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

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Abstract

Economic grievances often catalyze civil war. But which economic activities are likely to trigger grievances and civil war? And why would governments not act to limit economic grievances sufficiently to avert fighting? This article argues that economic activities that undermine a producer's ability to exit the formal economy cause governments to make taxation decisions that—despite the costliness of fighting—increase war likelihood. Low-valued economic exit also undermines regional autonomy deals by encouraging governments to grab short-term rents despite eventually triggering civil war. After deriving this redistributive grievance mechanism by analyzing an infinite-horizon bargaining model with endogenous labor supply and economic production, the article addresses a specific empirical source of redistributive grievances: oil-rich regions fight separatist civil wars relatively frequently. Capital-intense, geographically concentrated, and immobile oil production corresponds with conditions in the formal model that predict redistributive grievances and war. Applying the redistributive grievances mechanism to understanding the oil-separatism relationship also highlights shortcomings of alternative "greed"-based explanations.

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

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Economic grievances often catalyze civil war. Building on classic arguments such as Gurr (1970) and Horowitz (1985), scholars provide statistical evidence (Boix, 2008; Cederman, Weidmann and Gleditsch, 2011) and case-based evidence (Wood 2003; Sambanis 2005, 323-4) that demonstrates the importance of economic grievances and of other grievance sources (Cederman, Gleditsch and Buhaug, 2013).

However, two important puzzles remain. First, which economic activities are likely to trigger grievances and civil war? Broader critiques of grievance-based arguments characterize the ubiquity of grievances and the need to identify more specific contributors (Collier and Hoeffler, 2004; Fearon and Laitin, 2003). Many argue that natural resources "curse" prospects for civil peace by generating economic grievances, but different natural resources vary considerably in their production attributes and scholars disagree about the importance of grievances as opposed to other mechanisms. Even for the most-studied commodity, oil production, scholars propose an "embarrassment of mechanisms" (Humphreys, 2005, 510) that generate divergent considerations. Some argue that *governments* easily accrue oil revenues and 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). But this grievance argument faces important challenges. Other scholars propose a largely rival argument that oil production provides a particularly valuable opportunity for *rebel* finance (Collier and Hoeffler 2005, 44; Collier et al. 2009, 13; Lujala 2010). Does oil production contribute to conflict by enabling government exploitation and generating redistributive grievances, or by funding greedy rebels?[1] Comparing oil to other natural resources also raises important questions about the grievance mechanism. Exploited local residents cannot move oil fields—an immobile asset (Boix 2003, Acemoglu and Robinson 2006, 300-7)—but this property does not distinguish oil production from other natural resources, such as alluvial diamonds, that weakly correlate with civil war (Ross, 2015, 250).

Second, looking beyond specific sources of economic grievances, why would governments not act to limit economic grievances sufficiently to avert fighting? Scholars in the broader conflict literature examine rationalist motives—such as inability to commit to future deals—for actors to engage in costly fighting rather

[1] Many emphasize the importance of these 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."

than to strike Pareto-improving bargains.[2] However, researchers examining domestic conflict often do not apply these insights to purported civil war risk factors to which they devote considerable empirical attention, such as natural resources and broader economic grievances. For example, even if producing oil can potentially create grievances over unfair distribution, why would a government not limit exploitation—at least somewhat—to prevent fighting? Existing discussions of oil-conflict cases such as Angola and Sudan highlight that governments often exploit oil-rich groups, but do not explain the seemingly self-defeating nature of this behavior.

This article argues that economic activities that undermine a producer's ability to exit the formal economy cause governments to make taxation decisions that—despite the costliness of fighting—increase war likelihood. Low-valued economic exit also undermines regional autonomy deals by encouraging governments to grab short-term rents despite eventually triggering civil war. The second half of the article shows how this mechanism can help to explain the statistical relationship between regional oil production and separatist civil war onset demonstrated in the literature.

I develop the proposed redistributive grievances mechanism by analyzing a game that draws elements from existing dynamic bargaining models featuring commitment problems, and also endogenizes labor supply and economic production to provide a strategic choice for producers to escape government exploitation. Specifically, in each period of a repeated interaction between a government and regional challenger, the government proposes a tax rate on the challenger's formal economic production. However, the government cannot commit to future proposals—implying that offering a low tax rate on today's production does not prevent high taxation on tomorrow's production. Commitment inability yields different tax rates across periods because the challenger exogenously fluctuates between strong and weak rebellion capacity. After observing the tax proposal, the challenger then allocates labor between the formal and informal economy, which corresponds to an economic exit option. The challenger also chooses whether or not to fight a civil war—which would prevent future government taxation if successful.[3]

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

[3]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.

The model analysis yields a general redistributive grievances mechanism: a government's inability to commit to low taxes only causes war for economic activities that undermine a producer's economic exit threat. Specifically, economic activities that limit the value of the challenger's economic exit option (a function of the labor-elasticity of production and the value of the informal economy) create incentives for the government to tax at high rates in periods the challenger has weak capacity for rebellion because the challenger's threat to withhold labor minimally affects the government's tax intake. Combining this incentive with the government's inability to commit to limit taxes creates *redistributive grievances* in equilibrium—i.e., resulting from strategic government choices—and raises the challenger's incentives to fight when temporarily strong. By contrast, although the government cannot *commit* to low taxes when the challenger cannot fight, high-valued economic exit creates *economic incentives* for the government to offer low taxes even in weak periods—diminishing the challenger's incentives to fight when temporarily strong. Therefore, only economic activities that undermine the challenger's economic exit option create incentives to exercise its outside option—fighting—to prevent government exploitation.

This mechanism also explains why regional autonomy agreements promising low permanent taxes—a seemingly viable real-world possibility for solving redistributive grievances—often break down.[4] Low-valued economic exit options cause the government to undermine regional autonomy deals by grabbing short-term rents, despite eventually triggering civil war. In the model, a regional autonomy deal corresponds with a strategy profile in which the government offers the same tax rate in every period, backed by the challenger's threat to fight in the next period it has strong capacity for rebellion if the government deviates.[5] Economic activities that yield a low-valued economic exit option for the challenger facilitate higher rents if the government deviates. Therefore, even when the actors may in principle attempt to contract on low permanent taxes, the government may face strategic incentives to violate regional autonomy agreements and to *not* limit redistributive grievances—despite causing civil war.

