechanisms proposed by the literature and alongside empirical considerations about oil production casts doubt on the major greed arguments, which either logically *diminish* separatist incentives or theoretically raise equilibrium separatist civil war prospects only under poorly empirically supported assumptions.

In addition to contributing to debates about economic grievances and the conflict resource curse, the analysis also advances the applied formal theoretic literature. It explains how economic activities that undermine a producer's economic exit option exacerbate the commitment problem and how endogenizing economic production in a bargaining model delivers important insights into prospects for bargaining breakdown. The model builds off existing bargaining models of civil war (Fearon, 2004) and regime transitions (Acemoglu and Robinson, 2006) that use a general commitment problem mechanism (Powell, 2004; Krainin, 2017).

[4]Many have emphasized the importance of greed and grievance arguments in the conflict resource curse literature, including Humphreys (2005) and, more recently, Smith's (2016) review: "the theorized mechanisms linking resource wealth to civil conflict track fairly well along a grievance-greed continuum."

The key difference from Fearon (2004) is to endogenize economic production. The model also provides distinct findings even from other formal models that have applied a conflict bargaining framework to study oil politics, such as Dunning (2005, 2008), by integrating oil production into a general model of endogenous economic exit and civil war. Fearon (2004) mentions how lootable natural resources that facilitate contraband—as opposed to difficult-to-loot oil production—lengthen civil wars, but does not discuss oil production. Acemoglu and Robinson's (2000) model of franchise expansion allows an out-of-power faction to allocate labor between a taxable and non-taxable sector, but they introduce this assumption only to generate interior tax rates (as they discuss, pp. 1170) and do not take comparative statics on the elasticity of labor supply or on other aspects of production.

# 1 Baseline Model

This section presents and solves the baseline model, and then presents the key mechanism showing how an ineffective economic exit option triggers economic grievances and civil war.

## 1.1 Setup

A government ($G$) and regional challenger ($C$) interact in an infinite time horizon. Future payoffs are discounted by a common factor $\delta \in (0, 1)$ and time is denoted by $t \in \mathbb{Z}_+$. The stage game played in each period contains up to four sets of actions.

***1. Distribution of power stage.*** Nature chooses whether $C$ has strong capacity for rebellion (probability $\sigma$) or is weak (probability $1 - \sigma$) in each period. Only in a strong period can $C$ initiate hostilities (see stage 3), and $C$ wins a separatist civil war with probability $p \in (0, 1)$.[5] The distribution of power stage is degenerate in any period in which $C$ has previously won a separatist civil war because, as described below, $G$ and $C$'s

[5]For tractability purposes and to focus mainly on $C$'s fighting and production choices, $p$ is exogenous. However, Section 4.2 discusses substantive factors related to regional oil production that may affect $p$, and Section 4.3 presents an extension in which $p$ can change depending on the war outcome. Paine (2017) shows that endogenizing the probability of winning does not alter the core logic for explaining the relationship between oil and separatist civil war onset.

interaction ends if $C$ secedes. Overall, there are three states of the world in this stochastic game: $C$ is weak in the status quo territorial regime, $C$ is strong in the status quo territorial regime, and $C$ has seceded.

Stochastic shifts in $C$'s ability to secede reflect that political actors can only occasionally solve collective action problems and effectively challenge the government (Acemoglu and Robinson, 2006, 123-128). Windows of opportunity may arise, for example, when the government is temporarily vulnerable. As an example, the fall of the Iranian shah in 1979 created perceptions of temporary regime weakness by Iran's oil-rich Arab and Kurd minorities and facilitated separatist attempts (Ward, 2009, 230-233). Demonstration effects from the Iranian Revolution may have also facilitated mobilization in nearby countries. "There is little doubt that the Iranian Revolution helped galvanize politics and energize dissent among Shiites in neighboring countries. The revolution helped explain both the timing and some of the forces that encouraged Saudis to take to the streets" (Jones, 2010, 186). Saudi Arabia's Shiites are concentrated in the east, which contains the majority of Saudi Arabia's oil wealth. Similarly, Angola's long-running center-seeking civil war resumed after the opposition party UNITA rejected election results in 1992. The rebel group FLEC-FAC escalated its low-intensity separatist fight for oil-rich Cabinda shortly afterwards, "at a time when the government was facing its toughest military challenge yet from UNITA" (Porto, 2003, 5). This provided a window for FLEC-FAC to achieve military aims and to gain concessions.

***2. Taxation stage.*** $G$ proposes a tax rate $\tau_t \in [0, 1]$ that would transfer $\tau_t$ percentage of $C$'s period $t$ formal-sector economic output to $G$ if $C$ accepts. For simplicity, $G$ does not have a budget from which it can offer transfers to $C$, although Appendix Section A.3 discusses why introducing this possibility would not qualitatively change the results.

***3. Fighting decision stage.*** Two constraints prevent $G$ from taxing all of $C$'s production. First, in a strong period, $C$ can initiate a one-period separatist war[6] to create an independent territory.[7] In weak periods, however, $C$ cannot fight. Section 4.3 introduces the additional possibility that $C$ can engage in a "simple revolt" (e.g., a strike or riot) option short of insurgency in any period.

[6]Assuming the war lasts one period is done for simplicity, and all the results would be qualitatively identical for wars of finite length $n \in \mathbb{Z}_{++}$.

[7]Empirically, successful separation from the government can entail creating a newly independent country, as in South Sudan or East Timor, or de facto territorial control despite a lack of international recognition, as in Somaliland.

Although many considerations here contribute to understanding general incentives to fight, three reasons motivate modeling the fighting choice specifically as a separatist war, as opposed to a center-seeking civil war to capture the capital. First, the primary empirical application is to explaining the oil-separatist relationship. Second, although economic grievance arguments also apply to some extent to center-seeking civil wars, the core grievance posited here—central government exploitation of local production—can be solved without having to mobilize to capture the capital. Rebel groups enjoy information and recruitment advantages when fighting in their home territory, and can use guerrilla tactics to strategically avoid government advances rather than to capture new military targets. Therefore, fighting to create an autonomous region or fully independent state is the more feasible response to local grievances (Jenne, Saideman and Lowe, 2007). Third, the implicit assumption that the government has no a priori ability to commit to future concessions for the challenger corresponds with regions that have limited access to political power at the center (Cederman, Gleditsch and Buhaug, 2013). Empirically, politically excluded ethnic groups are usually numerically small in size, which limits their ability to fight for the center (Paine, 2017). Therefore, the low-commitment scope conditions are most appropriate for studying groups who tend to prefer separatist fighting.

***4. Labor supply stage.*** The second constraint on $G$'s taxation is that, in all periods, $C$ can divert effort to produce in an informal market. This incorporates the key theoretical idea that citizens can exit the formal economy by producing outside the reach of the state or by physically migrating (de Soto, 2000; Scott, 2010), and therefore the government must provide incentives for residents to generate taxable output (Olson, 2000). Bates (1981, 85-86) discusses the prevalence in post-colonial Africa of farmers choosing to produce subsistence crops rather than taxable cash crops, and smuggling cash crops across international borders. Activities such as stealing oil output or striking to disrupt production also affect the value of the informal sector.

Formally, in each period $C$ chooses labor $L_t \geq 0$ to supply for formal-sector production, and output equals $\theta(L_t)$. Assuming $\theta(L_t) = L_t^\eta$ and $\eta \in (0, 1)$ ensures the production function exhibits strictly positive and strictly diminishing marginal returns to labor input, and $\eta$ equals output elasticity. Because $\theta(\cdot)$ is a Cobb-Douglas production function with a single input, it follows that output elasticity $\frac{\partial \theta(L_t)}{\partial L_t} \cdot \frac{L_t}{\theta(L_t)} = \eta \cdot L_t^{\eta-1} \cdot \frac{L_t}{L_t^\eta} = \eta$. Larger $\eta$ implies that the amount produced is more greatly impacted by changes in labor input, i.e., formal-sector output is more labor-elastic.[8] The price of selling the good in the formal sector is

[8]Implicitly, there is also capital in the economic production function, but it is normalized to 1 in peace

normalized to 1 here, and the analysis below considers the effects of altering this price in a static sense and across periods.

Devoting labor to the formal economy entails an opportunity cost of $\kappa(L_t) = \frac{\omega}{1+\omega} \cdot L_t^{\frac{1+\omega}{\omega}}$ for $C$ from forgone production in the informal sector, for $\omega \in (0,1)$. Substantively, higher $\omega$ corresponds to a higher-valued option to exit into the informal economic sector. This functional form, which engenders a strictly positive and strictly increasing opportunity cost of labor, is commonly used in models with an endogenous labor supply because labor supply elasticity equals $\omega$ in the linear production technology case (e.g., Acemoglu et al. 2004; Besley and Persson 2011, 80).[9]

Assuming that a unitary actor makes regional production decisions is for simplicity. Appendix Lemma A.1 demonstrates that the unique symmetric equilibrium labor allocation is identical if $N \in \mathbb{Z}_{++}$ citizens of the region independently choose labor allocations if the rebel leader chooses not to fight. Additionally, the parameters $\eta$ and $\omega$ are modeled as independent of each other to facilitate comparative statics on different attributes of economic production. The substantive discussion in Section 3.2 provides examples of cases with varying values of $\eta$ and $\omega$ (Figure 3) to clarify these differences.[10]

periods and to 0 in war periods. An extension presented below models positive consumption during war periods to facilitate additional comparative statics predictions. Abstracting away from capital accumulation over time, which many economic growth models analyze, enables focusing attention on the elasticity of the production function ($\eta$) rather than on how countries attract and grow capital investment. Especially in the context of oil, much of this investment is international, and how countries attract international investment lies outside the scope of the theory.

[9]A somewhat less abstract way to model the economy is to assume that $C$ has one unit of labor it can sell either on the formal market at $L_t^\eta$ or on the informal market at $\frac{\omega}{1+\omega} \cdot \left(1 - L_t^{\frac{1+\omega}{\omega}}\right)$. Here, if $C$ devotes all its labor to the informal sector, then the yield from the informal sector reaches its maximum value $\frac{\omega}{1+\omega}$. Additionally, $C$ reaps 0 from the informal sector if it sets $L_t = 1$. This setup yields an identical optimal labor allocation as the setup described in the text, and I prefer the present setup because it does not impose the unnecessary upper bound of 1 on $C$'s labor choice.

[10]Also notable, every comparative statics prediction for $\eta$ is identical if $\omega = 1$, and vice versa for $\omega$ and $\eta = 1$. That is, having different parameters for elasticity of production to labor input and for the value of the informal economy is solely to highlight different substantive factors that affect the value of producers' economic exit options, and the main grievance results are not contingent on modeling both parameters.

***Payoffs.*** If $C$ accepts, then in the current period it consumes formal-sector output not extracted by $G$ minus the informal sector-induced opportunity cost of labor, $(1-\tau_t)\cdot\theta(L_t)-\kappa(L_t)$. $G$ consumes revenues extracted from $C$, yielding $\tau_t\cdot\theta(L_t)$. A strategically equivalent subgame begins in period $t+1$, and future continuation values for $G$ and $C$ under the status quo territorial regime are denoted respectively as $V^G_{\text{s.q.}}$ and $V^C_{\text{s.q.}}$.

If instead $C$ initiates a separatist civil war at time $t$, then neither player consumes in that period. If the separatist attempt fails, then period $t+1$ begins a subgame strategically equivalent to that in period $t$. If instead $C$ successfully separates, then the tax rate drops permanently to 0 in every future period and only the labor supply stage is played. This means that $G$ and $C$'s interaction becomes trivial. The future continuation value for $C$ in the subgame following successful secession is $V^C_{\text{sec}}$. The corresponding continuation value for $G$ equals 0 because $G$ has lost its revenue source. Figures 1 and 2 present trees for the stage games and Appendix Table A.1 summarizes the parameters and choice variables in the game.

**Figure 1: Tree of Stage Game if $C$ Has Not Seceded**

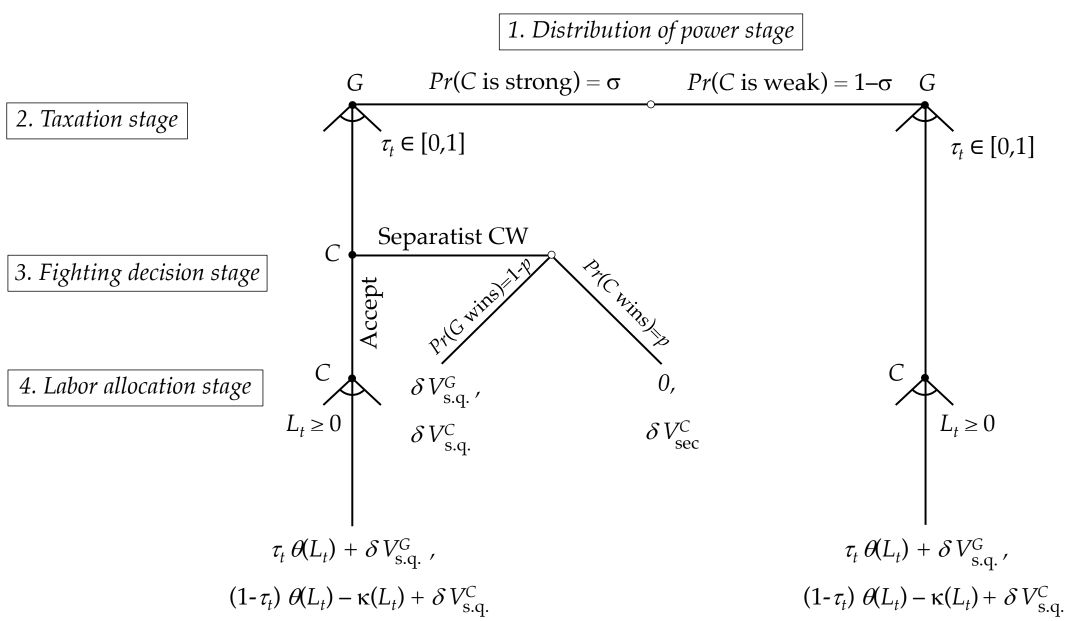
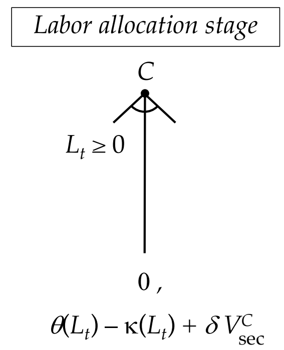


**Figure 2: Tree of Stage Game if $C$ Has Seceded**




## 1.2 Equilibrium Analysis

The analysis begins by considering an "institutions-free" environment. Formally, the analysis characterizes the Markov Perfect Equilibria (MPE) of the game.[11] This first cut at analyzing the model isolates how the challenger may coercively separate to escape its interaction with a weakly institutionalized state that is incapable of long-term commitments. Later, the analysis evaluates a non-Markovian strategy profile that enables the government, in principle, to resist exploitation even in periods the challenger is coercively weak by allowing the challenger to punish the government for actions taken in previous periods. To solve the model, this section applies the single-deviation principle to solve for optimal actions in a peaceful MPE[12]—which is unique when one exists—and the parameter values under which a peaceful MPE exists. It also characterizes actions in conflictual equilibria. The analysis solves backwards on the stage game and Appendix A proves the formal statements.

***Labor supply stage.*** $C$ faces a labor tradeoff because supplying more labor increases formal-sector output but also raises the opportunity cost induced by informal-sector exit. Increasing $L_t$ raises $C$'s marginal consumption by the percentage of formal-sector production it retains, $1-\tau_t$, multiplied by the effect of higher

[11]Markov Perfect Equilibrium requires players to choose best responses to each other, with strategies predicated upon the state of the world and on actions within the current period. Appendix A formally defines the equilibrium concept.

[12]In a peaceful MPE, peaceful bargaining occurs in every period along the equilibrium path. This is the natural baseline in the formal war literature, which focuses on why costly fighting would ever occur in equilibrium given Pareto-improving alternatives.

labor supply on increasing formal-sector output, $\frac{\partial\theta(L^*(\tau_t))}{\partial L_t}$. The marginal opportunity cost of supplying labor to the formal sector is $\frac{\partial\kappa(L^*(\tau_t))}{\partial L_t}$. $C$ chooses the unique labor supply that equates these terms, which enables implicitly characterizing $L^*(\tau_t)$:

$$\underbrace{(1-\tau_t)\cdot\frac{\partial\theta(L^*)}{\partial L_t}}_{\text{MB: } C \text{ consumes more from formal sector}} \quad = \quad \underbrace{\frac{\partial\kappa(L^*)}{\partial L_t}}_{\text{MC: Opp. cost from informal sector}}. \tag{1}$$

Substituting in functional forms enables explicitly solving:

$$L^*(\tau_t) = \Big[(1-\tau_t)\cdot\eta\Big]^{\frac{\omega}{1+\omega\cdot(1-\eta)}}. \tag{2}$$

$C$'s labor choice is the only strategic decision following a successful separatist attempt. Lemma 1 states optimal actions, per-period consumption amounts, and continuation values in this subgame.

> **Lemma 1** (Actions/consumption in a period following successful secession)**.** *If $C$ has successfully seceded before period $t$, then $C$ chooses $L_t = L_0^* \equiv \eta^{\frac{\omega}{1+\omega\cdot(1-\eta)}}$, and* $V_{sec}^C = \frac{1}{1-\delta}\cdot\big[\theta(L_0^*)-\kappa(L_0^*)\big]$.

***Fighting decision stage.*** If $C$ has not previously seceded and $G$ makes an unattractive proposal, then in a strong period $C$ can deviate from a peaceful strategy profile by fighting. $C$'s allure of initiating a separatist war is that $G$ cannot tax its production in any future period if $C$ wins. More formally, $C$ will accept a proposal $\tau_t$ in a strong period if current- and expected future-period consumption is at least as large as its lifetime expected utility from initiating a civil war:

$$\underbrace{(1-\tau_t)\cdot\theta\big(L^*(\tau_t)\big)-\kappa\big(L^*(\tau_t)\big)+\delta\cdot V_{s.q.}^C}_{E[U_C(\text{accept } \tau_t)]} \geq \underbrace{\delta\cdot\Big[p\cdot V_{sec}^C+(1-p)\cdot V_{s.q.}^C\Big]}_{E[U_C(\text{fight})]} \tag{3}$$

$C$ optimally accepts offers satisfying Equation 3 in strong periods because fighting in the current period—the single deviation from accepting—is not profitable.

***Taxation stage: weak periods.*** Although $C$ cannot fight in a weak period, $G$ still faces a tradeoff when setting the tax rate. $G$ will consume its proposed share of $C$'s formal-sector output, $\tau_t\cdot\theta\big(L^*(\tau_t)\big)$. On the one hand, raising taxes enables $G$ to consume a larger *percentage* of $C$'s formal-sector production. On the other hand, a higher tax rate also decreases the equilibrium *amount* of formal-sector production.

Higher taxes cause $C$ to substitute away from taxable labor by diminishing $C$'s marginal consumption from supplying labor, as Equations 1 and 2 demonstrate. This effect lowers $\theta\big(L^*(\tau_t)\big)$. $G$ sets $\tau_t$ to balance this tradeoff, and therefore the unique revenue-maximizing tax rate $\overline{\tau}$ is implicitly defined by:

$$\underbrace{\theta\big(L^*(\overline{\tau})\big)}_{\text{MB: } G \text{ receives higher \% of } C\text{'s formal-sector output}} = \underbrace{\overline{\tau} \cdot \frac{\partial\theta\big(L^*(\overline{\tau})\big)}{\partial L_t} \cdot \left[-\frac{dL^*(\overline{\tau})}{d\tau_t}\right]}_{\text{MC: } C\text{'s formal-sector output decreases}}. \tag{4}$$

This yields the explicit solution:

$$\overline{\tau} = \frac{1 + \omega \cdot (1 - \eta)}{1 + \omega}. \tag{5}$$

Lemma 2 summarizes this discussion.