Analyzing the redistributive grievances mechanism provides insights into empirical patterns. A core empirical finding about natural resources and conflict shows that oil-rich regions fight separatist civil wars

[4]Although some scholars in the broader grievances literature examine regional autonomy deals (Cederman et al., 2015), the resource curse literature does not closely analyze this possibility for averting conflict.

[5]Formally, the previous paragraph describes the unique Markov perfect equilibrium of the game, whereas this paragraph focuses on a non-Markovian subgame perfect Nash equilibrium.

relatively frequently. Capital-intense, geographically concentrated, and immobile oil production facilitates easy government taxation by diminishing the extent to which withholding local labor reduces output and by lowering the viability of the informal economy. Undermining the region's economic exit option makes civil war more likely. Similarly, easy-revenue properties of oil production make governments more likely to renege on regional autonomy deals, which Sudan's second civil war exemplifies. By contrast, governments face greater constraints to taxing most other economic activities because withholding local labor more greatly diminishes their output (e.g., many types of manufacturing) or because societal actors can more easily pivot to an informal sector (e.g., alluvial diamonds). These arguments contribute to existing resource curse research that discusses redistributive grievances (e.g., Sorens 2011, 574-5; Ross 2012, 151-2) by isolating grievances-inducing properties of oil production and by analyzing strategic government and rebel behavior.

Applying the redistributive grievances mechanism to understanding the oil-separatism relationship also highlights shortcomings of alternative "greed"-based explanations. Scholars 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). Strikingly, most of these arguments assume that rebels routinely access or can influence the distribution of oil revenues—contrasting with the core premise of grievances theories that governments easily control oil revenues. Combining the logic of greed and grievance mechanisms with empirical considerations about oil production shows that, contrary to existing arguments, greed mechanisms logically *diminish* separatist incentives, or raise equilibrium separatist civil war prospects only under unlikely empirical conditions.

In addition to contributing to debates about economic grievances and the conflict resource curse, this article also advances the applied formal theoretic literature. The model explains how economic activities that undermine a producer's economic exit option exacerbate the commitment problem and how endogenizing labor supply and economic production affects 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). The model differs from these, as well as models that examine asset mobility and taxability (Boix 2003; 2008, Acemoglu and Robinson 2006, 300-7), by endogenizing labor supply and economic production. This provides microfoundations for why fixed assets—as well as other less-studied attributes of economic production such as high capital intensity and dense geographic concentration—undermine a producer's economic exit option.[6] Although 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, they introduce this assumption only to generate interior tax rates (as they discuss, pp. 1170) and do not analyze how aspects of the challenger's economic exit option affect prospects for bargaining breakdown. The model also provides findings distinct from other formal models that apply 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.

The conclusion discusses broader theoretical, empirical, and policy implications. The model raises important questions about various proposed civil war risk factors ranging from ethnopolitical access to the central government (Cederman, Gleditsch and Buhaug, 2013) to rebels looting diamonds, while also generating empirical implications about different economic commodities. Furthermore, similar mechanisms based on inside versus outside options may also inform international conflict.

1 Baseline Model

This section presents and solves the baseline model, and then analyzes the key mechanism linking an ineffective economic exit option to economic grievances and civil war.

1.1 Setup

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

[6] It also departs from Boix (2003, 2008) by providing a dynamic setup, which is particularly important for examining incentives for governments to deviate from regional autonomy deals.

1. Distribution of power stage. Nature chooses whether C exhibits strong (probability σ) or weak (probability $1-\sigma$) capacity for rebellion in each period. C can initiate hostilities only in a strong period (see stage 3), and wins a separatist civil war with probability $p \in (0,1)$.[7] If C previously won a separatist civil war, then the distribution of power stage is degenerate because, as described below, successful secession ends G and C's interaction. Overall, this stochastic game features three states of the world: weak C in the status quo territorial regime, strong C in the status quo territorial regime, and post-secession.

Empirically, political actors can only occasionally solve collective action problems and effectively challenge the government (Acemoglu and Robinson, 2006, 123-128), which motivates modeling stochastic shifts in C's secession ability. Temporary government vulnerability often provides windows of opportunity. For example, Iran's oil-rich Arab and Kurd minorities perceived temporary regime weakness when the shah fell in 1979, facilitating separatist attempts (Ward, 2009, 230-233). Demonstration effects from the Iranian Revolution perhaps 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 reside primarily 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 τ_t percentage of C's period t formal-sector economic output to G if C accepts. For simplicity, G lacks a budget that would enable offering transfers to C, although Appendix Section A.3 discusses why introducing this possibility would not qualitatively change the results.

[7] For tractability purposes and to focus mainly on C's fighting and production choices, the model assumes 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.

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 to create an independent territory.[8] Empirically, successfully separating from the government may yield a newly independent country, as in South Sudan or East Timor, or de facto territorial control without international recognition, as in Somaliland. In weak periods, however, C cannot fight. Section 4.3 introduces the additional possibility that, in any period, C can engage in a "simple revolt" (e.g., a strike or riot) short of insurgency.

Although the model informs general fighting incentives, 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, explaining the oil-separatist relationship provides the primary empirical application. Second, although economic grievance arguments also apply to some extent to center-seeking civil wars, rebels can solve the core grievance posited here—central governments exploiting local production—without mobilizing 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, groups harboring local grievances can more feasibly fight to create an autonomous region or fully independent state (Jenne, Saideman and Lowe, 2007). Third, assuming that the government cannot commit a priori to future concessions for the challenger corresponds with regions whose residents lack political power access 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 apply most closely to groups that usually prefer separatist over center-seeking fighting.

4. Labor supply stage. G faces a second constraint to taxing production because, in all periods, C can divert effort to produce in an informal market. This possibility incorporates the key theoretical idea that citizens can exit the formal economy by producing outside the state's reach 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 farmers in post-colonial Africa often choosing to produce subsistence crops rather than taxable cash crops, and to smuggle cash crops across international borders. Activities such as stealing oil output or striking to disrupt production also affect the value of the informal sector.

[8]Assuming wars last any finite length $n \in \mathbb{Z}_{++}$ produces qualitatively identical results.

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 $\eta \in (0,1)$ implies that the production function exhibits strictly positive and strictly diminishing marginal returns to labor input, and η equals output elasticity.[9] Larger η implies that changes in labor input more strongly affect the amount produced, i.e., formal-sector output exhibits higher labor-elasticity.[10] I normalize the price of selling the good in the formal sector to 1, and extensions below parameterize this price.

Devoting labor to the formal economy entails an opportunity cost equaling $\kappa(L_t) = \frac{\omega}{1+\omega} \cdot L_t^{\frac{1+\omega}{\omega}}$ for C from forgone production in the informal sector, for $\omega \in (0,1)$. Higher ω corresponds to a higher-valued option to exit into the informal economic sector. Many scholars use this functional form, which engenders a strictly positive and strictly increasing labor opportunity cost, in models with an endogenous labor supply because labor supply elasticity equals ω in the linear production technology case (e.g., Acemoglu et al. 2004; Besley and Persson 2011, 80).[11]

Two final assumptions require attention. First, assuming that a unitary actor makes regional production decisions simplifies the analysis without qualitatively altering the findings. Appendix Lemma A.1 demonstrates

[9]This follows because $\theta(\cdot)$ is a Cobb-Douglas production function with a single input: $\frac{\partial \theta(L_t)}{\partial L_t} \cdot \frac{L_t}{\theta(L_t)} = \eta \cdot L_t^{\eta-1} \cdot \frac{L_t}{L_t^\eta} = \eta$.

[10]Implicitly, capital also appears in the economic production function, but I normalize it to 1 in peace 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 output elasticity (η) rather than on how countries attract and grow capital investment. Especially in the oil context, international actors contribute much of this investment, and the present theory does not address how countries attract international investment.

[11]A less abstract model of the economy would assume that C possesses one labor unit that it can sell either on the formal market at L_t^η 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 $\frac{\omega}{1+\omega}$. Conversely, C reaps 0 from the informal sector by setting $L_t = 1$. This alternative setup yields an identical optimal labor allocation as the present setup, which I prefer because it does not impose the unnecessary upper bound of 1 on C's labor choice.

an identical uniquely optimal symmetric labor allocation if $N \in \mathbb{Z}_{++}$ citizens in the region independently choose labor allocations upon the rebel leader choosing not to fight. Second, separately modeling η and ω facilitates analyzing comparative statics on different production attributes. Section 3.2 provides case examples with varying η and ω values (Figure 3) to clarify these differences. Related, the comparative statics predictions for η do not change if $\omega = 1$, and vice versa for ω if $\eta = 1$. Therefore, modeling different parameters for output elasticity to labor input and for the value of the informal economy highlights different substantive factors that affect the value of producers' economic exit options, but the main grievance results do not require incorporating *both* parameters.

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

If instead C initiates a separatist civil war in period t, then neither player consumes in that period. If the separatist attempt fails, then period $t + 1$ begins a subgame strategically equivalent to the period t subgame. If instead C successfully separates, then the tax rate drops permanently to 0 in every future period and C's labor allocation choice is the only strategic action. In the subgame following successful secession, C's future continuation value equals V^C_{sec}, and G's equals 0 because it lacks a revenue source. Figures 1 and 2 present trees for the stage games and Appendix Table A.1 summarizes the parameters and choice variables.

1.2 Equilibrium Analysis

The analysis begins by characterizing the game's Markov Perfect Equilibria (MPE).[12] This isolates why the challenger may attempt to coercively end its interaction with a weakly institutionalized state that cannot possibly promise credibly to limit taxation in weak periods. Markovian strategies disable the challenger from punishing the government for actions taken in previous periods, and the next section evaluates a non-Markovian strategy profile. Applying the single-deviation principle characterizes optimal actions in a peace-

[12]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.

Figure 1: Tree of Stage Game in Status Quo Territorial Regime

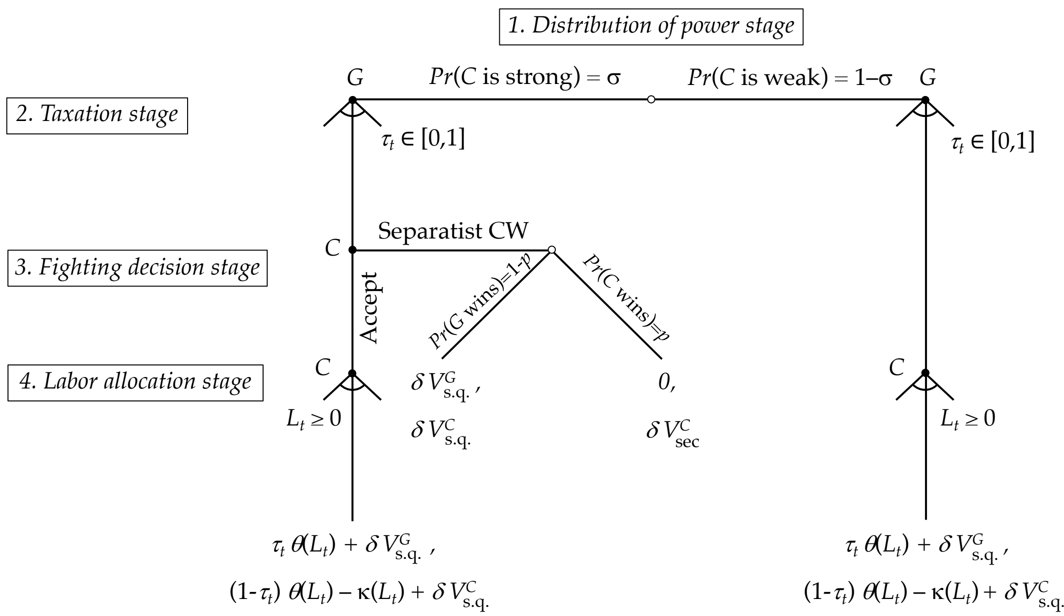
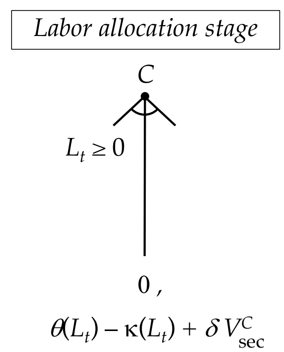


Figure 2: Tree of Stage Game Post-Secession



ful MPE[13]—which is unique when one exists—and in conflictual equilibria, and the parameter values under which a peaceful MPE exists. 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

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

consumption by the percentage of formal-sector production it retains, $1-\tau_t$, multiplied by the effect of higher 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 equals $\frac{\partial\kappa(L^*(\tau_t))}{\partial L_t}$. C chooses the unique labor supply that equates these terms, which implicitly characterizes $L^*(\tau_t)$:

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

Substituting in functional forms yields an explicit term:

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

Following secession, C's labor choice is the only strategic decision. 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 successfully secedes before period t, then C chooses $L_t = L_0^* \equiv \eta^{\frac{\omega}{1+\omega\cdot(1-\eta)}}$, which yields period t consumption $\theta(L_0^*) - \kappa(L_0^*)$ and $V_{sec}^C = \frac{1}{1-\delta}\cdot\big[\theta(L_0^*) - \kappa(L_0^*)\big]$.*

Fighting decision stage. If C did not previously secede and G makes an unattractive proposal, then in a strong period C can deviate from a peaceful strategy profile by fighting. C benefits from successful secession because G cannot tax its production. More formally, C will accept a proposal τ_t in a strong period if current- and expected future-period consumption weakly exceeds lifetime expected utility from initiating a civil war:

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

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 the share of C's formal-sector output it proposes, $\tau_t\cdot\theta\big(L^*(\tau_t)\big)$. 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 decreases the equilibrium formal-sector production *amount*. 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 τ_t to balance this tradeoff, and the following term implicitly defines the unique revenue-maximizing tax rate $\overline{\tau}$:

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

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 rebellion capacity, C wins a civil war with positive probability. Consequently, C may 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 always prefers to buy off C if possible in a strong period because G does not consume in a fighting period, and only with $1-p$ probability will G enjoy the same future consumption stream obtained with probability 1 following peaceful bargaining.

Alternatively, in a strong period, C may respond to *any* proposal by G by initiating a civil war. To understand why the actors may fail to bargain peacefully, if the per-period likelihood of strong rebellion capacity, σ, is small, then C only rarely experiences periods featuring a tax rate lower than $\overline{\tau}$. If, additionally, C wins a civil war with relatively high probability (high p) and exhibits patience (high δ), then C will fight when temporarily strong—forgoing short-term consumption to achieve higher expected long-term consumption. By contrast, high enough σ yields peaceful bargaining because G can credibly offer tax concessions frequently enough that C's fighting opportunity cost in a strong period outweighs expected fighting benefits.

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 exist a continuum of tax proposals that C will accept. If $\sigma < \overline{\sigma}$, then C will reject any tax offer, even $\tau_t = 0$, in a strong period. To see that large enough σ suffices for peace, the second term in Equation 6 cancels out if $\sigma = 1$, leaving a strictly positive term. Lemma 3 summarizes these considerations.

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

Lemma 3 (Actions/consumption in a strong period)**.** *Define τ_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 $U_C(strong)$ and G's as $U_G(strong)$, these terms and the status quo future continuation values equal:*
  - $U_C(strong) = (1-\tau_s^*)\cdot\theta(L_s^*) - \kappa(L_s^*)$
  - $V_{s.q.}^C = \frac{1}{1-\delta}\cdot\Big[\sigma\cdot U_C(strong) + (1-\sigma)\cdot U_C(weak)\Big]$. *Lemma 2 defines $U_C(weak)$.*
  - $U_G(strong) = \tau_s^*\cdot\theta(L_s^*)$
  - $V_{s.q.}^G = \frac{1}{1-\delta}\cdot\Big[\sigma\cdot U_G(strong) + (1-\sigma)\cdot U_G(weak)\Big]$. *Lemma 2 defines $U_G(weak)$.*
- *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_{strong}^C and G's as V_{strong}^G, the following equilibrium current-period consumption and future continuation terms differ if $\sigma < \overline{\sigma}$ as opposed to $\sigma > \overline{\sigma}$:*
  - $V_{strong}^C = \delta\cdot\Big[p\cdot V_{sec}^C + (1-p)\cdot V_{s.q.}^C\Big]$. *Lemma 1 defines V_{sec}^C.*
  - $V_{strong}^G = \delta\cdot(1-p)\cdot V_{s.q.}^G$

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

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

- *C seceded before period t: see Lemma 1.*
- *Weak C in period t: see Lemma 2.*
- *Strong C in period t: see Appendix Lemma 3.*

1.3 Economic Exit, Redistributive Grievances, and Civil War

The model yields a general redistributive grievances mechanism: G's inability to commit to low taxes only causes war for economic activities that undermine C's economic exit threat, captured by low ω and η. Low-valued economic exit raises G's revenue-maximizing tax rate—the equilibrium tax rate in weak periods—which naturally corresponds with economic grievances, or *redistributive grievances*. Higher taxes cause C to substitute away from supplying formal-sector labor (see Equations 1 and 2), which decreases taxable production. However, the *extent* to which higher taxes increase G's marginal cost of taxation (expressed in Equation 4) depends on the economic exit parameters: formal-sector output elasticity (η) and labor supply elasticity (ω). Low formal-sector output elasticity implies that decreasing C's labor supply only minimally diminishes formal-sector output. Low labor supply elasticity implies that higher taxes only minimally diminish equilibrium labor supply because C experiences low returns to producing in the informal sector.[14] Lemma 4 formally links C's economic exit option parameters and G's optimal tax rate, and Appendix Section A.2 further illustrates the elasticity logic by more generally parameterizing G's tax problem.

Lemma 4 (Redistributive grievances effect)**.** *A decrease in formal-sector output elasticity (η) and a decrease in the labor supply opportunity cost (ω) each increase the revenue-maximizing tax rate $\overline{\tau}$ that G levies in weak periods. 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 parameter range for which civil wars occur in equilibrium. C possesses two tools to prevent high taxes: threatening to fight and threatening to exit the formal sector. Strong contemporaneous coercive power suffices to prevent exploitation because G prefers buying off C

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

in a strong period to triggering fighting. Furthermore, an effective economic exit threat, i.e., high η and/or ω, prevents high taxes even in weak periods because G does not want to undermine its tax base—i.e., G's inability to *commit* to low taxes does not trigger war when coupled with *economic incentives* for low taxes. By contrast, groups with a low-valued economic exit option face a high equilibrium tax rate in weak periods. This redistributive grievance effect creates a large gap between how much C consumes in weak periods in the status quo territorial regime and how much it would consume by successfully seceding. An economically aggrieved challenger therefore faces higher incentives to initiate a separatist civil war in a period with strong capacity for rebellion 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.

Table 1: When Does the Government Exploit the Challenger?