> **Lemma 2** (Actions/consumption in a weak period)**.** *If $C$ is weak in period $t$, then $G$ offers $\tau_t = \tau_w^* = \overline{\tau}$, for $\overline{\tau}$ defined in Equations 4 and 5. $C$ chooses $L_t = L^*(\tau_t)$, for $L^*(\tau_t)$ defined in Equations 1 and 2. In equilibrium, $L_t = \overline{L} \equiv \Big[(1-\overline{\tau}) \cdot \eta\Big]^{\frac{\omega}{1+\omega\cdot(1-\eta)}}$. Denoting $C$'s equilibrium current-period consumption amount as $U_C(weak)$ and $G$'s as $U_G(weak)$, these terms equal:*
>
> - $U_C(weak) = (1-\overline{\tau}) \cdot \theta\big(\overline{L}\big) - \kappa\big(\overline{L}\big)$
> - $U_G(weak) = \overline{\tau} \cdot \theta\big(\overline{L}\big)$

***Taxation stage: strong periods.*** In a period with strong capacity for rebellion, $C$ wins a civil war with positive probability. Consequently, it might be optimal for $C$ to attempt to secede rather than accept $G$'s most-preferred tax rate detailed in Lemma 2. In equilibrium, if $G$ cannot buy off $C$ in a strong period by offering $\tau_t = \overline{\tau}$, then if possible it will choose the unique tax rate $\tau_s^* \in [0, \overline{\tau})$ that makes $C$ indifferent between accepting or fighting, i.e., that satisfies Equation 3 with equality. $G$ clearly will never set a tax rate lower than needed to induce acceptance. Furthermore, $G$ will always buy off $C$ if possible in a strong period because $G$ does not consume in a fighting period and only has a $1-p$ chance of enjoying the same future consumption stream that it obtains with probability 1 following a peaceful bargain.

Alternatively, in a strong period, it might be optimal for $C$ to reject *any* proposal by $G$, including $\tau_t = 0$. This implies that a civil war will occur. To understand why peaceful bargaining may not be possible, if $C$'s likelihood of having strong capacity for rebellion, $\sigma$, is small, then $C$ will only rarely experience periods along the equilibrium path in which it receives a favorable tax rate because $G$ cannot commit to tax at less than $\overline{\tau}$ in a weak period. If additionally $C$ is relatively likely to win a civil war (high $p$) and is patient (high $\delta$), then it may be optimal for $C$ to fight when temporarily strong and forgo short-term consumption to achieve higher expected long-term consumption. By contrast, high enough $\sigma$ is sufficient for peace because $G$ can credibly offer tax concessions frequently enough that $C$'s opportunity cost of fighting in a strong period outweighs the expected benefits of fighting.

Formally, Equation 6 substitutes $\tau_t = 0$ as well as equilibrium consumption amounts and continuation values from Lemmas 1 and 2 into Equation 3 solved with equality to define a threshold $\overline{\sigma} < 1$ with the following properties. For any $\sigma > \overline{\sigma}$, there exists a continuum of tax proposals that $C$ will optimally accept in a strong period. If $\sigma < \overline{\sigma}$, then $C$ will reject any tax offer, even $\tau_t = 0$, in a strong period. To see that large enough $\sigma$ is sufficient for peace, the second term in Equation 6 cancels out if $\sigma = 1$, leaving a strictly positive term. Appendix Lemma A.3 summarizes these considerations.

$$\Phi(\overline{\sigma}) \equiv \underbrace{(1-\delta)\cdot\big[\theta(L_0^*)-\kappa(L_0^*)\big]}_{\text{Accept } \tau_t = 0} - \underbrace{\delta\cdot p\cdot(1-\overline{\sigma})\cdot\Big\{\big[\theta(L_0^*)-\kappa(L_0^*)\big]-\big[(1-\overline{\tau})\cdot\theta(\overline{L})-\kappa\big(\overline{L}\big)\big]\Big\}}_{C\text{'s long-term opportunity cost from forgoing fighting}} = 0 \tag{6}$$

Proposition 1 states the equilibria. If $\sigma > \overline{\sigma}$, then there is a unique MPE that features peaceful bargaining in every period. If $\sigma < \overline{\sigma}$, then there are a continuum of payoff-equivalent MPE strategy profiles that along the equilibrium path feature a separatist civil war in every strong period until $C$ successfully separates.

**Proposition 1** (Equilibrium)**.** *The three lemmas summarize MPE actions and consumption amounts in each of the game's three states:*

- *If $C$ has seceded before period $t$: see Lemma 1.*
- *If $C$ is weak in period $t$: see Lemma 2.*
- *If $C$ is strong in period $t$: see Appendix Lemma A.3.*

### 1.3 Economic Exit, Redistributive Grievances, and Prospects for War

Economic activities that create low-valued economic exit options—captured by low $\omega$ or low $\eta$—enable the government to tax the challenger at high levels in weak periods. This strategic behavior creates *redistributive grievances* in equilibrium and decreases the range of parameter values in which $G$ can buy off $C$ in strong periods. This is a novel application of the commitment problem framework to explaining the relationship between redistributive grievances and civil war.

A weaker economic exit threat by $C$ raises $G$'s revenue-maximizing tax rate, which is the equilibrium tax rate in weak periods. Higher taxes cause $C$ to substitute away from supplying formal-sector labor (see Equations 1 and 2), which decreases taxable production. However, how much this raises $G$'s marginal cost of taxation, expressed in Equation 4, depends on formal-sector output elasticity and labor supply elasticity. If formal-sector output elasticity $\eta$ is low, then a decrease in $C$'s labor supply only minimally adversely affects formal-sector output. If the labor supply elasticity parameter $\omega$ is low, then an increase in taxation only minimally adversely affects equilibrium labor supply because $C$'s returns from producing in the informal sector are low.[13] Lemma 3 formally states the linkage between $C$'s economic exit option parameters and $G$'s optimal tax rate, and Appendix A further illustrates the elasticity logic with a more general parameterization of $G$'s tax problem.

**Lemma 3** (Redistributive grievances effect)**.** *A decrease in output elasticity ($\eta$) and a decrease in the opportunity cost of supplying labor ($\omega$) each increase the revenue-maximizing tax rate $\overline{\tau}$ that G levies in weak periods. Each effect is interpreted as increasing economic, or redistributive, grievances. Formally:*

***Part a.*** $-\frac{d\overline{\tau}}{d\eta} > 0.$

***Part b.*** $-\frac{d\overline{\tau}}{d\omega} > 0.$

The redistributive grievance effect increases the range of parameters for which civil wars will occur in equilibrium. $C$ has two tools to guard against high taxes: its threat to fight and its threat to exit the formal sector. Having strong contemporaneous coercive power is sufficient to prevent exploitation because $G$ prefers to buy off $C$ in a strong period than to trigger fighting. Furthermore, an effective economic exit threat, i.e., high $\eta$ and/or $\omega$, prevents high taxes even in weak periods because $G$ does not want to undermine its tax base. By contrast, groups with a low-valued economic exit option face a high equilibrium tax rate in weak periods. This creates a large gap between how much $C$ consumes in weak periods and how much it would consume in every period if it successfully seceded. $C$ therefore faces higher incentives to initiate a separatist civil war in a strong period because gaining its own state would eliminate future government exploitation, hence alleviating redistributive grievances. Table 1 summarizes this logic and Proposition 2 formally states the result.

[13] A low value of $\eta$ also exerts a reinforcing indirect effect that decreases the elasticity of $C$'s optimal labor supply function.

**Table 1: Characteristics of Periods in Which $C$ is Exploited**

| | | **$C$'s contemporaneous fighting ability** | |
|---|---|---|---|
| | | *Weak* | *Strong* |
| **$C$'s economy** | *More effective economic exit threat* | $C$ is not exploited | $C$ is not exploited |
| | *Less effective economic exit threat* | $C$ is exploited | $C$ is not exploited |

**Proposition 2** (Redistributive grievances raise secession incentives)**.** *An increase in redistributive grievances raises the likelihood of separatist civil wars in equilibrium, i.e., increases the range of $\sigma$ values small enough that $C$ will reject any offer in a strong period. Formally, for $\overline{\sigma}$ defined in Equation 6:*

***Part a.*** $-\frac{d\overline{\sigma}}{d\overline{\tau}} \cdot \frac{d\overline{\tau}}{d\eta} > 0.$

***Part b.*** $-\frac{d\overline{\sigma}}{d\overline{\tau}} \cdot \frac{d\overline{\tau}}{d\omega} > 0.$

This result provides a novel application of the commitment problem mechanism to explain fighting: economic activities that undermine a producer's economic exit option exacerbate the commitment problem. As in many models, $G$ cannot commit to offer $C$ a more favorable bargain in the present period than is dictated by $C$'s contemporaneous fighting ability. However, $G$'s inability to *commit* to a favorable weak-period bargain does not incentivize $C$ to fight in a strong period if the economic properties of $C$'s production provide *incentives* for $G$ to offer a low tax rate even in weak periods.

## 2 Explaining Strategic Government Intransigence

Existing grievance theories have overlooked a key question: what prevents a government from committing to a regional autonomy deal with a region—and hence lower permanent taxes—to eliminate costly fighting? This section moves beyond the institution-free environment in which the government cannot possibly commit to tax relief in periods the challenger does not pose a coercive threat. It analyzes a non-Markovian subgame perfect Nash equilibrium (SPNE) in which $G$ makes the same tax offer to $C$ in every period, backed by $C$'s threat to fight in the first strong period after $G$ deviates. The government can always offer low enough permanent taxes to prevent civil war, unlike with the Markovian equilibrium in which $G$ could not commit to tax relief in weak periods. However, the *government* will optimally renege on the regional autonomy deal—by deviating to a higher tax rate—if $C$ can only infrequently carry out its coercive threat because forgoing rents creates an opportunity cost. Activities that create low-valued economic exit options increase the profitability of this deviation by raising the revenue-maximizing tax rate (as Lemma 3 showed). This increases the short-term gains from maximally taxing easy revenue sources relative to the long-term expected costs from triggering a secession attempt. This logic explains how strategic government actions cause redistributive grievances to arise in equilibrium, therefore squarely analyzing actions that governments can take (or not take) to stem grievances. Appendix Section B provides additional formal details, and Section B.3 explains the countervailing effects of a higher discount factor on equilibrium prospects for war.

## 2.1 Formal Logic

Suppose $G$ makes the same offer $\tau_t = \hat{\tau}$ to $C$ in every period $t$. Although $C$'s continuation value after seceding, $\hat{V}^C_{sec} = \frac{1}{1-\delta} \cdot \big[\theta(L_0^*) - \kappa(L_0^*)\big]$, is unchanged from above, its per-period average continuation value in the status quo territorial regime is now $\hat{V}^C_{s.q.} = \frac{1}{1-\delta} \cdot \Big[(1-\hat{\tau}) \cdot \theta\big(L^*(\hat{\tau})\big) - \kappa\big(L^*(\hat{\tau})\big)\Big]$ because $C$ receives the same offer in every period, strong or weak. $C$ will accept this offer rather than initiate a separatist civil war in a period with strong capacity for rebellion if and only if:

$$(1-\hat{\tau}) \cdot \theta\big(L^*(\hat{\tau})\big) - \kappa\big(L^*(\hat{\tau})\big) + \delta \cdot \hat{V}^C_{s.q.} \geq +\delta \cdot \Big[p \cdot \hat{V}^C_{sec} + (1-p) \cdot \hat{V}^C_{s.q.}\Big]. \tag{7}$$

The assumed punishment strategy is that if $G$ ever reneges by proposing some $\tau_t > \hat{\tau}$, then $C$ initiates a separatist civil war in the next strong period. This is where relaxing the Markov assumption has bite because $C$ conditions its actions on $G$'s choices in previous periods. Appendix Section B discusses in more detail that, after a failed war, $G$ and $C$ are assumed to return to the original actions with $G$ offering $\hat{\tau}$ in every period and $C$ accepting any tax rate no greater than that. The analysis focuses on the best possible peaceful payoff for $G$: the highest possible $\hat{\tau}$ that enables buying off $C$ in a strong period. Define $\underline{\hat{\tau}}$ such that $\hat{\tau} = \underline{\hat{\tau}}$ solves Equation 7 with equality (see Appendix Equation B.1). Importantly, a unique $\underline{\hat{\tau}} > 0$ always exists. That is, with this SPNE profile but unlike with the MPE, it is always possible for $G$ to set $\hat{\tau}$ low enough to satisfy $C$'s no-fighting constraint. $C$ cannot profitably deviate to fight if taxation in the status quo regime is low enough in every period, for example, if $G$ proposes a tax rate close to 0 in every period.

Crucially, however, the *government* might have a profitable deviation to renege in a weak period by making an exploitative tax proposal even though this would trigger costly fighting in the next strong period. The optimal deviation for $G$ entails taxing at the revenue-maximizing rate $\overline{\tau}$ in all periods until the civil war occurs. If the expected number of periods until the secession attempt is high enough, i.e., if $\sigma$ is sufficiently low, then $G$ can profitably deviate from a strategy profile that would induce peace along the equilibrium path. Formally, $G$ does not have a profitable deviation from proposing the compromise tax rate $\hat{\underline{\tau}}$ in every period if and only if:

$$\underbrace{\delta \cdot \sigma \cdot \big[1 - \delta \cdot (1-p)\big] \cdot \hat{\tau} \cdot \theta\big(L^*(\hat{\underline{\tau}})\big)}_{G\text{'s expected losses starting in first strong period}} \geq \underbrace{(1-\delta) \cdot \Big[\overline{\tau} \cdot \theta(\overline{L}) - \hat{\underline{\tau}} \cdot \theta\big(L^*(\hat{\underline{\tau}})\big)\Big]}_{G\text{'s gains in every pre-war period}} \tag{8}$$

The left-hand side of Equation 8 states $G$'s net expected loss in all periods including and after the first strong period that follows the optimal deviation. This loss is strictly positive because there is no consumption in a war period, and the best possible outcome for $G$ is that it wins the war and receives the same consumption stream had it not deviated. By contrast, with probability $p$, $G$ loses and can never again tax $C$'s production. The right-hand side of Equation 8 states $G$'s net expected gain in utility in every period before the first strong period if it chooses the optimal deviation. This gain is strictly positive because $G$ taxes at the revenue-maximizing rate $\overline{\tau}$ in these periods rather than at the compromise rate $\hat{\underline{\tau}}$, which is strictly less than $\overline{\tau}$ in the substantively interesting parameter range in which $C$ can credibly threaten to fight in response to the revenue-maximizing tax rate.

The expected loss captured by the left-hand side of Equation 8 strictly increases in $\sigma$ and equals 0 if $\sigma = 0$, which formalizes why $G$ might have a profitable deviation. If $C$ only rarely has strong capacity for rebellion, then in expectation $G$ can reap the gains of reneging for many periods before paying the cost. The appendix shows the unique $\hat{\sigma}$ that solves Equation 8 with equality (Equation B.6). It is conceptually similar to $\overline{\sigma}$ defined in Equation 6: the strategy profile is incentive compatible for $G$ if $\sigma > \hat{\sigma}$ but not otherwise.

The analog to the comparative statics prediction in Proposition 2 is unchanged, as Proposition 3 shows. The effect of a weaker economic exit option on increasing $\overline{\tau}$ strictly raises fighting prospects by increasing $G$'s expected gains from deviating and taxing at $\overline{\tau}$ in periods before the war, relative to upholding the regional autonomy deal.

**Proposition 3** (Redistributive grievances in constant-tax SPNE)**.** *An increase in redistributive grievances raises the likelihood of separatist civil wars in equilibrium, i.e., increases the range of $\sigma$ values small enough that $C$ will reject any offer in a strong period. Formally, for $\hat{\sigma}$ defined in Equation B.6:*

***Part a.*** $-\frac{\partial \hat{\sigma}}{\partial \overline{\tau}} \cdot \frac{d\overline{\tau}}{d\eta} > 0.$

***Part b.*** $-\frac{\partial \hat{\sigma}}{\partial \overline{\tau}} \cdot \frac{d\overline{\tau}}{d\omega} > 0.$

# 3 Application to the Conflict Resource Curse

The remainder of the paper applies the model insights to analyze widespread arguments that natural resource production "curses" prospects for civil peace, focusing mainly on the strong positive relationship between regional oil production and separatist civil war established in the literature. After summarizing this pattern and explaining its importance to the broader conflict resource curse literature, this section then addresses existing arguments that resemble the present focus on economic grievances: governments often indiscriminately redistribute wealth away from oil-rich territories, which creates incentives for aggrieved oil-rich regions to secede and eliminate government exploitation (Sorens 2011, 574-5; Ross 2012, 151-2). This section advances these theories by applying the logic of the model to explain specific attributes of oil production—in particular capital-intensity and immobility—that undermine a region's economic exit option and therefore should make civil war more likely. Similarly, these easy revenue properties of oil production increase a government's incentives to renege on regional autonomy deals, as South Sudan exemplifies.

## 3.1 Statistical Relationship Between Regional Oil Production and Separatist Civil War

A considerable number of articles and papers have presented statistical evidence that separatist civil wars occur more frequently in oil-rich than in oil-poor regions using a variety of samples, civil war measures, oil measures, and research designs (Sorens, 2011; Morelli and Rohner, 2015; Hunziker and Cederman, 2017; Paine, 2017). Exemplifying patterns found in existing research, within a broad sample of ethnic minority groups between 1945 and 2013, groups with at least one giant oil field in their territory initiated a separatist civil war more than twice as frequently as oil-poor groups, 1.3% of years compared to 0.6%.[14] Table 2 shows that these separatist civil wars have ranged across geographical regions from Africa (Angola, Nigeria, Sudan) to the Middle East (Iran, Iraq) to South Asia (India, Pakistan) to Southeast Asia (Indonesia) to Eastern Europe (Russia).

Explaining the empirical oil-separatism pattern is crucial because widespread proclamations of a "conflict resource curse" hinge in large part on this specific relationship. Other natural resources do not robustly associate with civil war onset. Correlations for alluvial diamonds, for example, are statistically fragile (Ross, 2015, 250). Therefore, oil is important to examine not only because it is overwhelmingly the most valuable natural resource among internationally traded commodities—ten to one hundred times the next-most traded commodity (Colgan 2013, 12)—but also because it appears distinctive in its systematic conflict-inducing properties. Furthermore, even when specifically examining oil, there is no systematic relationship between oil production and aggregate civil war onset at the country level (Cotet and Tsui 2013, Bazzi and Blattman 2014; Ross 2015, 251), in particular because oil does not appear to "curse" prospects for the other major type of civil war, center-seeking civil wars in which rebels fight to capture the capital (Paine, 2016).

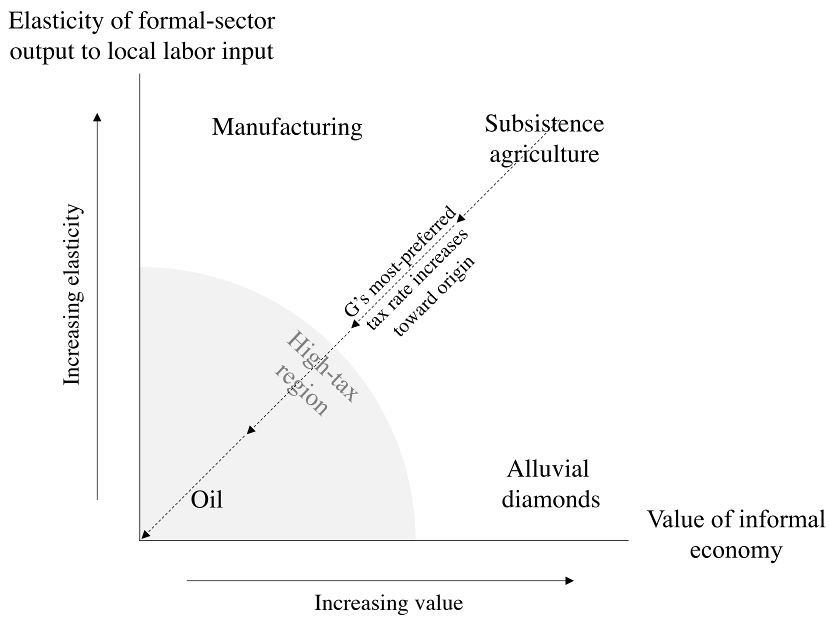
## 3.2 Why Oil Production Facilitates Government Revenues

Oil production—compared to other natural resources and broader economic activities—weakens a regional challenger's ability to constrain government taxation by diminishing its threat to exit the formal economy. Figure 3 plots different economic activities by how they affect producers' economic exit threat in two dimensions: the elasticity of formal-sector output to local labor input ($\eta$), and the value of producing in the informal economy ($\omega$).

High capital intensity and the ease of importing foreign labor makes oil output largely inelastic to local labor input. This corresponds to a low value on the vertical axis of Figure 3, i.e., low $\eta$. Producing oil requires large capital investments, which often are foreign-funded. Ross (2012, 46) shows the capital-to-labor ratio is considerably higher in the oil and gas industry than in any other major industry for U.S. businesses operating overseas. Menaldo (2016, 131-175) describes the intimate relationship between oil production

[14] Figures calculated by author by merging ethnic group and civil war data from the Ethnic Power Relations dataset (Vogt et al., 2015) with giant oil field data (Horn, 2015).

**Figure 3: Taxability of Different Economic Activities**




*Notes*: The two dimensions in Figure 3 correspond to the elasticity of formal-sector output to local labor input ($\eta$) and the value of the informal economy ($\omega$). Factors such as high capital intensity of formal-sector production and the ability to replace local with foreign workers decrease values on the vertical axis. Higher capital-intensity of formal-sector production, concentrated production areas, and immobility each decrease values on the horizontal axis.

in developing countries and foreign capital, technology, and technical production expertise.[15] Even labor that is needed for production can easily be imported because lower-level oil company employees require scant knowledge of local circumstances. For example, Arabian oil companies rely overwhelmingly on migrant workers (Johnston, 2015). Angola's oil industry exemplifies these characteristics. "International oil companies, and oil service companies, kept their staff and installations in Angola to a minimum, preferring wherever possible to run their Angolan operations from overseas" (Le Billon 2007, 108). Although oil production accounts for the majority of economic output and government revenues in Angola, the industry "employs less than 0.2 per cent of the active population, and is barely physically present in the country" (109). Ross (2012, 44-9) provides additional examples.

Oil production also undermines opportunities for societal actors to hide production from the government

[15]Menaldo (2016) also discusses how information asymmetries between international oil companies and governments in developing countries limit a government's ability to keep oil profits for itself. However, this concerns the distribution of rents between domestic governments and international actors, and does not contradict the present assertion that governments easily redistribute oil rents away from producing regions.

and to reap gains from informal activities outside the government's reach because oil is capital intensive, concentrated in production, and immobile. This corresponds to a low value on the horizontal axis of Figure 3, i.e., low $\omega$. Oil is a point-source resource because it is "exploited in small areas by a small number of capital-intensive operators" (Le Billon, 2005, 34). Because governments can relatively easily enforce military control over oil fields—relative to output produced in a non-concentrated area—extracting this point-source resource requires minimal bureaucratic capacity (Dunning, 2008, 40).[16] Furthermore, even a rebel group that gains military control over oil fields faces great difficulties to extracting oil and constructing a national distribution system to reap profits (Fearon, 2005, 500)—which relates to high capital costs, required technical know-how, and foreign assistance needs. Finally, because oil is an immobile asset, local producers cannot threaten to move their oil reserves outside the reach of the government if taxed at unfavorable rates (Boix, 2003, 42-43).

These attributes distinguish oil from many other types of economic production, which Figure 3 depicts.[17] Although alluvial diamond mining resembles oil because neither require local labor for extraction and both have a fixed location, alluvial diamonds necessitate higher bureaucratic capacity to monitor and entail lower capital costs, i.e., higher value on the horizontal axis of Figure 3. Alluvial diamonds are considered a diffuse resource because they are "exploited over wide areas through a large number of small-scale operators" (Le Billon, 2005, 32). Therefore, it is easier for societal actors to steal these "blood diamonds" and to prevent the government from accruing revenues. Operating a modern manufacturing plant resembles oil production because, after sinking the costs of building the factory, it is both concentrated in location and immobile. However, most industry is not nearly as capital-intensive as is oil production and therefore requires more labor—often, local and somewhat skilled labor, i.e., higher value on the vertical axis. And some types of manufacturing will be located further to the right in Figure 3. Large multinational corporations have sufficient liquidity even after sinking costs in a fixed asset to leave the country and to produce elsewhere in reaction to high taxes, whereas it is impossible to move an oil field. Subsistence agriculture differs from oil

[16] However, this trend may change in the future as unconventional oil sources, including oil shales and oil sands, become more prevalent in global production.

[17] Oil is not the only economic activity that could be plotted in the bottom-left quadrant of Figure 3. Kimberlite diamonds and deep-shaft minerals such as copper possess similar attributes (Le Billon 2005, 30). Unlike for oil, however, existing empirical evidence linking non-oil natural resources and separatist civil war is mixed (Ross 2015, 250).

production on both dimensions because it relies heavily on local labor and is diffuse, i.e., higher values on both the horizontal and vertical axes. This discussion substantively supports Assumption 1.

> **Assumption 1.** *Oil-rich territories have lower formal-sector output elasticity $\eta$ (lower value on vertical axis of Figure 3) and lower opportunity costs to supplying formal-sector labor $\omega$ (lower value on horizontal axis of Figure 3) than oil-poor territories.*

### 3.3 Applying the Theory: Oil, Redistributive Grievances, and Civil War

Combining these empirical considerations with the logic of Lemma 3 and Propositions 2 and 3 explains the redistributive grievances linkage between regional oil and civil war onset. By undermining a region's economic exit option, regional oil creates incentives to secede to prevent future government exploitation. Evidence from a wide range of oil-rich regions that have fought separatist civil wars supports this argument. In Iraq, Kurds have historically claimed that the oil-rich Kirkuk area "is Kurdish and therefore must be part of any Kurdish autonomous area. They further claim they should receive a percentage of oil revenues from the area" (Zanger, 2002, 41), contrary to Saddam Hussein's strategy of siphoning oil revenues from the north. In Angola, Cabinda (which produces most of the country's oil) is "one of the poorest provinces in Angola. An agreement in 1996 between the national and provincial governments stipulated that 10% of Cabinda's taxes on oil revenues should be given back to the province, but Cabindans often feel that these revenues are not benefiting the population as a whole" (Porto, 2003, 3).

Documenting this pattern more systematically, Table 2 lists every oil-rich region that has initiated a separatist civil war, and the note below the table describes the sample. For most of these conflicts, Rustad and Binningsbø (2012) code whether or not there is evidence that the conflict was related to the distribution of natural resource revenues. According to the codebook, "Two types of distributional issues are considered: distribution of the natural resource itself such as land, water or agricultural products, and conflicts over the distribution of natural resource revenues." Ten of the 12 oil-separatist cases in their dataset exhibit evidence of distribution.

Regarding regional autonomy deals, Sudan provides an example of a government actively undermining existing agreements to try to gain control over oil revenues. The northern-dominated Sudanese government granted an autonomous region in the south after a civil war that ended in 1972. Less than a decade later, oil discoveries in the south coincided with aggressive moves by the Khartoum government that effectively

**Table 2: Oil-Separatist Cases: Evidence for Redistributive Grievances, 1946–2006**

| Country | Region | First conflict year | Evidence of redistributive grievances from R&B (2012)? |
|---|---|---|---|
| Angola | Cabinda | 1975 | YES |
| Bangladesh | Chittagong Hills | 1974 | YES |
| India | Assam | 1990 | YES |
| Indonesia | Aceh | 1975 | YES |
| Iran | Kurdistan | 1966 | NO |
| Iran | Arabistan | 1979 | YES |
| Iraq | Kurdistan | 1961 | YES |
| Nigeria | Biafra | 1967 | YES |
| Nigeria | Niger Delta | 2004 | YES |
| Pakistan | Baluchistan | 1974 | YES |
| Russia | Chechnya | 1999 | YES |
| Sudan | South | 1983 | n.a. |
| Yemen | South | 1994 | NO |

*Notes*: Table 2 includes every case in Ross's (2012, 165) list of separatist conflicts in oil-producing regions that Rustad and Binningsbø (2012) also code as a natural resource war (plus South Sudan, where production did not begin until after the war started), using Ross's (2012) conflict onset year. Following Rustad and Binningsbø's (2012) temporal sample, the data run from 1946 to 2006. Table 3 also contains every case generated by an alternative coding procedure: spatially merging ethnic group polygons from the Ethnic Power Relations dataset (Vogt et al., 2015) with giant oil field data (Horn, 2015), and listing every group that has at least one giant oil field in their polygon and has fought a separatist civil war. Among the cases that Ross (2012) lists, the following are excluded from Table 3 because the region/ethnic group does not contain a giant oil field, nor do Rustad and Binningsbø (2012) code a natural resource war: Xinjiang (China), Bangladesh (independence war from Pakistan), or Kurdistan (Turkey).

abrogated the settlement of 1972. In 1980, Sudan's president "announced plans to redraw the borders between southern and northern provinces. When this proposal was blocked by the regional government, he conveniently created a new province . . . and removed the oil fields altogether from southern administrative jurisdiction" (Ofcansky, 1992). Khartoum followed this action by splitting the south into three regions, organizing and arming tribal militias in the south, and declaring Sharia law for the entire country in 1983. In reaction to the negated autonomy deal, the rebel group SPLA initiated a second major separatist civil war in 1983.

## 4 Alternative Explanation: Greedy Oil Rebellions

The model also provides a productive framework for evaluating leading alternative explanations for the oil-separatism pattern focused broadly on "greedy" rebels. Strikingly, most of these arguments assume that rebels routinely access or can influence the distribution of oil revenues, compared to the core grievance premise discussed with Assumption 1 that governments easily control oil revenues. Formalizing greed mechanisms proposed by the literature and alongside empirical considerations about oil production casts doubt on the major greed arguments, which either logically *diminish* separatist incentives or theoretically raise equilibrium separatist civil war prospects only under poorly empirically supported assumptions. Appendix Sections C.2 and C.3 evaluate arguments about a large prize (Collier and Hoeffler, 2005; Garfinkel and Skaperdas, 2006) and about volatile oil revenues (Karl, 1997).

### 4.1 Wartime Rebel Looting

One major greed argument concerns rebel *looting* and consumption during an ongoing civil war (Collier and Hoeffler (2005, 44; Ross 2012, 145-187). However, the aforementioned attributes of economic production imply that oil production should be difficult for rebel groups to loot during ongoing civil wars. Combining this empirical observation with the logic of the model highlights why rebel looting is unlikely to explain the oil-separatist relationship.

Empirically, considerable scholarship has examined rebel looting during ongoing civil wars and reveals very few cases of oil-generated rebel finance contributing to separatist civil wars. Ross (2012, 170-3) documents oil theft by rebels in the Niger Delta region of Nigeria in the 2000s during a low-intensity civil war, although even in this "exceptional case ... the government's oil revenue is larger than the rebels"' (Colgan 2015, 6). Collier and Hoeffler (2005, 44) state that one of the "two major reasons why natural resources might be a powerful risk factor" is "the opportunity that they provide to rebel groups to finance their activities during conflict." However, they do not mention rebel looting when presenting qualitative discussions of oil-secession cases in Nigeria's Biafra conflict, Indonesia, and Sudan (Collier and Hoeffler, 2005, 47-49).

To demonstrate the lack of evidence for rebel financing more systematically, Table 3 presents the same cases as in Table 2. Rustad and Binningsbø (2012) provide an indicator variable for evidence of resources funding the insurgency. They identify 31 natural resource civil wars that involved rebel financing, but *none* of these wars occurred in oil-rich territories. The financing conflicts instead involved natural resources such as cashew nuts, charcoal extraction, cocoa, copper, diamonds, drugs, gems, and timber. This list provides additional motivation for examining attributes of the natural resource: all except copper (present in one case) are diffuse resources that create difficulties for government control, indicating a high value on the horizontal axis of Figure 3.

Several cases suggest that coding *no* financing cases overstates the rarity of this phenomenon in separatist

**Table 3: Oil-Separatist Cases: Evidence for Financing, 1946–2006**

| Country | Region | First conflict year | Evidence of financing from R&B (2012)? |
|---|---|---|---|
| Angola | Cabinda | 1975 | NO |
| Bangladesh | Chittagong Hills | 1974 | NO |
| India | Assam | 1990 | NO |
| Indonesia | Aceh | 1975 | NO |
| Iran | Kurdistan | 1966 | NO |
| Iran | Arabistan | 1979 | NO |
| Iraq | Kurdistan | 1961 | NO |
| Nigeria | Biafra | 1967 | NO |
| Nigeria | Niger Delta | 2004 | NO |
| Pakistan | Baluchistan | 1974 | NO |
| Russia | Chechnya | 1999 | NO |
| Sudan | South | 1983 | n.a. |
| Yemen | South | 1994 | NO |

*Notes*: See the note for Table 2.

civil wars over oil-rich regions, although do not alter the main point that it has very rarely occurred. In addition to the Niger Delta case mentioned above, another possible example is southern Sudanese rebels that blew up pipelines and disrupted oil production during Sudan's second civil war, although this is more consistent with the disruption mechanism than with financing. Finally, there is clear evidence of rebels earning huge profits from oil sales during the post-2011 ISIS conflict in Iraq and Syria (Dilanian, 2014), which began after the final year in Rustad and Binningsbø's (2012) dataset. However, there is considerable ambiguity regarding how to code ISIS' civil war aims, who proclaimed to establish an Islamic Caliphate in territory captured from Iraq and Syria. The Armed Conflict Database (Gleditsch et al., 2002) codes ISIS as participating in a center-seeking civil in Iraq and a separatist civil war in Syria. Correlates of War (Dixon and Sarkees, 2015) codes ISIS as participating in a center-seeking civil war in Iraq and an intercommunal conflict in Syria. However, regardless of how ISIS' civil war aims are coded, it is an exception to the general trend that rebel groups have rarely gained significant looting profits from oil to fund separatist insurgencies.[18]

[18]Other cases of oil-funded insurgencies discussed in the literature—such as Colombia, Iraq after the 2003 U.S. invasion, and Libya in 2011—involved center-seeking civil wars. Although a similar argument about the general difficulty of looting applies to center-seeking civil wars as well (Paine, 2016), for the present exposition it is useful to disaggregate types of civil wars to highlight that this phenomenon has very rarely occurred in separatist civil war cases—and therefore is unlikely to explain why oil-rich regions fight separatist civil wars relatively frequently.

Combining Assumption 1 with the logic of the model helps to explain these findings. The model can easily be extended to address wartime consumption by assuming that actors consume a positive amount in a war period and that $C$'s formal-sector production is exogenously divided between $G$ and $C$. $G$ receives $(1-\phi)\cdot x(\eta)$ percent and $C$ receives $(1-\phi)\cdot\big[1-x(\eta)\big]$ percent, where $\phi \in (0,1)$ captures the destructiveness of war. The less reliant $C$'s formal-sector production is on local labor, the easier it is for $G$ to expropriate $C$'s resources even during a war. Formally, $x \in (0,1)$ strictly decreases in $\eta$, which implies that $C$'s percentage of wartime spoils are lower in an oil-rich region (Assumption 1). Because higher $x$ decreases $C$'s expected utility to fighting, this logic yields Proposition 4.

**Proposition 4** (Oil depresses looting possibilities)**.** *An increase in C's oil production through its effect on decreasing C's percentage share of formal-sector production during a war (less looting) decreases the likelihood of separatist civil wars in equilibrium, i.e., decreases the range of $\sigma$ values small enough that C will reject any offer in a strong period. Formally, for $\overline{\sigma}$ defined in Equation 6, $\frac{d\overline{\sigma}}{dx} < 0$.*

### 4.2 Oil-Financed Insurgent Build-Up

Another argument is that rebel groups often use oil to finance *building up* their insurgent organization, perhaps by borrowing from international actors in a "booty futures" market (Ross, 2012). However, in general, it is difficult for aspiring rebels to gain access to oil wealth, especially when considering the international component. Combining empirical observations with the logic of the model highlights shortcomings of this greed argument.

Empirically, rebel groups have almost never accessed oil revenues to fund start-up costs for challenging a government because, even when this might otherwise be possible, international actors often support incumbent oil-rich regimes to stabilize oil production and prices. Among Ross' (2004, 2012) review of cases, only Congo-Brazzaville in the 1990s exhibits evidence from an oil-rich country of rebels raising start-up funds via oil in a booty futures market, and this war was not separatist. In this exceptional case, rebel leader and former president Denis Sassou-Nguesso promised to restore French oil company Elf Aquitaine's monopoly over Congo's oil if he regained power, in return for assistance. However, cases in which international actors contract on future oil promises by rebel groups are extremely rare because international oil companies and their host governments favor incumbents over challengers to prevent costly disruptions to oil production. At least empirically, this argument appears true even beyond oil. Ross (2004, 50) concludes from examining 13 prominent civil wars involving a variety of natural resources that "nascent rebel groups never gained funding before the war broke out from the extraction or sale of natural resources, or from the extortion of others who extract, transport, or market resources."

Instead, theoretical and empirical considerations suggest that oil production in any region of a country should *decrease* the challenger's probability of winning a separatist civil war by providing funds to the government. Paine (2016) explains why governments have a large advantage over rebel groups for translating oil wealth into military capacity, contrary to common allegations that oil wealth weakens state capacity. Empirically, there is considerable evidence that oil-rich countries spend large amounts on their militaries (Wright et al. 2015, 15-17; Colgan 2015, 7 provides additional citations). This corresponds with Colgan's (2015) argument: "The government's oil income is typically so much larger than the rebels' share that the relative balance of power favors the incumbent government" and with his empirical finding that oil-rich countries win civil wars at higher rates than oil-poor countries (8). Overall, contrary to the seemingly sensible idea that a rebel group in an oil-producing territory should have an advantage in arming, these substantive considerations and empirical observations instead support the opposite assumption. By decreasing $C$'s expected utility to fighting, this logic yields Proposition 5.

> **Proposition 5** (Oil hinders insurgent success)**.** *An increase in C's oil production through its effect on decreasing its probability of winning decreases the likelihood of separatist civil wars in equilibrium, i.e., decreases the range of $\sigma$ values small enough that C will reject any offer in a strong period. Formally, for $\overline{\sigma}$ defined in Equation 6,* $-\frac{d\overline{\sigma}}{dp} < 0$.

### 4.3 Disrupting Oil Production

Another greed argument is that societal actors can often *disrupt* oil production. Collier, Hoeffler and Rohner (2009, 13) state that oil production enables activities such as "'bunkering' (tapping of pipelines and theft of oil), kidnapping and ransoming of oil workers, or extortion rackets against oil companies (often disguised as 'community support')." Blair (2014) argues that people living near oil production sites can engage in protests, strikes, sabotage, or theft at these facilities. Although these specific arguments focus on activities during peacetime, disruptions are often even starker during wartime. For example, SPLA's insurgency in South Sudan prevented Chevron from producing oil in the 1980s and 1990s despite earlier discovery.