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

Proposition 2 (Redistributive grievances generate secession incentives)**.** *An increase in redistributive grievances raises equilibrium separatist civil war likelihood, i.e., increases the range of σ 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. $-\frac{d\overline{\sigma}}{d\overline{\tau}} \cdot \frac{d\overline{\tau}}{d\omega} > 0.$

2 Reneging on Regional Autonomy Deals

The model further studies the redistributive grievances mechanism by incorporating a relevant real-world possibility: a government can limit redistributive grievances by granting regional autonomy with low permanent taxes. I analyze a non-Markovian strategy profile in which G offers the same tax rate to C in every period, backed by C's threat to fight in the first strong period following any deviation by G to a higher tax rate. The government can always offer low enough permanent taxes to prevent civil war. However, it will 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 devalue the economic exit option make deviating more profitable by raising the revenue-maximizing tax rate (as Lemma 4 showed). This increases the government's short-term gains from maximally taxing easy revenue sources relative to the long-term expected costs from triggering a secession attempt. Therefore, even when governments can enact low permanent taxes in principle, similar logic as in the baseline model undermines regional autonomy deals. Low-valued economic exit creates strategic incentives for the government to violate regional autonomy agreements and to *not* limit redistributive grievances—despite causing civil war. Appendix B provides additional formal details, and Appendix Section B.3 addresses a puzzle generated by comparing the distinct equilibria in this and the previous section by explaining the countervailing effects that a higher discount factor exerts on equilibrium war prospects.

Formally, suppose G offers $\tau_t = \hat{\tau}$ to C in every period t. Although C's post-secession continuation value, $\hat{V}^C_{sec} = \frac{1}{1-\delta} \cdot \big[\theta(L^*_0) - \kappa(L^*_0)\big]$, does not change from above, its continuation value in the status quo territorial regime now equals $\hat{V}^C_{s.q.} = \frac{1}{1-\delta} \cdot \Big[(1-\hat{\tau}) \cdot \theta\big(L^*(\hat{\tau})\big) - \kappa\big(L^*(\hat{\tau})\big)\Big]$ because C receives the same offer in every period, strong or weak. C will accept $\hat{\tau}$ rather than initiate a separatist civil war in a period with strong rebellion capacity if and only if:

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

I assume a punishment strategy in which if G ever reneges by proposing some $\tau_t > \hat{\tau}$, then C initiates a separatist civil war in the next strong period. Relaxing the Markov assumption bites because C conditions its actions on G's choices in previous periods. Appendix B discusses in more detail that, after a failed war, G and C 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 $\hat{\tau}$ 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. Therefore, in this strategy profile—but not for Markovian strategies—G can always set $\hat{\tau}$ low enough to satisfy C's no-fighting constraint. C cannot profitably deviate to fight if the status quo regime features low-enough taxes in every period, for example, if G proposes a tax rate close to 0 in every period.

Crucially, however, the *government* may profitably deviate in a weak period to making an exploitative tax proposal—despite triggering costly fighting in the next strong period. G's optimal deviation entails taxing at the revenue-maximizing rate $\overline{\tau}$ in all periods until the civil war occurs. High-enough expected time until the secession attempt, i.e., low σ, enables G to profitably deviate from a strategy profile that would induce peace along the equilibrium path. Formally, G will propose the compromise tax rate $\hat{\underline{\tau}}$ in every period if and only if:

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

The left-hand side of Equation 8 states G's net expected loss in all periods including and after the first strong period following optimal deviation. No consumption in a war period causes the strictly positive loss, and G achieves its best possible outcome by defeating the separatist attempt and subsequently receiving the original consumption stream. 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 utility gain in every period before the first strong period if it chooses the optimal deviation. G's strictly gains from taxing at the revenue-maximizing rate $\overline{\tau}$ 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 if proposed the revenue-maximizing tax rate.

The logic for why ineffective economic exit undermines regional autonomy deals and causes civil war resembles the mechanism in the baseline analysis. Because lower ω and η raise the revenue-maximizing tax rate $\overline{\tau}$, a low-valued regional exit option increases G's short-term gains to deviating from the regional autonomy deal, which Proposition 3 formalizes.

Proposition 3 (Redistributive grievances in constant-tax SPNE). *An increase in redistributive grievances raises equilibrium separatist civil war likelihood, i.e., increases the range of σ 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

Applying the model logic generates new insights into the conflict "resource curse," specifically, by helping to explain the strong positive statistical relationship between regional oil production and separatist civil war established in the literature. It first summarizes evidence for this pattern and explains its importance to the broader conflict resource curse literature. Insights from the model explain why capital-intense, geographically concentrated, and immobile oil production facilitates easy government taxation by undermining a region's economic exit option, therefore making civil war more likely. Easy-revenue properties of oil production also increase a government's incentives to renege on regional autonomy deals, which Sudan's second civil war exemplifies.

3.1 Statistical Relationship Between Regional Oil Production and Separatist Civil War

Many articles document statistical evidence that separatist civil wars occur more frequently in oil-rich than in oil-poor regions, using various 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 in non-OECD countries between 1945 and 2013, groups with at least one giant oil field in their territory initiated a separatist civil war 2.8 times more frequently than oil-poor groups, 1.02% of years compared to 0.37%.[15] Table 2 shows that oil-separatist civil wars range 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).

We need to explain the empirical oil-separatism pattern because widespread "conflict resource curse" proclamations 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, scholars should examine oil not only because it composes 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 oil appears distinctive in its systematic conflict-

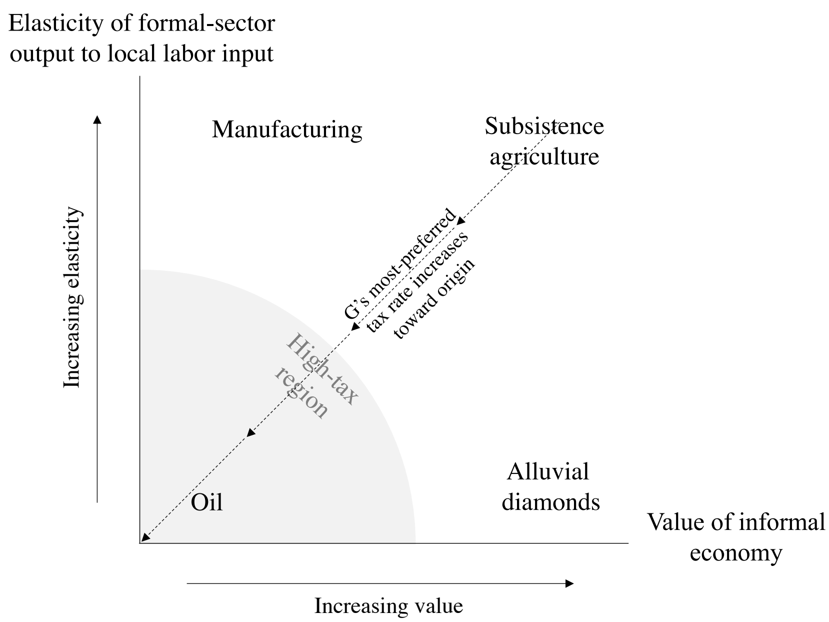
[15]Figures calculated by author by merging ethnic group and civil war data from the Ethnic Power Relations dataset (Vogt et al., 2015) with giant oil field location (Horn, 2015).