The following shows that distinguishing between disruption during peacetime and war is crucial. During peacetime, the disruption argument faces two important shortcomings. First, the implication that oil exerts an overall positive effect on improving $C$'s bargaining position contradicts the empirically grounded premises discussed above. Second, even if the disruption mechanism improves $C$'s economic exit option (or enhances the possibility of "simple revolt"), this implies that oil production makes war less rather than more frequent. The argument about wartime disruption does capture an internally consistent mechanism linking oil production to war, but is likely not a primary driver.

***Peacetime disruption.*** The first consideration for the peacetime disruption argument is that, in order to explain the general oil-separatist pattern, disrupting or stealing oil production must be systematically easier than interrupting other types of economic production—contradicting the evidence presented above. Thus, these ideas can naturally be incorporated into the framework by assuming that oil production increases the value of the challenger's economic exit option, i.e., moving up and/or to the right in Figure 3. If withholding local labor in oil-rich regions (perhaps in the form of protests or strikes) more greatly interrupts formal-sector production than if the region produced a different type of good, then oil production corresponds with a high value on the vertical axis. Despite cases such as Iran in 1978 and Venezuela in 2002 in which successful strikes temporarily shut down each country's oil production, the key question is whether oil output is more or less affected by what local residents do compared to other economic activities. As discussed, high capital-intensity of oil production and the usual ease of replacing local with foreign workers implies low elasticity (Assumption 1)—contrary to the disruption argument.

Similarly, if the challenger can more easily steal oil than other types of economic production, then this should increase the value of the informal economy and hence move oil production to the right on the horizontal axis in Figure 3. However, as noted, it is relatively easy for governments to guard oil fields because of their concentrated location, and quite difficult for rebels to gain the technical expertise and international assistance needed to reap large oil profits. Finally, these disruptions may also affect a government's ability to translate oil revenues into a strong military. But, especially during peacetime, it is unlikely that the disruptions will be sufficiently severe that more oil production *decreases* the government's probability of winning (i.e., higher $p$), given the funding advantages that governments enjoy over rebels.

Second, even if the assumptions behind these looting/disruption arguments were generally empirically relevant, the theoretical logic implies that oil production should *lower* separatist civil war incentives by triggering the opposite logic as just presented for the redistributive grievance mechanism. Research such as Blair (2014) has posited that threatening to interrupt oil production increases oil-rich residents' bargaining power relative to the government. In the language of the present model, higher $\eta$ or $\omega$ increases the value of $C$'s economic exit option, which decreases the equilibrium tax rate in weak periods and increases the size of the parameter space in which $G$ can buy off $C$ in a strong period. In other words, the opposite of Assumption 1 implies that oil production—as opposed to other economic bases—helps to smooth $C$'s income across periods and therefore *reduces* $C$'s incentives to launch a separatist bid when temporarily strong, via the logic of Proposition 2.

An alternative way to model this second consideration is to assume that $C$ has a "simple revolt" option in which it can engage in every period, receiving some value $R > 0$ rather than accepting the government's offer. This could invoke mass strikes or any other disruptive event short of conventional war definitions. If oil is assumed to increase $R$ by facilitating disruptions, then this weakly increases $C$'s lifetime expected consumption in the status quo regime which—as with the effects of increasing $\eta$ or $\omega$—makes $C$ less likely to initiate a separatist civil war in a strong period.

***Wartime disruption.*** A more compelling greed argument is that oil can trigger fighting because the process of fighting can disrupt oil production sufficiently to shift the distribution of power away from $G$. This can most clearly be considered in a model extension that allows for a third war outcome. Assume at the outset of the game there is a $p_t = p$ percentage that $C$ wins outright and gains independence, as in the baseline model. However, conditional on not winning, there are two possible outcomes. First, as in the baseline model, $C$ loses, which occurs with probability $(1-p) \cdot l$, for $l \in (0, 1)$. Second, with probability $(1-p) \cdot (1-l)$, $C$ does not secede but permanently shifts the distribution of power in its favor to some $p_t = p' > p$ in all future periods $t$.[19] If more oil production decreases $l$, then this mechanism increases $C$'s incentives to fight. This would be consistent with Lujala's (2010) finding that conflict lasts longer in territories with known hydrocarbon reserves even if there is no actual production. Although rebels do not directly profit from

[19]This idea is simple to incorporate into the model if power can only shift once. Specifically, assume the game begins at $p_t = p$, and there is a possibility of $C$'s probability of winning increasing via the intermediate war outcome if and only if $p_t = p$. If instead $p_t$ has previously shifted to $p'$ via the process described above, then $p_t = p'$ in all future periods and $l = 1$, i.e., the subgame in which a power shift has previously occurred is strategically identical to the baseline game.

looting oil, they can benefit from reducing the government's access to oil revenues. For example, rebels in South Sudan successfully prevented the government from using oil revenues by initiating fighting shortly after discovery and by blowing up pipelines.

Despite highlighting a more compelling logic than other greed mechanisms, the wartime disruption argument likely does not primarily drive the oil-separatist relationship. South Sudan is somewhat of an extreme case with regard to wartime disruption, and even in this case the disruption mechanism does not explain the strategic choices taken by the government, described above, that effectively ended the regional autonomy deal and drove SPLA to fight. Furthermore, this mechanism does not negate the general arming advantages governments enjoy from greater access to oil revenues both in peacetime and during war (Colgan, 2015, 7-8), which decreases $p$ and therefore diminishes incentives for $C$ to fight (Proposition 5). Finally, it also is not clear that oil production should systematically correlate with low $l$, as civil war disrupts all types of economic production, not just oil.[20]

## 5 Conclusion

Although rebel groups frequently fight in response to perceived economic grievances, we have limited understanding of two foundational questions. Which types of economic production tend to trigger grievances and civil war, and why? Why would a strategic government not limit economic grievances to prevent fighting? This paper offers two contributions. First, it analyzes an infinite-horizon bargaining game between a government and regional challenger, which can protect its economic production by exiting the formal economy or by coercively seceding. Economic activities that limit the value of the challenger's economic exit option exacerbate the adverse consequences of the government's commitment inability by incentivizing high tax rates (Lemma 3). This strategic behavior creates redistributive grievances in equilibrium and increases civil war likelihood (Proposition 2). Furthermore, strategic governments may choose not to limit the challenger's grievances by granting regional autonomy because forgoing rents creates an opportunity cost (Proposition 3).

Second, the article applies the logic to explain a core empirical finding about natural resources and conflict: oil-rich regions fight separatist civil wars relatively frequently. The capital-intense and immobile nature of

[20]Blattman and Miguel (2010, 37-45) summarize evidence of economic disruption during civil wars.

oil production facilitates easy government tax revenues. This corresponds with model conditions predicting war by creating economic grievances, and differentiates oil from other economic activities that are more difficult for governments to tax (Figure 3). Therefore, insights from theories of commitment problems and civil war can be productively applied to inform the widely debated conflict resource curse. Finally, applying and extending the model enables evaluating greed mechanisms focused on how resource production enhances rebel capacity, the main alternative explanations for the oil-separatist pattern. Combining the theoretical logic with empirical observations shows that greed arguments do not convincingly explain the oil-separatist pattern (Propositions 4 and 5).

These findings also carry theoretical and empirical implications for various grievances and greed mechanisms in the broader civil war literature. The article provides a framework for understanding how properties of economic production—such as output elasticity, the value of exiting to an informal sector, and price volatility—create redistributive grievances and foster civil war incentives. The theoretical implications from the model yield hypotheses that could be tested empirically for various economic commodities, for example, by combining the theoretical logic of the model with commodities in different positions in Figure 3. Furthermore, the model analysis of regional autonomy deals also carries insights into broader questions about grievances such as why a government would exclude ethnic groups from political power if this raises the likelihood of a costly activity, civil war (Cederman, Gleditsch and Buhaug, 2013), by focusing on why a government may strategically choose not to alleviate grievances.

Additionally, understanding why greed theories cannot explain the oil-separatist relationship may also help to better understand scope conditions for mechanisms such as rebel looting and rebel finance. Natural resources more easily looted than oil—such as alluvial diamonds—provide more viable sources of rebel finance. Therefore, if looting is a generally relevant mechanism for causing civil wars, then easily lootable resources such as alluvial diamonds should be systematically associated with separatism. However, although additional research is needed, existing empirical results show the relationship between alluvial diamonds and civil war is somewhat weak (Ross, 2015, 250). Continued analysis of which aspects of economic production trigger grievances and war, and why strategic governments may choose not to stem these grievances, will provide greater insight into civil wars.

## References


Acemoglu, Daron and James A. Robinson. 2000. "Why did the West Extend the Franchise? Democracy, Inequality, and Growth in Historical Perspective." *Quarterly Journal of Economics* 115(4):1167–1199.

Acemoglu, Daron and James A. Robinson. 2006. *Economic Origins of Dictatorship and Democracy*.

Acemoglu, Daron, Thierry Verdier and James A. Robinson. 2004. "Kleptocracy and Divide-and-Rule: A Model Of Personal Rule." *Journal of the European Economic Association* 2(2-3):162–192.

Bates, Robert H. 1981. *Markets and States in Tropical Africa*. University of California Press.

Bazzi, Samuel and Christopher Blattman. 2014. "Economic Shocks and Conflict: Evidence from Commodity Prices." *American Economic Journal: Macroeconomics* 6(4):1–38.

Besley, Timothy and Torsten Persson. 2011. *Pillars of Prosperity: The Political Economics of Development Clusters*. Princeton University Press.

Blair, Graeme. 2014. "On the Geography of Assets and Citizens: How Proximity to Oil Production Shapes Political Order." Ph.D. dissertation, Department of Politics, Princeton University.

Blattman, Christopher and Edward Miguel. 2010. "Civil War." *Journal of Economic Literature* 48(1):3–57.

Boix, Carles. 2003. *Democracy and Redistribution*. Cambridge University Press.

Boix, Carles. 2008. "Economic Roots of Civil Wars and Revolutions in the Contemporary World." *World Politics* 60(3):390–437.

Cederman, Lars-Erik, Kristian Skrede Gleditsch and Halvard Buhaug. 2013. *Inequality, Grievances, and Civil War*. Cambridge University Press.

Cederman, Lars-Erik, Nils B. Weidmann and Kristian Skrede Gleditsch. 2011. "Horizontal Inequalities and Ethnonationalist Civil War: A Global Comparison." *American Political Science Review* 105(3):478–495.

Colgan, Jeff D. 2013. *Petro-Aggression: When Oil Causes War*. Cambridge University Press.

Colgan, Jeff D. 2015. "Oil, Domestic Conflict, and Opportunities for Democratization." *Journal of Peace Research* 52(1):3–16.

Collier, Paul and Anke Hoeffler. 1998. "On Economic Causes of Civil War." *Oxford Economic Papers* 50(4):563–573.

Collier, Paul and Anke Hoeffler. 2004. "Greed and Grievance in Civil War." *Oxford Economic Papers* 56(4):563–595.

Collier, Paul and Anke Hoeffler. 2005. The Political Economy of Secession. In *Negotiating Self-Determination*, ed. Hurst Hannum and Eileen F. Babbitt. Lexington Books pp. 37–60.

Collier, Paul, Anke Hoeffler and Dominic Rohner. 2009. "Beyond Greed and Grievance: Feasibility and Civil War." *Oxford Economic Papers* 61(1):1–27.

Cotet, Anca M. and Kevin K. Tsui. 2013. "Oil and Conflict: What Does the Cross Country Evidence Really Show?" *American Economic Journal: Macroeconomics* 5(1):49–80.

de Soto, Hernando. 2000. *The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else*. Basic Books.

Dilanian, Ken. 2014. "ISIS Became the Richest Terrorist Group Ever by Raising Money Like a Mafia." Business Insider. Accessed 11/19/14.

Dixon, Jeffrey S. and Meredith Reid Sarkees. 2015. *A Guide to Intra-State Wars: An Examination of Civil, Regional, and Intercommunal Wars, 1816-2014*. CQ Press.

Dunning, Thad. 2005. "Resource Dependence, Economic Performance, and Political Stability." *Journal of Conflict Resolution* 49(4):451–482.

Dunning, Thad. 2008. *Crude Democracy: Natural Resource Wealth and Political Regimes*. Cambridge University Press.

Fearon, James D. 1995. "Rationalist Explanations for War." *International Organization* 49(3):379–414.

Fearon, James D. 2004. "Why Do Some Civil Wars Last So Much Longer Than Others?" *Journal of Peace Research* 41(3):275–301.

Fearon, James D. 2005. "Primary Commodity Exports and Civil War." *Journal of Conflict Resolution* 49(4):483–507.

Fearon, James D. and David D. Laitin. 2003. "Ethnicity, Insurgency, and Civil War." *American Political Science Review* 97(1):75–90.

Garfinkel, Michelle R. and Stergios Skaperdas. 2006. Economics of Conflict: An Overview. In *Handbook of Defense Economics, Vol. 2: Defense in a Globalized World*, ed. Todd Sander and Keith Hartley. North-Holland pp. 649–710.

Gleditsch, Nils Petter, Peter Wallensteen, Mikael Eriksson, Margareta Sollenberg and Håvard Strand. 2002. "Armed Conflict 1946-2001: A New Dataset." *Journal of Peace Research* 39(5):615–637.

Gurr, Ted Robert. 1970. *Why Men Rebel*. Princeton University Press.

Horn, Mike. 2015. "Giant, Supergiant & Megagiant Oil and Gas Fields of the World.". Dataset available at `https://worldmap.harvard.edu/data/geonode:giant_oil_and_gas_fields_of_the_world_co_yxz`. Accessed 7/17/17.

Horowitz, Donald L. 1985. *Ethnic Groups in Conflict*. University of California Press.

Humphreys, Macartan. 2005. "Natural Resources, Conflict, and Conflict Resolution: Uncovering the Mechanisms." *Journal of Conflict Resolution* 49(4):508–537.

Hunziker, Philipp and Lars-Erik Cederman. 2017. "No Extraction Without Representation: The Ethno-Regional Oil Curse and Secessionist Conflict." *Journal of Peace Research* 54(3):365–381.

Jenne, Erin K., Stephen M. Saideman and Will Lowe. 2007. "Separatism as a Bargaining Posture: The Role of Leverage in Minority Radicalization." *Journal of Peace Research* 44(5):539–558.

Johnston, Trevor. 2015. "Authoritarian Abdication: Bargaining Power and the Role of Firms in Migrant Welfare." Working paper, Department of Political Science, University of Michigan. Accessed 11/8/17.

Jones, Toby Craig. 2010. *Desert Kingdom: How Oil and Water Forged Modern Saudi Arabia*. Harvard University Press.

Karl, Terry Lynn. 1997. *The Paradox of Plenty: Oil Booms and Petro-States*. University of California Press.

Krainin, Colin. 2017. "Preventive War as a Result of Long Term Shifts in Power." *Political Science Research and Methods* 5(1):103–121.

Le Billon, Philippe. 2005. *Fuelling War: Natural Resources and Armed Conflicts*. Routledge.

Le Billon, Philippe. 2007. Drilling in Deep Water: Oil, Business and War in Angola. In *Oil Wars*, ed. Terry Lynn Karl Mary Kaldor and Yahia Said. Pluto Press pp. 100–129.

Lujala, Päivi. 2010. "The Spoils of Nature: Armed Civil Conflict and Rebel Access to Natural Resources." *Journal of Peace Research* 47(1):15–28.

Menaldo, Victor. 2016. *The Institutions Curse: Natural Resources, Politics, and Development*. Cambridge University Press.

Morelli, Massimo and Dominic Rohner. 2015. "Resource Concentration and Civil Wars." *Journal of Development Economics* 117:32–47.

Ofcansky, Thomas. 1992. "Sudan: Country Studies - Federal Research Division, Library of Congress. Chapter 1.".

Olson, Mancur. 2000. *Power and Prosperity: Outgrowing Communist and Capitalist Dictatorships*. Basic Books.

Paine, Jack. 2016. "Rethinking the Conflict "Resource Curse": How Oil Wealth Prevents Center-Seeking Civil Wars." *International Organization* 70(4):727–761.

Paine, Jack. 2017. "A Theory of Strategic Civil War Aims: Explaining the Mixed Oil-Conflict Curse." Working paper, Department of Political Science, University of Rochester. Accessed 11/16/17.

Porto, João Gomes. 2003. *Cabinda: Notes on a Soon-to-be-Forgotten War*. Institute for Security Studies. Paper 77.

Powell, Robert. 2004. "The Inefficient Use of Power: Costly Conflict with Complete Information." *American Political Science Review* 98(2):231–241.

Ross, Michael L. 2004. "How Do Natural Resources Influence Civil War? Evidence from Thirteen Cases." *International Organization* 58(1):35–67.

Ross, Michael L. 2012. *The Oil Curse: How Petroleum Wealth Shapes the Development of Nations*. Princeton University Press.

Ross, Michael L. 2015. "What Have We Learned About the Resource Curse?" *Annual Review of Political Science* 18:239–259.

Rustad, Siri Aas and Helga Malmin Binningsbø. 2012. "A Price Worth Fighting For? Natural Resources and Conflict Recurrence." *Journal of Peace Research* 49(4):531–546.

Sambanis, Nicholas. 2005. Conclusion: Using Case Studies to Refine and Expand the Theory of Civil War. In *Understanding Civil War, Volume 2: Europe, Central Asia, and Other Regions*, ed. Paul Collier and Nicholas Sambanis. World Bank pp. 299–330.

Scott, James C. 2010. *The Art of Not Being Governed: An Anarchist History of Upland Southeast Asia*. Yale University Press.

Smith, Benjamin. 2016. Exploring the Resource-Civil War Nexus. In *What do We Know About Civil War?*, ed. T. David Mason and Sara Mitchell. Rowman & Littlefield pp. 215–30.

Sorens, Jason. 2011. "Mineral Production, Territory, and Ethnic Rebellion: The Role of Rebel Constituencies." *Journal of Peace Research* 48(5):571–585.

Vogt, Manuel, Nils-Christian Bormann, Seraina Rüegger, Lars-Erik Cederman, Philipp Hunziker and Luc Girardin. 2015. "Integrating Data on Ethnicity, Geography, and Conflict: The Ethnic Power Relations Data Set Family." *Journal of Conflict Resolution* 59(7):1327–1342.

Walter, Barbara F. 2009. "Bargaining Failures and Civil War." *Annual Review of Political Science* 12:243–261.

Ward, Steven R. 2009. *Immortal: A Military History of Iran and Its Armed Forces*. Georgetown University Press.

Wood, Elisabeth Jean. 2003. *Insurgent Collective Action and Civil War in El Salvador*. Cambridge University Press.

Wright, Joseph, Erica Frantz and Barbara Geddes. 2015. "Oil and Autocratic Regime Survival." *British Journal of Political Science* 45(2):287–306.

Zanger, Maggy. 2002. "Refugees in Their Own Country." *Middle East Report* (222):40–43.

# Supplementary Information

## Contents



## List of Tables

# List of Figures



# A Supporting Information for Baseline Model

**Table A.1: Summary of Parameters and Choice Variables**

| **Stage** | **Variables/description** |
|---|---|
| Primitives | • $G$: government<br>• $C$: regional challenger<br>• $\delta$: discount factor<br>• $t$: time |
| 1. Distribution of power stage | • $\sigma$: Probability $C$ is strong in any period $t$ in the s.q. territorial regime |
| 2. Taxation stage | • $\tau_t$: $G$'s proposed tax rate |
| 3. Fighting decision stage | • $p$: $C$'s probability of winning if it initiates a war in a strong period |
| 4. Labor supply stage | • $L_t$: $C$'s formal-sector labor supply<br>• $\theta(\cdot)$: formal-sector production function<br>• $\eta$: formal-sector output elasticity<br>• $\kappa(\cdot)$: opportunity cost, from foregoing informal-sector production, of supplying formal-sector labor<br>• $\omega$: parameterizes opportunity cost of formal-sector labor (higher $\omega \implies$ higher labor elasticity) |
| Continuation values | • $V^G_{\text{s.q.}}$: $G$'s future continuation value in the s.q. territorial regime<br>• $V^C_{\text{s.q.}}$: $C$'s future continuation value in the s.q. territorial regime<br>• $V^C_{\text{sec}}$: $C$'s future continuation value in the secession subgame |
| Parameters in greed extensions | • $\phi$: Percentage of $C$'s formal-sector production destroyed in the period of a separatist civil war<br>• $x$: Percentage of $C$'s formal-sector production (not destroyed by the war) that accrues to $G$<br>• $R$: Value to $C$ of simple revolt option<br>• $Y^C$: value of formal-sector output<br>• $\frac{Y^C}{b}$: value of formal-sector output in bust periods<br>• $\gamma$: frequency of boom periods |

## A.1 Equilibrium Existence

A Markov Perfect Equilibrium (MPE) requires players to choose best responses to each other, with strategies predicated upon the state of the world and on actions within the current period. Three types of periods compose the three values of the state variable $\mu_t$ in a generic period $t$. If $C$ is strong in period $t$, then $\mu_t = \mu^s$. If $C$ is weak in period $t$, then $\mu_t = \mu^w$. If $C$ has won a civil war in a previous period, then $\mu_t = \mu^0$. The superscripts respectively stand for "strong," "weak," and "0 taxation after secession."

If $\mu_t \in \{\mu^s, \mu^w\}$, then $G$'s strategy is a function $\tau(\cdot)$ that assigns a tax rate to each state. Formally, $\tau : \{\mu^s, \mu^w\} \to [0, 1]$, and $\tau^*_s$ and $\tau^*_w$ represent equilibrium choices. If $\mu_t = \mu^0$, then $\tau_t$ is fixed at 0 by assumption. $C$'s strategy consists of two functions, $\alpha(\cdot)$ and $L(\cdot)$, that respectively assign an acceptance/fighting decision and a formal-sector labor supply to each state of the world and to $G$'s current-period choice of $\tau_t$. Formally, $\alpha : \{\mu^s\} \times [0,1] \to [0,1]$, and $\alpha^*$ represents the equilibrium probability of acceptance term. Additionally, $L : \Big(\{\mu^s, \mu^w\} \times [0,1]\Big) \cup \{\mu^0\} \to \mathbb{R}_+$, and $L_s^*$, $L_w^*$, and $L_0^*$ represent equilibrium choices. An MPE is a strategy profile $\{\tau_s^*, \tau_w^*, L_s^*, L_w^*, L_0^*, \alpha^*\}$ such that $G$'s and $C$'s strategies compose best responses to each other. An MPE strategy profile is peaceful if $\alpha^* = 1$.

***Proof of Lemma 1.*** $C$ solves:

$$L^*(\tau_t) \in \arg\max_{L_t \geq 0} \ (1-\tau_t) \cdot \theta(L_t) - \kappa(L_t) + \delta \cdot V^C_{\text{s.q.}}$$

For expositional clarity, I will solve this as an unconstrained optimization problem and then verify that the constraint $L_t \geq 0$ is satisfied. Because $\theta(L_t)$ is strictly concave in $L_t$ and $\kappa(L_t)$ is strictly convex in $L_t$, the objective function is strictly concave in $L_t$. This implies that the solution to the first-order condition is the unique maximizer. The first order condition implicitly defines $L^*$:

$$(1-\tau_t) \cdot \frac{\partial \theta(L^*)}{\partial L_t} - \frac{\partial \kappa(L^*)}{\partial L_t} = 0$$

Substituting in $\frac{\partial \theta(L_t)}{\partial L_t} = \eta \cdot L_t^{\eta-1}$ and $\frac{\partial \kappa(L^*)}{\partial L_t} = L_t^{\frac{1}{\omega}}$ yields:

$$\underbrace{(1-\tau_t) \cdot \eta \cdot L_t^{\eta-1}}_{\text{MB}} = \underbrace{L_t^{\frac{1}{\omega}}}_{\text{MC}}$$

This solves to:

$$L^*(\tau_t) = \Big[(1-\tau_t) \cdot \eta\Big]^{\frac{\omega}{1+\omega\cdot(1-\eta)}} \tag{A.1}$$

Finally, $L^*(\tau_t) \geq 0$ for all $\tau_t$ because $\tau_t \leq 1$ and $\eta > 0$ by assumption. The consumption terms stated in Lemma 1 follow directly. ■

Lemma A.1 formalizes the claim from the text that the results would be unchanged if residents of the region independently make labor allocation decisions after the rebel leader makes a decision to fight or not.

**Lemma A.1.** *If $N \in \mathbb{Z}_{++}$ residents independently choose how much labor to supply, then total labor allocation in the unique symmetric equilibrium is identical to the case considered in the paper of a single leader among $C$ choosing the labor allocation.*

***Proof.*** Assume $\theta(\cdot)$ and $\kappa(\cdot)$ are each a function of average labor input. Therefore, a generic resident $i$ solves:

$$\max_{L_i} \ (1-\tau_t) \cdot \left(\frac{L_i + \sum_{N\setminus\{i\}} L_j}{N}\right)^{\eta} - \frac{\omega}{1+\omega} \cdot \left(\frac{L_i + \sum_{N\setminus\{i\}} L_j}{N}\right)^{\frac{1+\omega}{\omega}}$$

Denote the per-person equilibrium labor supply as $L^*$ and the average equilibrium labor supply as $\overline{L}^* \equiv \frac{\sum_N L^*}{N}$. Solving the first-order condition yields:

$$(1-\tau_t) \cdot \eta \cdot \frac{1}{N} \cdot \left(\overline{L}^*\right)^{-(1-\eta)} = \frac{1}{N} \cdot \left(\overline{L}^*\right)^{\frac{1}{\omega}}$$

This yields the same average labor supply function in the text:

$$\overline{L}^*(\tau_t) = \Big[(1-\tau_t)\cdot\eta\Big]^{\frac{\omega}{1+\omega\cdot(1-\eta)}} \qquad \blacksquare$$

The following lemma will be used to prove Lemma 2.

**Lemma A.2.** *If $a \in (0,1)$, then $f(\tau) = \tau \cdot (1-\tau)^a$ is strictly concave in $\tau$ over $\tau \in (0,1)$.*

***Proof.*** It suffices to show that the second derivative is strictly negative. $f' = (1-\tau)^a - \tau \cdot a \cdot (1-\tau)^{a-1}$ and $f'' = -a\cdot(1-\tau)^{a-2}\cdot\big[2\cdot(1-\tau)+\tau\cdot(1-a)\big]$. This term is strictly negative if $a \in (0,1)$ and $\tau \in (0,1)$. $\blacksquare$

***Proof of Lemma 2.*** Solving backwards on the stage game, Equation 2 characterizes $C$'s optimal labor supply function. $G$ solves:

$$\overline{\tau} \in \arg\max_{\tau_t\in[0,1]} \tau_t \cdot \theta\big(L^*(\tau_t)\big) + \delta \cdot V^G_{\text{s.q.}},$$

For expositional clarity, I will solve this as an unconstrained optimization problem and then verify that the constraint $\tau_t \in [0,1]$ is satisfied. After substituting in functional forms, this objective function is equivalent to:

$$\overline{\tau} \in \arg\max_{\tau_t\in[0,1]} \tau_t \cdot \Big[(1-\tau_t)\cdot\eta\Big]^{\frac{\omega\cdot\eta}{1+\omega\cdot(1-\eta)}} + \delta\cdot V^G_{\text{s.q.}}.$$

Because $\omega \in (0,1)$ and $\eta \in (0,1)$, $\frac{\omega\cdot\eta}{1+\omega\cdot(1-\eta)} \in (0,1)$. Furthermore, $\eta^{\frac{\omega\cdot\eta}{1+\omega\cdot(1-\eta)}} > 0$. Therefore, invoking Lemma A.2 implies that the objective function is strictly concave in $\tau_t$, which implies that the solution to the first-order condition is the unique maximizer.

The first-order condition solves to:

$$\Big[(1-\overline{\tau})\cdot\eta\Big]^{\frac{\omega\cdot\eta}{1+\omega(1-\eta)}} \cdot \left[1-\overline{\tau}\cdot\left(1-\frac{\omega\cdot\eta}{1+\omega(1-\eta)}\right)\right] = 0 \tag{A.2}$$

Rearranging yields:

$$\overline{\tau} = \frac{1+\omega\cdot(1-\eta)}{1+\omega}$$

Because $\omega > 0$ and $\eta < 1$ by assumption, $\overline{\tau} > 0$. Because additionally $\eta > 0$ by assumption, $\overline{\tau} < 1$. $\blacksquare$

Definition A.1 characterizes a minimum discount rate for $C$ to credibly separate in a strong period in reaction to an offer $\tau_t = \overline{\tau}$ in every period in the status quo territorial regime. Sufficient patience is necessary because $C$ does not reap the expected gains of fighting until the future. It is possible to explicitly solve for $\delta$ because none of the optimal choice variables included in Definition A.1 are a function of $\delta$.

**Definition A.1** (Lower bound discount rate for credible fighting threat)**.**

$$\underline{\delta}_C \equiv \frac{(1-\overline{\tau})\cdot\theta(\overline{L})-\kappa(\overline{L})}{p\cdot\Big\{\big[\theta(L_0^*)-\kappa(L_0^*)\big]-\big[(1-\overline{\tau})\cdot\theta(\overline{L})-\kappa(\overline{L})\big]\Big\}}$$

Definition A.2 revises Equation 3 to characterize the current-period tax offer in a strong period that makes $C$ indifferent between accepting and fighting, holding fixed future equilibrium values. This offer is unique because $\Psi(\tau_t)$ strictly decreases in $\tau_t$, which can be shown by applying the envelope theorem to $C$'s consumption function. It is only possible to have $\Psi(\tau_t)=0$ if $\delta > \underline{\delta}_C$.

**Definition A.2** (Indifference condition for current-period tax rate)**.**

$$\Psi(\tau_t) \equiv (1-\tau_t)\cdot\theta\big(L^*(\tau_t)\big)-\kappa\big(L^*(\tau_t)\big)$$

$$+\frac{\delta\cdot p}{1-\delta}\cdot\Big\{\sigma\cdot\Big[(1-\tau_s^*)\cdot\theta(L_s^*)-\kappa(L_s^*)\Big]+(1-\sigma)\cdot\Big[(1-\overline{\tau})\cdot\theta(\overline{L})-\kappa(\overline{L})\Big]\Big\}$$

$$-\frac{\delta\cdot p}{1-\delta}\cdot\Big[\theta(L_0^*)-\kappa(L_0^*)\Big]=0$$

Lemma A.3 characterizes optimal actions in a strong period.

**Lemma A.3** (Actions/consumption in a strong period)**.** *Define $\tau_s^*$ as the equilibrium strong-period tax rate proposal. If $C$ is strong in period $t$:*

- *If $\sigma > \overline{\sigma}$, then $G$ offers $\tau_t = \tau_s^* = \overline{\tau}$ if this satisfies Equation 3, and otherwise offers the unique $\tau_t = \tau_s^* \in (0,\overline{\tau})$ that satisfies Equation 3 with equality. $C$ accepts with probability 1 any offer that satisfies Equation 3 and chooses $L_t = L^*(\tau_t)$, for $L^*(\tau_t)$ defined in Equations 1 and 2. $C$ fights with probability 1 in response any offer that does not satisfy Equation 3. In equilibrium, $L_s^* \equiv \Big[(1-\tau_s^*)\cdot\eta\Big]^{\frac{\omega}{1+\omega\cdot(1-\eta)}}$. Denoting $C$'s equilibrium current-period consumption amount as $U_C(\mathit{strong})$ and $G$'s as $U_G(\mathit{strong})$, these terms and the status quo future continuation values equal:*
  - $U_C(\mathit{strong}) = (1-\tau_s^*)\cdot\theta(L_s^*)-\kappa(L_s^*)$
  - $V_{\mathit{s.q.}}^C = \frac{1}{1-\delta}\cdot\Big[\sigma\cdot U_C(\mathit{strong})+(1-\sigma)\cdot U_C(\mathit{weak})\Big]$*. Lemma 2 defines $U_C(\mathit{weak})$.*
  - $U_G(\mathit{strong}) = \tau_s^*\cdot\theta(L_s^*)$
  - $V_{\mathit{s.q.}}^G = \frac{1}{1-\delta}\cdot\Big[\sigma\cdot U_G(\mathit{strong})+(1-\sigma)\cdot U_G(\mathit{weak})\Big]$*. Lemma 2 defines $U_G(\mathit{weak})$.*
- *If $\sigma < \overline{\sigma}$, then $\tau_t \in [0,1]$. $C$ fights with probability 1 in response to any tax offer. Denoting $C$'s continuation value following a strong period in the status quo regime as $V_{\mathit{strong}}^C$ and $G$'s as $V_{\mathit{strong}}^G$, the following equilibrium current-period consumption and future continuation terms differ if $\sigma < \overline{\sigma}$ as opposed to $\sigma > \overline{\sigma}$:*
  - $V_{\mathit{strong}}^C = \delta\cdot\Big[p\cdot V_{\mathit{sec}}^C+(1-p)\cdot V_{\mathit{s.q.}}^C\Big]$*. Lemma 1 defines $V_{\mathit{sec}}^C$.*
  - $V_{\mathit{strong}}^G = \delta\cdot(1-p)\cdot V_{\mathit{s.q.}}^G$

The proof of Lemma A.3 begins by defining $C$'s optimal acceptance function and $G$'s optimization problem for $\tau_t$, and proving that three cases partition the parameter space. In the first two cases, a peaceful path of play is possible in equilibrium. Case 1 characterizes optimal actions if $G$ can induce acceptance from $C$ in a strong period by offering $\tau_t = \overline{\tau}$. Case 2 characterizes optimal actions if $G$ cannot induce acceptance from $C$ in a strong period by offering $\tau_t = \overline{\tau}$ but there do exist $\tau_t > 0$ such that $G$ can induce acceptance. Case 3 characterizes optimal actions if a peaceful path of play is not possible in equilibrium.

***Proof of Lemma A.3.***

**Preliminaries.** Solving backwards on the stage game if $\mu_t = \mu^s$, Equation 2 characterizes $C$'s unique optimal labor supply function. For the fighting decision stage, recall that $\alpha(\tau_t)$ denotes $C$'s probability of acceptance given the period $t$ proposed tax rate if the continuation values specify acceptance in all future periods. Any equilibrium must satisfy:

$$\alpha(\tau_t) = \begin{cases} 0 & \Psi(\tau_t) < 0 \\ [0,1] & \Psi(\tau_t) = 0 \\ 1 & \Psi(\tau_t) > 0, \end{cases} \tag{A.3}$$

for $\Psi(\tau_t)$ defined in Definition A.2. $C$ cannot profitably deviate to $\alpha(\tau_t) > 0$ if $\Psi(\tau_t) < 0$, or to $\alpha(\tau_t) < 1$ if $\Psi(\tau_t) > 0$.

If $G$ chooses $\tau_t$ to buy off $C$, it solves:

$$\max_{\tau_t \in [0,1]} \tau_t \cdot \Big[(1-\tau_t)\cdot\eta\Big]^{\frac{\omega\cdot\eta}{1+\omega\cdot(1-\eta)}} + \delta \cdot V^G_{\text{s.q.}} \text{ s.t. } \Psi(\tau_t) \geq 0 \tag{A.4}$$

This optimization problem posits a single deviation for $G$ from the posited equilibrium strong-period tax offer $\tau_s^*$ because $\tau_s^*$ is assumed to be fixed in future periods, a term subsumed into the continuation value $V^G_{\text{s.q.}}$ and into $\Psi(\tau_t)$. Equation A.4 can be written as a Lagrangian with an inequality constraint. Because the optimal strong-period tax rate is interior for the same reasons as shown in Lemma 2, I ignore the boundary constraints on the tax rate to avoid notational clutter. Defining the Lagrange multiplier on the inequality as $\lambda$, the first-order condition enables implicitly solving for $\tau_s^*$:

$$\Big[(1-\tau_s^*)\cdot\eta\Big]^{\frac{\omega\cdot\eta}{1+\omega(1-\eta)}} \cdot \left[1 - \tau_s^* \cdot \left(1 - \frac{\omega\cdot\eta}{1+\omega(1-\eta)}\right) - \lambda\right] = 0,$$

This term is nearly is identical to Equation A.2. The difference arises from the multiplier $\lambda$, and that part of the expression results from applying the envelope theorem to $C$'s consumption function. This simplifies to the first KKT condition:

$$(1) \quad \lambda^* = 1 - \tau_s^* \cdot \left(1 - \frac{\omega\cdot\eta}{1+\omega(1-\eta)}\right)$$

The other KKT conditions are:

$$(2)\ \lambda^*\cdot\Psi^*(\tau_s^*) = 0, \quad (3)\ \lambda^* \geq 0, \quad (4)\ \Psi^*(\tau_s^*) \geq 0,$$

which follows from substituting in the equilibrium term $\tau_t = \tau_s^*$ and modifying the definition of $\Psi(\cdot)$ in Definition A.2 to define:

$$\Psi^*(\tau_s^*) \equiv (1-\tau_s^*)\cdot\theta(L_s^*) - \kappa(L_s^*) + \frac{\delta\cdot p}{1-\delta}\cdot\Big\{\sigma\cdot\Big[(1-\tau_s^*)\cdot\theta(L_s^*) - \kappa(L_s^*)\Big] + (1-\sigma)\cdot\Big[(1-\overline{\tau})\cdot\theta(\overline{L}) - \kappa(\overline{L})\Big]\Big\}$$
$$-\frac{\delta\cdot p}{1-\delta}\cdot\Big[\theta(L_0^*) - \kappa(L_0^*)\Big] = 0$$

Three cases generically partition the parameter space:

1. $\Psi^*(\overline{\tau}) > 0$
2. $\Psi^*(\overline{\tau}) < 0 < \Psi^*(0)$
3. $\Psi^*(0) < 0$

Cases 1 and 2 feature peaceful bargaining in equilibrium. Applying the envelope theorem to $C$'s consumption function establishes that $\Psi^*(\tau_s^*)$ strictly decreases in $\tau_s^*$, which implies that these cases partition the parameter space.

**Case 1. $\boldsymbol{\Psi^*(\overline{\tau}) > 0}$**. Need to show that if $\Psi^*(\overline{\tau}) > 0$, then $\tau_s^* = \overline{\tau}$. First, prove $\tau_s^* = \overline{\tau}$ is a solution. If $\Psi^*(\overline{\tau}) \geq 0$ and $\tau_s^* = \overline{\tau}$, then the fourth KKT condition is trivially satisfied. Substituting the term for $\overline{\tau}$ from Equation 5 into the first KKT condition yields $\lambda^* = 0$, which also trivially satisfies the second and third KKT conditions.

Second, prove $\tau_s^* = \overline{\tau}$ is the unique solution by generating contradictions for alternative candidate solutions.

- Any $\tau_s^* > \overline{\tau}$ cannot be a solution. $\lambda^*$, as defined in KKT condition 1, is a strictly decreasing function of $\tau_s^*$. Because $\lambda^* = 0$ for $\tau_s^* = \overline{\tau}$, the first KKT condition implies $\lambda^* < 0$ for any $\tau_s^* > \overline{\tau}$, which violates the third KKT condition. (For high enough $\tau_s^*$, $C$ may reject the offer. This does not alter the proof, however, because it is not incentive-compatible for $G$ to offer $\tau_s^* > \overline{\tau}$ and experience fighting rather than to consume maximum revenues in every period.)
- If $\Psi^*(\overline{\tau}) = 0$, then $\tau_s^* = \overline{\tau}$ is a solution (see above), and it is unique because the strict monotonicity of $\Psi^*(\tau_s^*)$ implies that any solution is unique.
- If $\Psi^*(\overline{\tau}) > 0$, then any $\tau_s^* < \overline{\tau}$ cannot be a solution. KKT condition 1 shows that $\lambda^* > 0$ for any $\tau_t < \overline{\tau}$. Furthermore, because $\Psi^*$ strictly decreases in $\tau_s^*$, if $\Psi^*(\overline{\tau}) > 0$ and $\tau_s^* < \overline{\tau}$, then $\Psi^*(\tau_s^*) > 0$. Having both $\lambda^* > 0$ and $\Psi^*(\tau_s^*) > 0$ violates the second KKT condition.