inducing properties. Furthermore, oil production and *aggregate* civil war onset do not systematically correlate at the country level (Cotet and Tsui 2013, Bazzi and Blattman 2014; Ross 2015, 251). Oil does not "curse" prospects for the other major type of civil war, center-seeking civil wars in which rebels fight to capture the capital, a discrepancy that Paine (2016, 2017) examines.

3.2 Why Oil Production Facilitates Government Revenues

Producing oil—as opposed to other natural resources or economic activities—undermines regional actors' threat to exit the formal economy, which the formal model links to high government taxation. Figure 3 plots different economic activities by how they affect producers' economic exit threat in two dimensions: formal-sector output elasticity to local labor input (η), and informal economic production value (ω). Values closer to the origin indicate a higher most-preferred tax rate for the government, $\overline{\tau}$.

Figure 3: Taxability of Different Economic Activities



Notes: The two dimensions in Figure 3 correspond to: formal-sector output elasticity to local labor input (η) and the value of the informal economy (ω). Factors such as highly capital intensive 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.

High capital intensity and how easily producers can import 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 η. Producing oil requires large capital investments, which foreign actors often fund. Ross (2012, 46) shows the capital-to-labor ratio in the oil and gas industry exceeds that in any other major industry for U.S. businesses operating overseas. Menaldo (2016, 131-175) describes the intimate relationship between oil production in developing countries and foreign capital, technology, and technical production expertise.[16] Companies can also easily import labor needed for production 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 also 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 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 ω. 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).[17] 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, immobile oil fields imply that local producers cannot threaten to move their oil reserves outside the government's reach if taxed at unfavorable rates (Boix, 2003, 42-43).

[16]Menaldo (2016) also discusses how information asymmetries between international oil companies and governments in developing countries limit the host government's take from oil profits. 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.

[17]However, this trend may change in the future as unconventional oil sources, including oil shales and oil sands, gain prevalence in global production.

These attributes distinguish oil from many other economic activities, which Figure 3 depicts.[18] 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. Scholars consider alluvial diamonds as a diffuse resource because they are "exploited over wide areas through a large number of small-scale operators" (Le Billon, 2005, 32). Therefore, societal actors can more easily steal these "blood diamonds" and prevent the government from accruing revenues. Operating a modern manufacturing plant resembles oil production because, after sinking factory-building costs, the plant is concentrated in location and immobile. However, most industry does not resemble oil production's high capital-intensity. Therefore, most manufacturing requires more labor—often, local and somewhat skilled labor—yielding a higher value on the vertical axis. And some manufacturing activities locate further to the right in Figure 3. Large multinational corporations enjoy sufficient liquidity even after sinking costs in a fixed asset to leave the country and to produce elsewhere in reaction to high taxes, whereas companies cannot move oil fields. Subsistence agriculture differs from oil 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. Growing illicit drugs exhibits similar traits because producers can relatively easily conceal them from governments (especially by often selling in international markets). This discussion substantively supports Assumption 1.

> **Assumption 1.** *Oil-rich territories exhibit lower formal-sector output elasticity η (lower value on vertical axis of Figure 3) and lower opportunity costs to supplying formal-sector labor ω (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 implications from Lemma 4 and Propositions 2 and 3 explains the redistributive grievances linkage between regional oil production and civil war onset. By undermining a region's economic exit option and facilitating high government taxes, regional oil production

[18]Other economic activities besides oil also belong 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, scholars demonstrate mixed existing empirical evidence linking non-oil natural resources and separatist civil war (Ross 2015, 250).

creates incentives to secede to prevent future government exploitation. Evidence from various oil-rich regions with separatist civil wars supports this argument. In Iraq, Kurds historically claim 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 to siphon 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 initiated a separatist civil war, and the table notes describe the sample. For most conflicts, Rustad and Binningsbø (2012) code an indicator variable for whether the distribution of natural resource revenues influenced the conflict. Their codebook states that they consider two types of distributional issues: "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 for redistributive grievances.

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

Country	Region	First conflict year	Evidence for 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 ethnic group with at least one giant oil field in their polygon that fought a separatist civil war, using spatial ethnic group data and conflict data from the Ethnic Power Relations dataset (Vogt et al., 2015) and giant oil field data from Horn (2015). Table 3 excludes the following cases listed by Ross (2012, 165) 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).

Regarding regional autonomy deals, Sudan exemplifies a government actively undermining existing agreements to control 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 abrogated the 1972 settlement. 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 in the south, he conveniently created a new province and removed the oil-fields altogether from southern jurisdiction" (Ali and Matthews, 1999, 209). 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 analysis provides further insight into the resource curse by evaluating and highlighting shortcomings of alternative "greed"-based explanations for the oil-separatism relationship. Strikingly, most arguments assume that *rebels* routinely access or can influence the distribution of oil revenues—contrasting with the core grievance premise (Assumption 1) that *governments* easily control oil revenues. Combining the logic of greed mechanisms with empirical considerations about oil production shows that, contrary to existing arguments, greed mechanisms logically *diminish* separatist incentives, or raise equilibrium separatist civil war prospects only under unlikely empirical conditions.

4.1 Wartime Rebel Looting

Some argue that oil production often enables rebel *looting* and consumption during civil wars (Collier and Hoeffler 2005, 44; Ross 2012, 145-187). However, the aforementioned attributes of oil production imply that rebel groups should face difficulties looting oil production during ongoing civil wars. The logic of the model highlights why rebel looting likely cannot explain the oil-separatist relationship.