**Case 2. $\boldsymbol{\Psi^*(\overline{\tau}) < 0 < \Psi^*(0)}$**. I will further disaggregate this case into four parts. Part 1 solves for the offer $\tau_t = \tau_s^*$ such that $\Psi^*(\tau_s^*) = 0$. Part 2 shows that $C$ does not have a profitable deviation from playing $\alpha(\tau_s^*) = 1$, i.e., accepting with probability 1 the strong-period offer that makes it indifferent between accepting and fighting. Part 3 shows that no equilibrium exists in which $\alpha(\tau_s^*) < 1$, i.e., there is no equilibrium in which $C$ rejects with positive probability an offer that makes it indifferent between accepting and fighting. Part 4 shows that $G$ cannot profitably deviate from offering $\tau_t = \tau_s^*$.

*Part 1.* Need to show that if $\Psi^*(\overline{\tau}) < 0 < \Psi^*(0)$, then there exists a unique $\tau_s^* \in (0, \overline{\tau})$ such that $\Psi^*(\tau_s^*) = 0$. If $\Psi^*(\overline{\tau}) < 0$, then only $\tau_s^*$ such that $\tau_s^* < \overline{\tau}$ can possibly satisfy the fourth KKT condition from the optimization problem in Equation A.4. The first KKT condition implies for any $\tau_s^* < \overline{\tau}$ that $\lambda^* > 0$ (which trivially satisfies the third KKT condition). This in turn implies that only $\tau_s^*$ such that $\Psi^*(\tau_s^*) = 0$ satisfy the second

KKT condition (which also trivially satisfies the fourth KKT condition). Applying the intermediate value theorem demonstrates the existence of at least one $\tau_s^* \in (0, \overline{\tau})$ such that $\Psi^*(\tau_s^*) = 0$.

- We are currently assuming $\Psi^*(\overline{\tau}) < 0$.
- We are currently assuming $\Psi^*(0) > 0$.
- $L^*(\tau_t)$ is a continuous function and $\theta(\cdot)$ is assumed to be continuous in $L_t$. Therefore, $\Psi^*(\cdot)$ is continuous in $\tau_s^*$.

Furthermore, the strict monotonicity of $\Psi^*(\cdot)$ in $\tau_s^*$ implies the $\tau_s^*$ that satisfies all four KKT conditions is unique.

*Part 2.* Follows immediately from Equation A.3 and from defining $\tau_s^*$ as the solution to $\Psi^*(\tau_s^*) = 0$.

*Part 3.* I will demonstrate that there does not exist an equilibrium strategy profile in which $\alpha(\tau_s^*) < 1$ by generating a contradiction. If $\alpha(\tau_s^*) < 1$, then a peaceful equilibrium strategy profile requires offering some $\tau_t > \tau_s^*$ (see the definition of a peaceful equilibrium strategy profile above when defining the equilibrium concept, and Equation A.3). Modifying Equation A.4, $G$ therefore chooses:

$$\max_{\tau_t \in [0,1]} \tau_t \cdot \Big[(1-\tau_t)\cdot\eta\Big]^{\frac{\omega\cdot\eta}{1+\omega\cdot(1-\eta)}} + \delta \cdot V_{\text{s.q.}}^G \text{ s.t. } \Psi(\tau_t) > 0$$

The strict inequality on the constraint generates an open set problem that yields a profitable deviation for $G$ from any $\tau_t$ such that $\tau_t > \tau_s^*$.

*Part 4.* Combining Equation A.3 and Part 3 establishes that the only possible equilibrium acceptance functions for $C$ involve acceptance with probability 1, if $\tau_t \geq \tau_s^*$, or acceptance with probability 0, if $\tau_t < \tau_s^*$. If it is possible to induce acceptance, i.e., if $\Psi^*(\overline{\tau}) < 0 < \Psi^*(0)$, then $G$ cannot profitably deviate to making an unacceptable offer $\tau_t > \tau_s^*$ if:

$$\tau_s^* \cdot \Big[(1-\tau_s^*)\cdot\eta\Big]^{\frac{\omega\cdot\eta}{1+\omega\cdot(1-\eta)}} + \delta \cdot V_{\text{s.q.}}^G \geq \delta \cdot \Big[p \cdot V_{\text{sec}}^G + (1-p)\cdot V_{\text{s.q.}}^G\Big],$$

which is true because $V_{\text{s.q.}}^G > V_{\text{sec}}^G$. The proof of Case 2 shows $G$ will not deviate to choosing $\tau_t < \tau_s^*$.

**Case 3. $\mathbf{\Psi^*(0) < 0}$.** I will further disaggregate this case into two parts. First, I characterize the conditions under which $\overline{\sigma} \in (0, 1)$, defined in Equation 6. Second, I characterize equilibrium actions in a conflictual equilibrium.

**Part 1.** Because $\Psi^*(\cdot)$ strictly decreases in $\tau_s^*$, it follows that $\Psi^*(\cdot) < 0$ for all $\tau_s^* \in [0, 1]$ if $\Psi^*(0) < 0$. For $\delta < \underline{\delta}_C$ (Definition A.2), algebraic manipulation easily demonstrates that $\Psi^*(0) > 0$ for all $\sigma$. In this case, $\overline{\sigma}$ is set to 0. If $\delta > \underline{\delta}_C$, then applying the intermediate value theorem demonstrates the existence of at least one $\overline{\sigma}$ that satisfies $\Psi^*(\tau_s^*) = 0$. Note that $\Phi(\overline{\sigma})$ defined in Equation 6 is equivalent to $\Psi^*(0)$.

- $\Phi(0) < 0$ if $\delta > \underline{\delta}_C$

- $\Phi(1) = \theta(L_0^*) - \kappa(L_0^*) > 0$
- $\Phi(\cdot)$ is continuous in $\sigma$

Furthermore, because $\Phi(\cdot)$ strictly increases in $\sigma$, $\overline{\sigma}$ constitutes a unique threshold such that $\Phi(\cdot) < 0$ if $\sigma < \overline{\sigma}$ and $\Phi(\cdot) > 0$ if $\sigma > \overline{\sigma}$.

**Part 2.** If and only if $C$ strictly prefers to fight in a strong period than to accept a tax offer of 0, any equilibrium will feature fighting in every strong period. This is formalized as:

$$V_s^C > U_C(\tau_t = 0) + \delta \cdot \Big[\sigma \cdot V_s^C + (1-\sigma) \cdot V_w^C\Big], \tag{A.5}$$

where $V_s^C$ is $C$'s continuation value in the posited strategy profile in a strong period, $V_w^C$ is $C$'s continuation value in a weak period, and $U_C(\tau_t\!=\!0) = \theta(L_0^*) - \kappa(L_0^*)$. The following two equations enable solving for $V_s^C$ and $V_w^C$:

$$V_s^C = \delta \cdot \left\{ p \cdot \frac{U_C(\tau_t = 0)}{1-\delta} + (1-p) \cdot \Big[\sigma \cdot V_s^C + (1-\sigma) \cdot V_w^C\Big] \right\} \tag{A.6}$$

$$V_w^C = U_C(\tau_t = \overline{\tau}) + \delta \cdot \Big[\sigma \cdot V_s^C + (1-\sigma) \cdot V_w^C\Big], \tag{A.7}$$

for $U_C(\tau_t = \overline{\tau}) = \big(1 - \overline{\tau}\big) \cdot \theta\big(\overline{L}\big) - \kappa\big(\overline{L}\big)$. Solving the system of equations defined by Equations A.6 and A.7 and substituting the continuation values into Equation A.5 yields $\sigma \leq \overline{\sigma}$, for the same $\overline{\sigma}$ defined in Equation 6. This is consistent with the imposed parameter assumption $\sigma < \overline{\sigma}$ for the conflictual equilibrium. Finally, $G$ cannot profitably deviate from mixing over all possible $\tau_t$ in a strong period. Because $C$ fights in response to any offer, $G$'s utility is not a function of $\tau_t$.

For all these cases, the equilibrium strategic actions immediately imply the consumption amounts stated in Lemma A.3. ■

## A.2 Comparative Statics

***Proof of Lemma 3.*** $-\frac{d\overline{\tau}}{d\eta} = \frac{\omega}{1+\omega} > 0$ because $\omega > 0$ by assumption. $-\frac{d\overline{\tau}}{d\omega} = \frac{\eta}{(1+\omega)^2} > 0$ because $\eta > 0$ by assumption. ■

The relationship between elasticity and the tax rate, discussed in the text, can be illustrated even more clearly in a more general parameterization of a government's tax problem. Suppose $C$'s optimal formal-sector labor supply is $\big[(1-\tau_t) \cdot \mu\big]^\alpha$, for some $\mu \in (0,1)$ and $\alpha \in (0,1)$, and formal-sector output equals $L_t^\beta$, for some $\beta \in (0,1)$. Here, $\alpha$ is labor-supply elasticity and $\beta$ is output elasticity. Then, $G$'s tax objective function is $\tau_t \cdot \big[(1-\tau_t) \cdot \mu\big]^{\alpha\beta}$ and the optimal tax rate solves to $\tau^* = \frac{1}{1+\alpha\beta}$. This is clearly a strictly decreasing function of both the labor supply elasticity parameter and the output elasticity parameter.

The following lemma will be used to prove several of the propositions.

**Lemma A.4.** *For a generic parameter $\epsilon$, if $\frac{\partial \Phi(\overline{\sigma})}{\partial \epsilon} > 0$, for $\Phi(\overline{\sigma})$ defined in Equation 6, then*

$\frac{\partial \overline{\sigma}}{\partial \epsilon} < 0$. *If* $\frac{\partial \Phi(\overline{\sigma})}{\partial \epsilon} < 0$, *then* $\frac{\partial \overline{\sigma}}{\partial \epsilon} > 0$.

***Proof.*** Using the implicit function theorem to calculate the partial derivative of $\overline{\sigma}$ (defined in Equation 6) with respect a generic parameter $\epsilon$ yields:

$$\frac{\partial \overline{\sigma}}{\partial \epsilon} = \frac{\frac{\partial \Phi(\overline{\sigma})}{\partial \epsilon}}{-\frac{\partial \Phi(\overline{\sigma})}{\partial \sigma}}$$

It suffices to demonstrate that the denominator is strictly negative:

$$-\frac{\partial \Phi(\overline{\sigma})}{\partial \sigma} = -\delta \cdot p \cdot \left\{ \left[ \theta(L_0^*) - \kappa(L_0^*) \right] - \left[ (1 - \overline{\tau}) \cdot \theta(\overline{L}) - \kappa(\overline{L}) \right] \right\} < 0.$$

The strict positivity of the term in brackets follows because $C$'s consumption function strictly decreases in $\tau_t$, which can be shown by applying the envelope theorem to $C$'s consumption function. ■

***Proof of Proposition 2.*** Applying the envelope theorem demonstrates that $\frac{d\overline{\sigma}}{d\overline{\tau}} = \frac{\partial \overline{\sigma}}{\partial \overline{\tau}}$. Therefore, for parts a and b, because of Assumption 1, Lemma 3, and Lemma A.4, it suffices to demonstrate:

$$\frac{\partial \Phi(\overline{\sigma})}{\partial \overline{\tau}} = -\delta \cdot p \cdot (1 - \overline{\sigma}) \cdot \theta(\overline{L}) < 0.$$

■

## A.3 Government Transfers?

For simplicity, the setup does not provide a budget from which $G$ can offer $C$ transfers in any period. However, introducing this possibility would not qualitatively alter Lemmas 2 and A.3. $G$ would not offer transfers in a weak period because $C$ does not pose a coercive threat. Transfers from $G$ would facilitate a wider range of parameters in which $G$ can buy off $C$ in a strong period by raising the opportunity cost of seceding, but the absence of equilibrium transfers in a weak period would still imply that, for low enough $\sigma$, $G$ would not be able to buy off $C$ in a strong period with a finite budget constraint.

# B Supporting Information for Non-Markovian SPNE

## B.1 Equilibrium Existence

The following formally states the strategy profile.

**Proposition B.1.** ***Part a.*** *If $\sigma > \hat{\sigma} > 0$ and $\delta > \max\left\{\underline{\delta}_C, \underline{\underline{\delta}}_C\right\}$, for $\hat{\sigma}$ defined below in Equation B.6, $\underline{\delta}_C$ defined in Definition A.1, and $\underline{\underline{\delta}}_C$ defined below in Equation B.10, the following composes a SPNE strategy profile. Define $\mathbb{W}$ as the set of periods since the greater of the first period of the game and the period in which the most recent civil war occurred. Equation B.1 below defines $\hat{\underline{\tau}}$.*

1. *G's tax offer:*
   (a) *If $\tau_j \leq \hat{\underline{\tau}}$ for all $j \in \mathbb{W}$, then $\tau_t = \hat{\underline{\tau}}$.*
   (b) *If $\tau_j > \hat{\underline{\tau}}$ for any $j \in \mathbb{W}$, then $\tau_t = \overline{\tau}$.*
2. *C's separatist civil war decision if $\mu_t = \mu^s$:*
   (a) *If $\tau_j \leq \hat{\underline{\tau}}$ for all $j \in \mathbb{W}$, then $C$ accepts $\tau_t \leq \hat{\underline{\tau}}$ and fights otherwise.*
   (b) *If $\tau_j > \hat{\underline{\tau}}$ for any $j \in \mathbb{W}$, then $C$ fights in response to any $\tau_t \in [0, 1]$.*
3. *C sets labor optimally according to Equation 2.*
4. *Secession subgame is identical to the MPE in Proposition 1.*

***Part b.*** *If $\delta < \underline{\delta}_C$, then $G$ proposes $\tau_t = \overline{\tau}$ in every period, $C$ accepts any offer $\tau_t \leq \overline{\tau}$, and $C$ sets labor optimally according to Equation 2. Secession subgame is identical to MPE.*

Part a is the main case of interest. It describes equilibrium actions if a peaceful path of play is possible and $\hat{\underline{\tau}} < \overline{\tau}$. Part b is the trivial case in which $C$'s discount rate is so low that it prefers to accept any offer in a strong period no greater than the $G$'s revenue-maximizing tax rate because it assigns sufficiently low weight to the potential gains from fighting (note that the full strategy specification for part b entails a threshold value of $\tau_t$ higher than $\overline{\tau}$ that $C$ will accept).

This is not the only non-Markovian SPNE of the game, of which there are infinite, but it is substantively relevant for several reasons. First, the constant tax rate across periods naturally expresses the idea of a regional autonomy deal. Notably, within the class of punishment strategies stated in Proposition B.1, cooperation could be sustained for a lower value of $\sigma$ if $G$ taxed at 0 in strong periods and at a rate in weak periods that satisfies Equation 7 with equality (which will exceed $\hat{\underline{\tau}}$). This minimizes $G$'s incentives to deviate from the cooperative strategy in a weak period. However, the intuition is qualitatively similar for this strategy profile, and it is less substantively interesting because we would not expect governments and regional challengers to construct regional autonomy deals in this manner. Second, the chosen punishment strategy—$C$ punishes any deviation by $G$ with a civil war in the next period it can, before returning to cooperation—also appears substantively relevant. Although cooperation could be achieved for a wider range of $\sigma$ values with a grim trigger-type punishment strategy with war in every strong period after a single defection, empirically, it seems infeasible for a challenger to follow-through with permanent war (plus, initiating even a single civil war is quite a costly punishment in reaction to a deviation).

The following proves the non-trivial case with an interior tax offer.

***Proof of Proposition B.1, part a.*** First, need to prove the existence of a unique $\underline{\hat{\tau}} \in (0, \overline{\tau})$. Equation 7 follows from identical considerations as Equation 3 and states the conditions under which $C$ will accept a constant per-period tax offer $\hat{\tau}$. Substituting

$$\hat{V}^C_{sec} = \frac{\theta(L_0^*) - \kappa(L_0^*)}{1-\delta} \text{ and } \hat{V}^C_{s.q.} = \frac{(1-\hat{\tau}) \cdot \theta\big(L^*(\hat{\tau})\big) - \kappa\big(L^*(\hat{\tau})\big)}{1-\delta}$$

into Equation 7 and re-arranging yields:

$$\chi(\underline{\hat{\tau}}) \equiv (1-\delta) \cdot \Big[(1-\underline{\hat{\tau}}) \cdot \theta\big(L^*(\underline{\hat{\tau}})\big)\Big] - \delta \cdot p \cdot \Big\{\Big[\theta(L_0^*) - \kappa(L_0^*)\Big] - \Big[(1-\underline{\hat{\tau}}) \cdot \theta\big(L^*(\underline{\hat{\tau}})\big) - \kappa\big(L^*(\underline{\hat{\tau}})\big)\Big]\Big\} = 0 \tag{B.1}$$

Applying the intermediate value theorem demonstrates the existence of at least one $\hat{\tau} \in (0, \overline{\tau})$ that satisfies Equation B.1:

- $\chi(0) = (1-\delta) \cdot \Big[\theta(L_0^*) - \kappa(L_0^*)\Big] > 0$
- $\delta > \underline{\delta}_C$ implies $\chi(\overline{\tau}) < 0$.
- $\theta(\cdot)$ and $\kappa(\cdot)$ are assumed to be continuous functions of $\tau_t$, which implies $\chi(\cdot)$ is continuous in $\hat{\tau}$.

Additionally, applying the envelope theorem to $C$'s consumption function shows that $\chi(\underline{\hat{\tau}})$ strictly decreases in $\hat{\tau}$, which establishes the uniqueness of $\underline{\hat{\tau}}$.

Now we can check the incentive-compatibility of each action specified in the Proposition B.1 strategy profile.

**1a.** $G$'s lifetime expected utility to following the strategy profile in any period is:

$$\frac{\underline{\hat{\tau}} \cdot \theta\big(L^*(\underline{\hat{\tau}})\big)}{1-\delta} \tag{B.2}$$

$G$'s most profitable deviation entails offering $\tau_t = \overline{\tau}$ in a period that $C$ has weak capacity for rebellion. The lifetime value of this deviation, evaluated from the perspective of the period of the defection, is denoted as $V_w^G$ and equals:

$$V_w^G = \overline{\tau} \cdot \theta(\overline{L}) + \delta \cdot \Big[\sigma \cdot V_s^G + (1-\sigma) \cdot V_w^G\Big],$$

where $V_s^G$ expresses $G$'s lifetime expected utility from the perspective of the next period that $C$ has strong capacity for rebellion. The recursive equation solves to:

$$V_w^G = \frac{\overline{\tau} \cdot \theta(\overline{L}) + \delta \cdot \sigma \cdot V_s^G}{1-\delta(1-\sigma)}. \tag{B.3}$$

$C$ will initiate a civil war in the first strong period, and therefore:

$$V_s^G = \frac{\delta}{1-\delta} \cdot (1-p) \cdot \underline{\hat{\tau}} \cdot \theta\big(L^*(\underline{\hat{\tau}})\big). \tag{B.4}$$

After the war, with probability $p$, $G$ never consumes $C$'s production again because $C$ successfully secedes. With probability $1-p$ the secession attempt fails and the players revert to the original regional autonomy deal.

Then, substituting Equation B.4 into Equation B.3 and comparing to Equation B.2 yields the inequality that governs $G$'s incentive compatibility constraint in a weak period.

$$\underbrace{\underline{\hat{\tau}} \cdot \theta\big(L^*(\underline{\hat{\tau}})\big)}_{\text{Follow strategy profile}} \geq \underbrace{\frac{(1-\delta)\cdot\overline{\tau}\cdot\theta(\overline{L}) + \delta^2\cdot\hat{\sigma}\cdot(1-p)\cdot\underline{\hat{\tau}}\cdot\theta\big(L^*(\underline{\hat{\tau}})\big)}{1-\delta(1-\hat{\sigma})}}_{\text{Optimal deviation}} \tag{B.5}$$

This implicitly defines a threshold value of $\hat{\sigma}$ such that $G$ does not renege if $\sigma > \hat{\sigma}$ but does if $\sigma < \hat{\sigma}$. The threshold $\hat{\sigma}$ is the analog of $\overline{\sigma}$ for this SPNE:

$$\Omega(\hat{\sigma}) \equiv \Bigg\{1-\delta\cdot\Big[1-\hat{\sigma}\cdot\big[1-\delta\cdot(1-p)\big]\Big]\Bigg\}\cdot\underline{\hat{\tau}}\cdot\theta\big(L^*(\underline{\hat{\tau}})\big) - (1-\delta)\cdot\overline{\tau}\cdot\theta(\overline{L}) = 0 \tag{B.6}$$

It is easy to see that $\hat{\sigma} > 0$: (1) the expression in Equation B.6 is strictly negative if $\sigma = 0$ and (2) it strictly increases in $\sigma$.

**1b.** Because $C$ will initiate a civil war in the next strong period regardless of $G$'s current-period action, $G$ cannot profitably deviate from setting the revenue-maximizing tax rate.

**2a.** This is incentive-compatible because, by construction, $\tau_t \leq \underline{\hat{\tau}}$ satisfies Equation 8 whereas $\tau_t > \underline{\hat{\tau}}$ violates it.

**2b.** Need to verify that it is incentive-compatible for $C$ to reject any offer in a strong period if $G$ has previously deviated. Denote $C$'s payoff to the punishment phase as $\hat{V}^C_{punish}$. Because the most favorable offer that $G$ can make to $C$ entails $\tau_t = 0$, need:

$$\delta\cdot\Big[p\cdot\hat{V}^C_{sec} + (1-p)\cdot\hat{V}^C_{s.q.}\Big] \geq \underbrace{\theta\big(L^*_0\big) - \kappa\big(L^*_0\big)}_{E[U_C(\tau_t=0)]} + \delta\cdot\hat{V}^C_{punish},$$

which easily rearranges to:

$$\underbrace{\delta\cdot\Big[p\cdot\hat{V}^C_{sec} + (1-p)\cdot\hat{V}^C_{s.q.} - \hat{V}^C_{punish}\Big]}_{\text{LT benefit of fighting}} \geq \underbrace{E\big[U_C(\tau_t=0)\big]}_{\text{ST cost of fighting}} \tag{B.7}$$

Because $C$'s calculus involves weighing a long-term benefit against a short-term cost, $C$ needs to be sufficiently patient to uphold the punishment. The following characterizes $\underline{\delta}_C$. We have:

$$\hat{V}^C_{punish} = \sigma\cdot\delta\cdot\Big[p\cdot\hat{V}^C_{sec} + (1-p)\cdot\hat{V}^C_{s.q.}\Big] + (1-\sigma)\cdot\Big\{E\big[U_C(\tau_t=\overline{\tau})\big] + \delta\cdot\hat{V}^C_{punish}\Big\},$$

which solves to:

$$\hat{V}^C_{punish} = \frac{\sigma\cdot\delta\cdot\big[p\cdot\hat{V}^C_{sec} + (1-p)\cdot\hat{V}^C_{s.q.}\big] + (1-\sigma)\cdot E\big[U_C(\tau_t=\overline{\tau})\big]}{1-\delta\cdot(1-\sigma)}$$

Substitution enables rearranging the left-hand side of Equation B.7 to:

$$\frac{\delta}{1-\delta\cdot(1-\sigma)}\cdot\Big[(1-\delta)\cdot\big[p\cdot\hat{V}^C_{sec} + (1-p)\cdot V^C_{s.q.}\big] - (1-\sigma)\cdot E\big[U_C(\tau_t=\overline{\tau})\big]\Big]$$

Substituting in for the continuation values yields the following statement for the long-term expected benefit of fighting:

$$\frac{\delta}{1-\delta\cdot(1-\sigma)}\cdot\left[p\cdot E\big[U_C(\tau_t=0)\big]+(1-p)\cdot E\big[U_C(\tau_t=\underline{\hat{\tau}})\big]-(1-\sigma)\cdot E\big[U_C(\tau_t=\overline{\tau})\big]\right] \tag{B.8}$$

This term is strictly positive because $E\big[U_C(\tau_t=0)\big]>E\big[U_C(\tau_t=\underline{\hat{\tau}})\big]>E\big[U_C(\tau_t=\overline{\tau})\big]$. Deriving Equation B.8 with respect to $\delta$ shows the LT benefit of fighting strictly increases in $\delta$:

$$\frac{1}{\big[1-\delta\cdot(1-\sigma)\big]^2}\cdot\left\{p\cdot E\big[U_C(\tau_t=0)\big]+(1-p)\cdot E\big[U_C(\tau_t=\underline{\hat{\tau}})\big]-(1-\sigma)\cdot E\big[U_C(\tau_t=\overline{\tau})\big]\right\}$$
$$+\frac{\delta\cdot(1-p)}{1-\delta\cdot(1-\sigma)}\cdot\frac{d}{d\delta}E\big[U_C(\tau_t=\underline{\hat{\tau}})\big] \tag{B.9}$$

Given the result just proven, the term on the first line of Equation B.9 is strictly positive. Therefore, it suffices to demonstrate $\frac{d}{d\delta}E\big[U_C(\tau_t=\underline{\hat{\tau}})\big]>0$. By construction of $\underline{\hat{\tau}}$, we know:

$$E\big[U_C(\tau_t=\underline{\hat{\tau}})\big]=\delta\cdot\left\{p\cdot E\big[U_C(\tau_t=0)\big]+(1-p)\cdot E\big[U_C(\tau_t=\underline{\hat{\tau}})\big]\right\},$$

which solves to:

$$E\big[U_C(\tau_t=\underline{\hat{\tau}})\big]=\frac{\delta\cdot p}{1-\delta\cdot(1-p)}\cdot E\big[U_C(\tau_t=0)\big],$$

Therefore:

$$\frac{d}{d\delta}E\big[U_C(\tau_t=\underline{\hat{\tau}})\big]=\frac{p}{\big[1-\delta\cdot(1-p)\big]^2}\cdot E\big[U_C(\tau_t=0)\big]>0$$

Because Equation B.8 is continuous and strictly increases in $\delta$, we can define a unique $\underline{\underline{\delta}}_C$ such that Equation B.7 holds if $\delta\geq\underline{\underline{\delta}}_C$ and not otherwise:

$$\underline{\underline{\delta}}_C\equiv\frac{A}{1+(1-\sigma)\cdot A}, \tag{B.10}$$

for:

$$A\equiv\frac{E\big[U_C(\tau_t=0)\big]}{p\cdot E\big[U_C(\tau_t=0)\big]+(1-p)\cdot E\big[U_C(\tau_t=\underline{\hat{\tau}})\big]-(1-\sigma)\cdot E\big[U_C(\tau_t=\overline{\tau})\big]}$$

**3.** This consideration is unchanged from the MPE case. ■

## B.2 Comparative Statics

The following states formally and proves the analog to Proposition 2 for the constant-tax SPNE strategy profile, after presenting the analog of Lemma A.4.

**Lemma B.1.** *For a generic parameter $\epsilon$, if $\frac{\partial\Omega(\hat{\sigma})}{\partial\epsilon}>0$, for $\Omega(\hat{\sigma})$ defined in Equation B.6, then $\frac{\partial\hat{\sigma}}{\partial\epsilon}<0$. If $\frac{\partial\Omega(\hat{\sigma})}{\partial\epsilon}<0$, then $\frac{\partial\hat{\sigma}}{\partial\epsilon}>0$.*

***Proof.*** Using the implicit function theorem to calculate the partial derivative of $\hat{\sigma}$ (defined in Equation B.6) with respect a generic parameter $\epsilon$ yields:

$$\frac{\partial \hat{\sigma}}{\partial \epsilon} = \frac{\frac{\partial \Omega(\hat{\sigma})}{\partial \epsilon}}{-\frac{\partial \Omega(\hat{\sigma})}{\partial \sigma}}$$

It suffices to demonstrate that the denominator is strictly negative:

$$-\frac{\partial \Omega(\hat{\sigma})}{\partial \sigma} = -\delta \cdot \big[1 - \delta \cdot (1-p)\big] \cdot \underline{\tau} \cdot \theta\big(L^*(\underline{\tau})\big) < 0$$

■

***Proof of Proposition 3.*** Because $\frac{d\hat{\tau}}{d\overline{\tau}} = 0$, it follows that $\frac{d\hat{\sigma}}{d\overline{\tau}} = \frac{\partial \hat{\sigma}}{\partial \overline{\tau}} + \frac{\partial \hat{\sigma}}{\partial \hat{\tau}} \cdot \frac{d\hat{\tau}}{d\overline{\tau}} = \frac{\partial \hat{\sigma}}{\partial \overline{\tau}}$. Therefore, for parts a and b, because of Assumption 1, Lemma 3, and Lemma B.1, it suffices to demonstrate $\frac{\partial \Omega(\hat{\sigma})}{\partial \overline{\tau}} = -(1-\delta) \cdot \theta(\overline{L}) < 0$. ■

***Proof of Proposition B.2, part a.*** Given Lemma A.4, it suffices to demonstrate:

$$\frac{\partial \Theta(\overline{\sigma})}{\partial \delta} = -\big[\theta(L_0^*) - \kappa(L_0^*)\big] - p \cdot (1-\overline{\sigma}) \cdot \Big\{\big[\theta(L_0^*) - \kappa(L_0^*)\big] - \big[(1-\overline{\tau}) \cdot \theta(\overline{L}) - \kappa\big(\overline{L}\big)\big]\Big\} < 0$$

***Part b.***

$$\frac{\partial \hat{\sigma}}{\partial \delta} = -\frac{\Big[1 - \hat{\sigma} \cdot \big[1 - \delta \cdot (1-p)\big]\Big] \cdot \delta \cdot \hat{\sigma} \cdot (1-p) \cdot \underline{\tau} \cdot \theta\big(L^*(\underline{\tau})\big) + \overline{\tau} \cdot \theta(\overline{L})}{\delta \cdot \big[1 - \delta \cdot (1-p)\big] \cdot \underline{\tau} \cdot \theta\big(L^*(\underline{\tau})\big)} < 0$$

Applying the implicit function theorem to Equation B.6 yields:

$$\frac{\partial \hat{\sigma}}{\partial \underline{\tau}} = -\frac{1 - \delta \cdot \Big[1 - \hat{\sigma} \cdot \big[1 - \delta \cdot (1-p)\big]\Big]}{\delta \cdot \big[1 - \delta \cdot (1-p)\big] \cdot \underline{\tau}} < 0$$

Applying the implicit function theorem to Equation B.1 yields:

$$\frac{d\hat{\underline{\tau}}}{d\delta} = -\frac{(1-\hat{\underline{\tau}}) \cdot \theta\big(L^*(\hat{\underline{\tau}})\big) + p \cdot \Big\{\big[\theta(L_0^*) - \kappa(L_0^*)\big] - \Big[(1-\hat{\underline{\tau}}) \cdot \theta\big(L^*(\hat{\underline{\tau}})\big) - \kappa\big(L^*(\hat{\underline{\tau}})\big)\Big]\Big\}}{\big[1 - \delta \cdot (1-p)\big] \cdot \theta\big(L^*(\hat{\underline{\tau}})\big)} < 0$$

■

Intuitively, for $\frac{\partial \hat{\sigma}}{\partial \delta} < 0$, higher $\delta$ decreases the weight that $G$ places on greater consumption prior to the war, and more weight on the strictly higher payoff following the first strong period from not deviating. For $\frac{\partial \hat{\sigma}}{\partial \underline{\tau}} < 0$, a higher regional autonomy tax rate increases $G$'s opportunity cost to deviating to a high tax rate, generating a smaller range of $\sigma$ values in which $G$ deviates. For $\frac{d\hat{\underline{\tau}}}{d\delta} < 0$, higher $\delta$ increases the value of $C$'s war option, which lowers the tax rate that makes $C$ indifferent between accepting and fighting.

## B.3 Discount Factor and War

The Markov Perfect equilibrium provides a surprising result relative to many models of conflict: war becomes *more* likely in equilibrium as players become increasingly patient. By contrast, the opposite may be true in the subgame perfect Nash equilibrium just presented, as Table B.1 summarizes. The first, anti-folk theorem result arises because $C$ suffers a short-term cost (war) to potentially achieve a long-term benefit by gaining independence. A more patient challenger places greater weight on the long-term gain and therefore war occurs under a wider range of parameter values.

**Table B.1: Costs and Benefits to Fighting in Different Equilibria**

| | **MPE** | **Constant-tax MPE** |
|---|---|---|
| Cost of fighting | ST for $C$ | Direct: LT for $G$<br>Indirect: ST for $C$ |
| Benefit of fighting | LT for $C$ | Direct: ST for $G$<br>Indirect: LT for $C$ |
| Effect of $\delta$ | Higher $\delta$ causes fighting | Direct: higher $\delta$ prevents fighting<br>Indirect: higher $\delta$ causes fighting |

The constant-tax SPNE features countervailing direct and indirect effects. The direct effect of higher $\delta$ creates opposing incentives for $G$ compared $C$'s incentives in the MPE. In the SPNE, $G$ can always choose a tax rate low enough that $C$ will optimally accept in strong periods. Deviating yields a short-term *benefit* for $G$ because it maximally taxes $C$ until the first strong period, but $G$ subsequently suffers an expected long-term *cost* because of the fighting period and the possibility of $C$ permanently seceding. However, two indirect effects of $\delta$ in the constant-tax SPNE resemble those from the MPE because higher $\delta$ increases $C$'s expected utility from fighting. First, $C$'s greater bargaining leverage decreases $\underline{\hat{\tau}}$, which increases $G$'s incentives to deviate. Second, $C$'s war punishment is not incentive compatible in the SPNE unless it is sufficiently patient. This implies that the anti-folk theorem result from the MPE is necessary to generate the negative direct effect of $\delta$ on $\hat{\sigma}$ in the SPNE by enforcing $G$'s cooperation.[21] Proposition B.2 formalizes these claims.[22]

**Proposition B.2** (Discount factor and war)**.**

***Part a.***

$$\frac{d\overline{\sigma}}{d\delta} > 0$$

***Part b.***

$$\frac{d\hat{\sigma}}{d\delta} = \underbrace{\frac{\partial\hat{\sigma}}{\partial\delta}}_{<0} + \underbrace{\frac{\partial\hat{\sigma}}{\partial\underline{\hat{\tau}}}}_{<0} \cdot \underbrace{\frac{d\underline{\hat{\tau}}}{d\delta}}_{<0}$$

[21]If instead the players had different discount factors, $\delta_G$ and $\delta_C$, then higher $\delta_G$ would unambiguously make peace more likely in the constant-tax SPNE because the direct effect works solely through $\delta_G$ and the indirect effects solely through $\delta_C$.

[22]Powell's (1993) model of the guns and butter tradeoff provides another example of an anti-folk theorem result in the conflict literature.

# C Supporting Information for Greed Results

## C.1 Looting and Rebel Build-Up

For Proposition 4, need to restate an analog for $\overline{\sigma}$ that accounts for the additional wartime consumption parameters (also note that $C$ now chooses a labor amount even in a war period). This is denoted $\overline{\sigma}_g$, where "$g$" stands for greed. Introducing wartime consumption adds one additional technical consideration: $G$ must be sufficiently patient to prefer to buy off $C$ in a strong period, so Proposition 4 only holds for $\delta$ sufficiently high (it is straightforward to analytically characterize the lower-bound discount factor).

$$\Phi(\overline{\sigma}_g) \equiv \overbrace{(1-\delta) \cdot \Big\{ \big[\theta(L_0^*) - \kappa(L_0^*)\big] - \big[(1-\phi) \cdot (1-x) \cdot \theta\big(L^*(x)\big) - \kappa\big(L^*(x)\big)\big] \Big\}}^{C\text{'s contemporaneous gains from accepting } \tau_t = 0 \text{ rather than fighting}}$$
$$- \underbrace{\delta \cdot p \cdot (1-\overline{\sigma}_g) \cdot \Big\{ \big[\theta(L_0^*) - \kappa(L_0^*)\big] - \big[(1-\overline{\tau}) \cdot \theta(\overline{L}) - \kappa\big(\overline{L}\big)\big] \Big\}}_{C\text{'s long-term opportunity cost from forgoing fighting}} = 0 \qquad \text{(C.1)}$$

***Proof of Proposition 4.*** Applying the envelope theorem demonstrates $\frac{d\overline{\sigma}_g}{dx} = \frac{\partial \overline{\sigma}_g}{\partial x}$. Because an analog of Lemma A.4 holds for Equation C.1, it suffices to demonstrate:

$$\frac{\partial \Phi(\overline{\sigma}_g)}{\partial x} = (1-\delta) \cdot (1-\phi) \cdot \theta\big(L^*(x)\big) > 0.$$

■

***Proof of Proposition 5.*** It is trivial to demonstrate that $\frac{d\overline{\sigma}}{dp} = \frac{\partial \overline{\sigma}}{\partial p}$. Because an analog of Lemma A.4 holds for Equation C.1, it suffices to demonstrate:

$$-\frac{\partial \Phi(\overline{\sigma})}{\partial p} = -\delta(1-\overline{\sigma}) \cdot \Big\{ \big[\theta(L_0^*) - \kappa(L_0^*)\big] - \big[(1-\overline{\tau}) \cdot \theta(\overline{L}) - \kappa\big(\overline{L}\big)\big] \Big\} > 0.$$

■

## C.2 Fighting for a Large Prize

A distinct greed hypothesis is that oil production raises fighting prospects by creating a lucrative secession prize. For example, Collier and Hoeffler (2005, 44) proclaim a second major reason that natural resources might be a powerful risk factor for civil wars is "the lure of capturing resource ownership permanently if the rebellion is victorious." Laitin (2007, 22) proclaims: "If there is an economic motive for civil war in the past half-century, it is in the expectation of collecting the revenues that ownership of the state avails, and thus the statistical association between oil (which provides unimaginably high rents to owners of states) and civil war." However, the theoretical effect of a large prize is ambiguous. Although it raises the expected utility of fighting, it also increases the opportunity cost of fighting. Furthermore, the argument that $p$ should be low in oil-rich regions also diminishes the magnitude of the conflict-inducing prize of winning mechanism, and therefore a larger prize could in fact deter separatism—similar to accepted mechanisms linking rich countries to few civil wars.

Formally, assume that $C$'s formal sector output sells a price $Y^C > 0$ (as opposed to 1 in the baseline model), which captures the size of the prize. It is uncontroversial to assert that oil is a high-yield economic activity that should raise the value of $C$'s formal-sector production, $Y^C$, although the necessity of negotiating with international oil companies dampens this effect somewhat (Menaldo, 2016). Correspondingly, greed theories correctly argue that the "prize of winning" oil effect raises separatist propensity, i.e., higher $Y^C$ increases $C$'s consumption conditional on winning a civil war (Collier and Hoeffler 2004, 2005; Garfinkel and Skaperdas 2006; Besley and Persson 2011, ch. 4). However, these theories have not carefully examined a crucial countervailing effect that renders ambiguous the overall impact of a larger prize. A larger prize also diminishes fighting incentives by raising the opportunity cost of initiating a civil war. Higher $Y^C$ increases the amount of output destroyed from $C$'s region during a fight. This "prize opportunity cost" effect increases the relative lucre of the wealth-sharing deal that $C$ gets from $G$—compared to fighting and decreasing consumption in that period.