Empirically, considerable scholarship examines rebel looting during civil war and reveals very few separatist cases with oil-generated rebel finance. Ross (2012, 170-3) documents oil theft by rebels in Nigeria's Niger Delta region 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, their qualitative discussions of oil-secession cases in Nigeria's Biafra conflict, Indonesia, and Sudan do not mention rebel looting (Collier and Hoeffler, 2005, 47-49).

To more systematically demonstrate evidence against rebel financing, 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 additionally motivates distinguishing natural resources by production attributes: all except copper (present in one case) are diffuse resources that impede government control, indicating a high value on the horizontal axis of Figure 3.

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

Country	Region	First conflict year	Evidence for 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.

Several cases suggest that coding *no* financing cases overstates how rarely this phenomenon occurs in separatist civil wars over oil-rich regions, although do not alter the main point that massive looting very rarely occurs. In addition to the Niger Delta case mentioned above, southern Sudanese rebels provide another possible example because they blew up pipelines and disrupted oil production during Sudan's second civil war, although this evidence more closely resembles the disruption mechanism (see below) than the financing mechanism. Finally, rebels earned 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, scholars disagree on how to correctly code ISIS' civil war aims, who proclaimed to establish an Islamic Caliphate in territory captured from Iraq and Syria. Either way, the overall rarity of massive oil looting during separatist conflicts implies that this mechanism provides an unconvincing explanation for the empirical oil-separatist relationship.[19]

Combining Assumption 1 with the logic of the model anticipates this pattern. Extending the model addresses wartime consumption: assume that actors consume a positive amount in a war period and that G and C exogenously divide C's formal-sector production. G receives $(1-\phi)\cdot x(\eta)$ percent and C receives $(1-\phi)\cdot \big[1-x(\eta)\big]$ percent, and $\phi \in (0,1)$ captures war destructiveness. The less that C's formal-sector production depends on local labor, the more easily G can expropriate C's resources even during a war. Formally, the evidence that motivated Assumption 1 also supports assuming that $x \in (0,1)$ strictly decreases in η, which implies that oil production lowers C's percentage of wartime spoils. 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 equilibrium separatist civil war likelihood, i.e., decreases the range of σ 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

A corollary to the looting argument posits that oil-rich challengers should enjoy an arming advantage from using oil to finance *building up* their insurgent organization. Related, rebels may leverage expected future control over oil reserves to borrow from international actors in a "booty futures" market (Ross, 2012). However, rebels usually face great difficulties to gaining access to oil wealth, especially when considering

[19]The Armed Conflict Database (Gleditsch et al., 2002) codes ISIS as participating in a center-seeking civil war 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. Other 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 difficulty-of-looting argument also applies to center-seeking civil wars (Paine, 2016), disaggregating civil war types highlights that this phenomenon rarely occurs in separatist civil war cases.

the international component. By contrast, governments frequently fund their military using oil revenues. Combining empirical observations with logic from the model highlights shortcomings of this greed argument.

Empirically, rebel groups almost never access oil revenues to fund start-up costs for challenging a government because, even when otherwise 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 in which rebels raised start-up funds via oil in a booty futures market, and these rebels did not seek secession. 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, international actors rarely contract on future oil promises by rebel groups because international oil companies and their host governments favor incumbents over challengers to prevent costly oil production disruptions. At least empirically, this argument appears true even beyond oil. Ross (2004, 50) concludes from examining 13 prominent civil wars involving various 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 anywhere in a country should *decrease* the challenger's probability of winning a separatist civil war by funding the government. Consistent with Assumption 1, Paine (2016) explains why governments enjoy large advantages over rebel groups for translating oil wealth into military capacity, contrary to common allegations that oil wealth weakens state capacity. Empirically, scholars' evidence shows 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 rebel groups in oil-producing territories should enjoy arming advantages, these 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 equilibrium separatist civil war likelihood, i.e., decreases the range of σ 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

Scholars also argue 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, which improves their bargaining position relative to the government. Although these specific arguments focus on activities during peacetime, ongoing wars often feature even starker disruptions. For example, SPLA's insurgency in South Sudan prevented Chevron from producing oil in the 1980s and 1990s despite earlier major oil discoveries. Combining the logic of the model with empirical observations casts doubt that the peacetime disruption mechanism is empirically relevant, although—highlighting why we need to distinguish between disruption during peacetime and war—the wartime mechanism exhibits higher plausibility.

Peacetime disruption. During peacetime, the disruption argument faces two important shortcomings. First, the empirically grounded premises discussed above show that oil production does not improve C's bargaining position. If the disruption mechanism works as scholars propose, then oil production should increase the value of C's economic exit option and decrease equilibrium tax rates, i.e., moving up and/or to the right in Figure 3. If withholding local labor in oil-rich regions (perhaps via protests or strikes) more greatly interrupts formal-sector production than if the region produced an alternative commodity, 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 concerns whether local residents' actions affect oil output more or less than other economic activities. As discussed, highly capital-intense oil production and the usual ease with which firms replace local with foreign workers implies low elasticity (Assumption 1)—contrary to the disruption argument.

Similarly, if residents can steal oil more easily than other economic activities, then this would raise the value of the informal economy and oil production should locate farther to the right on the horizontal axis in Figure 3. However, as noted, governments can relatively easily guard oil fields because actors extract oil in concentrated locations, whereas rebels face great difficulties to gain the technical expertise and international assistance needed to reap large oil profits. Disruptions may also affect a government's ability to translate oil revenues into a strong military. But, especially during peacetime, disruptions will likely lack sufficient destruction 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 disruption mechanism did enhance C's economic exit option, then oil production would *decrease* incentives for fighting by triggering the opposite logic as presented for the redistributive grievance mechanism. For example, Blair (2014) posits that threatening to interrupt oil production increases oil-rich residents' bargaining power relative to the government. Using language from the present model, higher η or ω increases the value of C's economic exit option, which decreases the equilibrium tax rate in weak periods and increases the parameter range in which G can buy off C in a strong period. In other words, reversing Assumption 1 implies that oil production—as opposed to other economic bases—helps to smooth C's consumption across periods and therefore *reduces* C's incentives to launch a separatist bid when temporarily strong, via the logic of Proposition 2.

Alternatively, we could assume that C can also choose a "simple revolt" option—e.g., mass strikes or other disruptive events short of conventional war definitions—in any period and consume $R > 0$ rather than accepting the government's offer. If oil production increases R by facilitating disruptions, then this effect weakly increases C's lifetime expected consumption in the status quo regime and—similar to increasing η or ω—decreases C's incentives to initiate a separatist civil war in a strong period.