As a preliminary result, the prize term slightly changes $C$'s optimal labor supply function, although $G$'s most-preferred tax rate is unchaged:

$$L^*(\tau_t) = \Big[(1-\tau_t)\cdot\eta\cdot Y^C\Big]^{\frac{\omega}{1+\omega\cdot(1-\eta)}} \tag{C.2}$$

Accepting an offer $\tau_t = 0$ from $G$ as opposed to fighting yields a gain in consumption of $\theta(L_0^*)\cdot Y^C - \kappa(L_0^*)$. Therefore, a larger prize increases the marginal opportunity cost of fighting by $\theta(L_0^*)$, the prize opportunity cost effect. By contrast, conditional on winning, initiating a separatist civil war yields a net expected benefit of $\frac{\delta}{1-\delta}\cdot(1-\sigma)\cdot\Big\{\big[\theta(L_0^*)\cdot Y^C - \kappa(L_0^*)\big] - \big[(1-\overline{\tau})\cdot\theta(\overline{L})\cdot Y^C - \kappa(\overline{L})\big]\Big\}$ in future periods. Therefore, a larger prize increases the marginal benefit to fighting, conditional on winning, by $\frac{\delta}{1-\delta}\cdot(1-\sigma)\cdot\Big[\theta(L_0^*) - (1-\overline{\tau})\cdot\theta(\overline{L})\Big]$. This is the future-period prize of winning effect. Finally, the magnitude of the prize of winning effect is modified by $C$'s probability of winning, $p$, since $C$ only reaps secessionist gains if it wins the war.

For Proposition C.1, need to restate an analog for $\overline{\sigma}$ that account for the prize parameter. This is denoted $\overline{\sigma}_p$, where "$p$" stands for prize.

$$\Phi(\overline{\sigma}_p) \equiv \overbrace{(1-\delta)\cdot\big[\theta(L_0^*)\cdot Y^C - \kappa(L_0^*)\big]}^{C\text{'s contemporaneous gains from accepting } \tau_t = 0 \text{ rather than fighting}}$$
$$-\underbrace{\delta\cdot p\cdot(1-\overline{\sigma}_p)\cdot\Big\{\big[\theta(L_0^*)\cdot Y^C - \kappa(L_0^*)\big] - \big[(1-\overline{\tau})\cdot\theta(\overline{L})\cdot Y^C - \kappa(\overline{L})\big]\Big\}}_{C\text{'s long-term opportunity cost from forgoing fighting}} = 0 \tag{C.3}$$

Proposition C.1 states a threshold value of $p$ that determines which of these two effects dominates the other.

**Proposition C.1** (Coercive capacity and the countervailing effects of a larger prize)**.** *An increase in $C$'s oil production through its effect on increasing the prize, $Y^C$, ambiguously affects the range of $\sigma$ values small enough that fighting occurs.*

- *If $p$ is sufficiently large, then the probability of winning multiplied by prize of winning effect, $p\cdot\frac{\delta}{1-\delta}\cdot(1-\sigma)\cdot\big[\theta(L_0^*) - (1-\overline{\tau})\cdot\theta(\overline{L})\big]$, dominates the prize opportunity cost effect, $\theta(L_0^*)$, and an increase in $Y^C$ increases the likelihood of separatist civil wars in equilibrium, i.e., increases the range of $\sigma$ values small enough that fighting occurs.*

*Formally, if $p > \overline{p}$, then $\frac{d\overline{\sigma}_p}{dY^C} > 0$, for $\overline{p}$ defined in the proof and $\overline{\sigma}_p$ defined in Equation C.3.*

- *If $p < \overline{p}$, then the prize opportunity cost effect dominates the probability of winning times prize of winning effect, and an increase in $Y^C$ diminishes $\overline{\sigma}_p$. Formally, if $p < \overline{p}$, then $\frac{d\overline{\sigma}_p}{dY^C} < 0$.*

***Proof.*** It is trivial to demonstrate that $\frac{d\overline{\sigma}_p}{dY^C} = \frac{\partial\overline{\sigma}_p}{\partial Y^C}$. Because of Lemma A.4, the sign of $\frac{d\overline{\sigma}_p}{dY^C}$ has the opposite sign as $\frac{\partial\Phi(\overline{\sigma}_p)}{\partial Y^C}$. This can be calculated as:

$$\frac{\partial\Phi(\overline{\sigma}_p)}{\partial Y^C} = (1-\delta)\cdot\theta(L_0^*) - \delta\cdot p\cdot(1-\overline{\sigma}_p)\cdot\Big[\theta(L_0^*) - (1-\overline{\tau})\cdot\theta(\overline{L})\Big]$$

$\frac{\partial\Phi(\overline{\sigma}_p)}{\partial Y^C}$ strictly decreases in $p$, and is positive if $p < \overline{p}$ and negative if $p > \overline{p}$, for:

$$\overline{p} \equiv \frac{\overbrace{(1-\delta)\cdot\theta(L_0^*)}^{\text{Prize opportunity cost effect}}}{\underbrace{\delta\cdot(1-\overline{\sigma})\cdot\Big[\theta(L_0^*) - (1-\overline{\tau})\cdot\theta(\overline{L})\Big]}_{\text{Prize of winning effect}}}$$

■

Overall, the prize effect is indeterminate. Furthermore, the substantive considerations that oil production should tend to lower $p$ suggest that oil-rich regions often do not exhibit the parameter values in which the overall prize effect is conflict-inducing because their oil production provides revenues to the government, which can lower $p$. This finding resembles Chassang and Padro-i Miquel's (2009) result that the size of the economy is insufficient to explain civil war onset. However, the present setup with endogenous labor allocation enables studying the tradeoff between the prize of winning and the opportunity cost of fighting with regard to how an aspect of state capacity impacts the overall effect, as opposed to their model where these two mechanisms perfectly cancel out. Here, if the government has strong military capacity, then the prize of winning effect is small in magnitude and a larger prize diminishes fighting prospects.

In fact, emphasizing the importance of the opportunity cost mechanism largely follows the logic of arguments for why rich countries tend not to fight civil wars. Although richer countries create a larger prize, richer citizens also face a higher opportunity cost to rebelling. Because governments in rich countries tend to have strong coercive capacity, the opportunity cost effect tends to outweigh the prize of winning effect to deter civil war. Furthermore, the fact that citizens in oil-rich regions tend not to be rich follows from the redistributive grievances argument rather than from the large prize.

## C.3 Oil Discoveries and Volatile Oil Prices

To facilitate focusing on core issues in the greed and grievances debate, the model so far has abstracted away from another important attribute of oil income: volatility. Ross (2012, 50-54) and Karl (1997) each detail this aspect of oil production, albeit without linking it to civil wars. Two important components of this variance are (a) discovering a new oil field, especially a giant oil field, can cause a dramatic spike in income (Lei and Michaels, 2014), and (b) historically, international oil prices have been quite volatile (Ross 2012, 51). This section incorporates these considerations by assuming periods differ between boom and bust. The main finding is that greater inter-period volatility in formal-sector income increases the likelihood of separatist civil wars if bust periods occur infrequently. The overall logic resembles that for the prize mechanism despite yielding a somewhat different substantive implication. The first section sketches the argument and the following, more technical, section provides most of the formal details.

***Main theoretical insights.*** Formally, the value of $C$'s formal-sector output is $Y^C$ in boom periods (as in the previous extension) and $\frac{Y^C}{b}$ in bust periods, for $b > 1$. Higher $b$ decreases the value of output in bust periods and therefore corresponds with higher inter-period income volatility. Under the substantively relevant assumption that oil-rich regions have higher income volatility, we are interested in comparative statics for $b$. The analysis considers two cases. First, an oil discovery case in which period 1 is a bust period and all future periods are boom periods. In other words, an oil field is discovered in period 1 but does not come online until period 2. Second, a volatile prices case in which each period is boom with probability $\gamma \in (0, 1)$ and bust with complementary probability, and these draws are independent across periods. This extension features six states of the world determined by all permutations of (a) $C$ is weak in the status quo territorial regime, $C$ is strong in the status quo territorial regime, and $C$ has seceded, and (b) boom and bust production periods. It is solved with MPE. This setup bears some resemblance to Dunning (2005), although his two-period model examines how price volatility affects incentives to fund public goods rather than how the present tradeoffs affect prospects for civil wars.

The key considerations are closely related to those discussed for the prize effect. With volatile income, the opportunity cost of fighting in a bust period is $\theta\big(L_b^*(0)\big) \cdot \frac{Y^C}{b} - \kappa\big(L_b^*(0)\big)$. The term $L_b^*(\cdot)$ is the analog of the optimal labor supply function defined in Equation C.2 for bust periods, and is formally defined below. The bust period opportunity cost decreases as volatility increases because, simply, there is less to destroy. This result follows an identical logic as the prize opportunity cost effect presented in Proposition C.1. However, although higher $b$ also decreases the future prize of winning effect, $b$ only affects future *bust* periods—unlike $Y^C$, which affects consumption in all future periods.

In the oil discovery case, all future periods are boom. The only effect of higher volatility is to lower the period 1 opportunity cost of fighting and, therefore, higher $b$ unambiguously increases prospects for separatist civil war (assuming the non-trivial case in which $C$ has strong capacity for rebellion in period 1). These considerations are somewhat more involved in the volatile prices case because $b$ also affects $C$'s consumption in some future periods. Therefore, higher $b$ not only lowers the opportunity cost of fighting in a present bust period, but also lowers the expected utility of seceding. However, the less frequent are future bust periods, i.e., the higher is $\gamma$, the less that the volatility parameter $b$ affects future-period considerations. If $\gamma$ is sufficiently large, then the overall effect of higher $b$ increases equilibrium prospects for separatist civil war by decreasing the opportunity cost of fighting by a greater magnitude than it decreases the expected utility of secession. Therefore, volatile oil prices may provide an additional trigger to separatism, but only when the future is expected to be valuable.

These findings about income volatility relate to some existing theoretical arguments and empirical evidence. Showing that oil discoveries can cause civil war resembles an implication from Bell and Wolford (2015), although the present result focuses on the opportunity cost mechanism rather than on oil causing future shifts in the balance of power. Instead, combining the result from this section with Proposition C.1 yields a point of congruence with Chassang and Padro-i Miquel (2009): larger *fluctuations* in income rather than higher income *levels* provide a more coherent explanation for war onset because income variability creates periods with relatively low opportunity costs of fighting relative to the expected future prize of fighting. Empirically, this theoretical result corresponds with Blair's (2014) finding that oil discoveries positively correlate with separatist civil war onset, and the Sudan case presented in the text provides an example.

***Additional formal details.*** $C$'s optimal labor choice in a bust period differs slightly from that in every period in the original model because the lower value of formal-sector output affects the marginal benefit of supplying labor. Defining $C$'s labor supply function in a bust period as $L_b(\cdot)$ and solving a similar optimization problem as in Lemma 1, we have:

$$L_b^*(\tau_t) = \left[(1-\tau_t)\cdot\eta\cdot\frac{Y^C}{b}\right]^{\frac{\omega}{1+\omega\cdot(1-\eta)}}.$$

The revenue-maximizing tax rate $\overline{\tau}$ is unchanged in bust periods because $\overline{\tau}$ is not a function of the value of formal sector output (see Equation 5). Following similar logic as used to define $\overline{\sigma}$ in Equation 6, offering $\tau_s^* = 0$ in every strong period enables $G$ to buy off $C$ in a bust period in which $C$ is coercively strong if and only if:

$$\theta\big(L_b^*(0)\big)\cdot\frac{Y^C}{b} - \kappa\big(L_b^*(0)\big) - \delta\cdot p\cdot\left(\tilde{V}_{\text{sec}}^C - \tilde{V}_{\text{s.q.}}^C\right) \geq 0, \tag{C.4}$$

The continuation values are defined as follows:

$$\tilde{V}_{\text{sec}}^C = \gamma\cdot\Big[\theta(L_0^*)\cdot Y^C - \kappa(L_0^*)\Big] + (1-\gamma)\cdot\Big[\theta\big(L_b^*(0)\big)\cdot\frac{Y^C}{b} - \kappa\big(L_b^*(0)\big)\Big] \tag{C.5}$$

$$\begin{aligned}\tilde{V}_{\text{s.q.}}^C &= \gamma\cdot\Big\{\sigma\cdot\Big[\theta(L_0^*)\cdot Y^C - \kappa(L_0^*)\Big] + (1-\sigma)\cdot\Big[(1-\overline{\tau})\cdot\theta(\overline{L})\cdot Y^C - \kappa(\overline{L})\Big]\Big\}\\ &+ (1-\gamma)\cdot\Big\{\sigma\cdot\Big[\theta\big(L_b^*(0)\big)\cdot\frac{Y^C}{b} - \kappa\big(L_b^*(0)\big)\Big] + (1-\sigma)\cdot\Big[(1-\overline{\tau})\cdot\theta\big(L_b^*(\overline{\tau})\big)\cdot\frac{Y^C}{b} - \kappa\big(L_b^*(\overline{\tau})\big)\Big]\Big\}\end{aligned} \tag{C.6}$$

Substituting Equations C.5 and C.6 into Equation C.4 and finding a $\sigma$ threshold that solves Equation C.4 with equality, denoted $\tilde{\sigma}$, yields:

$$\begin{aligned}\Gamma(\tilde{\sigma}) \equiv (1-\delta)\cdot&\Big[\theta\big(L_b^*(0)\big)\cdot\frac{Y^C}{b} - \kappa\big(L_b^*(0)\big)\Big]\\ -\delta\cdot p\cdot(1-\tilde{\sigma})\cdot&\Big\{\gamma\cdot\Big(\big[\theta(L_0^*)\cdot Y^C - \kappa(L_0^*)\big] - \big[(1-\overline{\tau})\cdot\theta(\overline{L})\cdot Y^C - \kappa(\overline{L})\big]\Big)\\ + (1-\gamma)\cdot&\Big(\Big[\theta\big(L_b^*(0)\big)\cdot\frac{Y^C}{b} - \kappa\big(L_b^*(0)\big)\Big] - \Big[(1-\overline{\tau})\cdot\theta\big(L_b^*(\overline{\tau})\big)\cdot\frac{Y^C}{b} - \kappa\big(L_b^*(\overline{\tau})\big)\Big]\Big)\Big\} = 0\end{aligned} \tag{C.7}$$

**Proposition C.2** (Volatile oil income and secession)**.** *The effect of an increase in C's oil production on increasing b strictly increases the range of $\sigma$ values small enough that fighting occurs if $\gamma > \tilde{\gamma}$, and strictly decreases this range of $\sigma$ values otherwise. Formally, for $\tilde{\sigma}$ defined in Equation C.7, $\frac{d\tilde{\sigma}}{db} > 0$ if $\gamma > \tilde{\gamma}$, and $\frac{d\tilde{\sigma}}{db} < 0$ if $\gamma < \tilde{\gamma}$.*

***Proof.*** Applying the implicit function theorem to Equation C.7 yields:

$$\frac{d\tilde{\sigma}}{db} = -\frac{\frac{\partial\Gamma}{\partial b}}{\frac{\partial\Gamma}{\partial\tilde{\sigma}}}$$

for

$$\frac{\partial\Gamma}{\partial b} = -\Big\{(1-\delta)\cdot\theta\big(L_b^*(0)\big) - \delta\cdot p\cdot(1-\tilde{\sigma})\cdot(1-\gamma)\cdot\Big[\theta\big(L_b^*(0)\big) - (1-\overline{\tau})\cdot\theta\big(L_b^*(\overline{\tau})\big)\Big]\Big\}\cdot\frac{Y^C}{b^2}$$

and

$$\frac{\partial \Gamma}{\partial \tilde{\sigma}} = \delta \cdot p \cdot \Bigg\{ \gamma \cdot \bigg[ \Big( \theta(L_0^*) \cdot Y^C - \kappa(L_0^*) \Big) - \Big( (1-\overline{\tau}) \cdot \theta(\overline{L}) \cdot Y^C - \kappa(\overline{L}) \Big) \bigg]$$

$$+ (1-\gamma) \cdot \bigg[ \Big( \theta\big(L_b^*(0)\big) \cdot \frac{Y^C}{b} - \kappa\big(L_b^*(0)\big) \Big) - \Big( (1-\overline{\tau}) \cdot \theta\big(L_b^*(\overline{\tau})\big) \cdot \frac{Y^C}{b} - \kappa\big(L_b^*(\overline{\tau})\big) \Big) \bigg] \Bigg\} > 0$$

$\frac{d\tilde{\sigma}}{db}$ is strictly positive if and only if $\frac{\partial \Gamma}{\partial b}$ is strictly negative, which is true if and only if:

$$\gamma > \tilde{\gamma} \equiv 1 - \frac{(1-\delta) \cdot \theta\big(L_b^*(0)\big)}{\delta \cdot p \cdot (1-\tilde{\sigma}) \cdot \Big[ \theta\big(L_b^*(0)\big) - (1-\overline{\tau}) \cdot \theta\big(L_b^*(\overline{\tau})\big) \Big]} \qquad \blacksquare$$

In the oil discovery case, $\gamma = 1$ (note that this implies the continuation values are identical to those in the baseline game). Therefore, an increase in $b$ raises equilibrium separatism prospects for all parameter values in the oil discovery case. For the price volatility case, bust periods must be sufficiently rare to generate the same result.

# References


Bell, Curtis and Scott Wolford. 2015. "Oil Discoveries, Shifting Power, and Civil Conflict." *International Studies Quarterly* 59(3):517–530.

Besley, Timothy and Torsten Persson. 2011. *Pillars of Prosperity: The Political Economics of Development Clusters*. Princeton University Press.

Blair, Graeme. 2014. "On the Geography of Assets and Citizens: How Proximity to Oil Production Shapes Political Order." Ph.D. dissertation, Department of Politics, Princeton University.

Chassang, Sylvain and Gerard Padro-i Miquel. 2009. "Economic Shocks and Civil War." *Quarterly Journal of Political Science* 4(3):211–228.

Collier, Paul and Anke Hoeffler. 2004. "Greed and Grievance in Civil War." *Oxford Economic Papers* 56(4):563–595.

Collier, Paul and Anke Hoeffler. 2005. The Political Economy of Secession. In *Negotiating Self-Determination*, ed. Hurst Hannum and Eileen F. Babbitt. Lexington Books pp. 37–60.

Dunning, Thad. 2005. "Resource Dependence, Economic Performance, and Political Stability." *Journal of Conflict Resolution* 49(4):451–482.

Garfinkel, Michelle R. and Stergios Skaperdas. 2006. Economics of Conflict: An Overview. In *Handbook of Defense Economics, Vol. 2: Defense in a Globalized World*, ed. Todd Sander and Keith Hartley. North-Holland pp. 649–710.

Karl, Terry Lynn. 1997. *The Paradox of Plenty: Oil Booms and Petro-States*. University of California Press.

Laitin, David D. 2007. *Nations, States, and Violence*. New York: Oxford University Press.

Lei, Yu-Hsiang and Guy Michaels. 2014. "Do Giant Oilfield Discoveries Fuel Internal Armed Conflicts?" *Journal of Development Economics* 110:139–157.

Menaldo, Victor. 2016. *The Institutions Curse: Natural Resources, Politics, and Development*. Cambridge University Press.

Powell, Robert. 1993. "Guns, Butter, and Anarchy." *American Political Science Review* 87(1):115–132.

Ross, Michael L. 2012. *The Oil Curse: How Petroleum Wealth Shapes the Development of Nations*. Princeton University Press.