Wartime disruption. A more compelling greed argument posits that oil can trigger fighting because ongoing fighting can disrupt oil production sufficiently to shift the distribution of power away from G. Extending the model to allow for a third war outcome enables evaluating this argument. Assume at the game's outset that C wins outright and gains independence with probability $p_t = p$, as in the baseline model. However, conditional on not winning, two possible outcomes occur. First, as in the baseline model, C may lose, which occurs with probability $(1-p) \cdot (1-s)$, for $s \in (0, 1)$. Second, with probability $(1-p) \cdot s$, 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.[20] If oil production increases the power-shifting probability s, then this mechanism increases C's incentives to fight—consistent with Lujala's (2010) finding that conflict lasts longer in territories with known hydrocarbon reserves even if no production occurs. Although rebels do not directly profit by disrupting oil production in this setup, reducing the government's access to oil revenues can reap indirect benefits. For example, rebels in southern Sudan in the 1980s prevented the government from extracting oil revenues by initiating fighting shortly after discovery and by blowing up pipelines.

Although the wartime disruption argument highlights a more compelling logic than other greed mechanisms, it cannot explain many empirical oil-separatism cases, either. High wartime disruption in Sudan's second civil war is an outlier. And even in this case, the disruption mechanism does not explain the government's strategic choices (described above) that effectively ended the regional autonomy deal and drove SPLA to fight—as opposed to SPLA blowing up pipelines to exploit a hapless government. Furthermore, this mechanism does not negate the general arming advantages that governments enjoy from greater access to oil revenues both in peacetime and during war (Colgan, 2015, 7-8), which decreases p and diminishes C's fighting incentives (Proposition 5). Nor does oil production necessarily covary with high s. Civil war disrupts all economic output, not just oil.[21]

4.4 Price and Prize Effects

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). Contrary to existing arguments, a large prize does not necessarily raise civil war likelihood. Although a large prize increases the challenger's expected utility to fighting, it also raises the war opportunity cost. The volatile revenues argument exhibits higher theoretical plausibility. Price busts or time prior to a newly discovered oil field coming online generate low contemporaneous opportunity costs, but the prize contains high *future* value. Focusing on an

[20]The model can easily incorporate this idea if power can only shift once. Specifically, assume that the game begins in state $p_t = p$, and only this state exhibits a positive probability that—if a war occurs—C's future probability of winning increases via the intermediate war outcome. If instead p_t previously shifted to p', then $p_t = p'$ in all future periods and $s = 0$, i.e., the subgame in which a power shift previously occurred strategically replicates the baseline game.

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

opportunity cost mechanism also distinguishes the logic from Bell and Wolford (2015), who analyze oil discoveries and shifts in the future distribution of power.

5 Conclusion

This article posits a strategic linkage between economic grievances and civil war onset, and also provides insights into a specific empirical pattern: oil-rich regions fight separatist civil wars relatively frequently. The findings carry theoretical and empirical implications for various grievances and greed mechanisms in the civil war literature, and highlight new considerations for broader international relations research. The article provides a framework for understanding how economic production attributes—such as output elasticity, exit options to an informal sector, and price volatility—create redistributive grievances and foster civil war incentives. The model's theoretical implications yield hypotheses that scholars could test empirically for various economic commodities, for example, by combining the model's theoretical logic with commodities in different positions in Figure 3. Furthermore, the regional autonomy analysis informs broader questions about grievances. For example, Cederman, Gleditsch and Buhaug (2013) show that ethnic groups that lack access to political power at the center more frequently fight civil wars. But why would a government exclude ethnic groups if this choice raises civil war likelihood? The model provides insight into why a government may strategically choose not to alleviate grievances, which future research could extend.

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 rebel finance sources. Therefore, if looting often triggers civil wars, then easily lootable resources such as alluvial diamonds should systematically associate with separatism. However, although we require additional research, existing statistical results show a weak relationship between alluvial diamonds and civil war (Ross, 2015, 250). Perhaps the non-finding for alluvial diamonds arises because these minerals are secondary to state weakness for causing civil war onset. Only amid severe state weakness can rebels control territory and mine diamonds. This consideration explains how rebels looted and financed their armies using alluvial diamonds during conflicts in Angola, Liberia, and Sierra Leone—and ISIS's control over oil fields—but also why rebels usually cannot loot en masse.

Finally, the dual inside options (economic exit) and outside options (fighting) in the model may also provide insights into international warfare. Considerable international conflict research examines shifts in power over time (Fearon, 1995; Powell, 2004), but less research analyzes alternatives to fighting to mitigate adverse shifts in the distribution of power. In oil-rich countries, for example, anticipated depletion of oil reserves over time implies an adverse future power shift relative to great powers. In response, many oil-rich countries actively invest in alternative industries (similar to the economic exit option in the model) to minimize expected future exploitation from producing less oil. More perversely, pursuing weapons of mass destruction and exiting international institutions generates a similarly valuable inside option. Based on GDP and industrial production alone, weak countries like North Korea would perhaps face exploitation when bargaining via standard diplomatic options. Developing nuclear weapons serves as a viable exit option to gain favorable outcomes despite weak traditional bargaining leverage. Overall, these considerations suggest the model's mechanisms, perhaps with substantively appropriate extensions, may help to explain various international and domestic conflict outcomes.

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Online Appendix

A Supporting Information for Baseline Model

Table A.1: Summary of Parameters and Choice Variables

Stage	Variables/description
Primitives	• G: government • C: regional challenger • δ: discount factor • t: time
1. Distribution of power stage	• σ: Probability C is strong in any period t in the s.q. territorial regime
2. Taxation stage	• τ_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 • $\theta(\cdot)$: formal-sector production function • η: formal-sector output elasticity • $\kappa(\cdot)$: opportunity cost, from foregoing informal-sector production, of supplying formal-sector labor • ω: 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 • $V^C_{\text{s.q.}}$: C's future continuation value in the s.q. territorial regime • V^C_{sec}: C's future continuation value in the secession subgame
Parameters in greed extensions	• ϕ: Percentage of C's formal-sector production destroyed in the period of a separatist civil war • x: Percentage of C's formal-sector production (not destroyed by the war) that accrues to G • R: Value to C of simple revolt option • Y^C: value of formal-sector output • $\frac{Y^C}{b}$: value of formal-sector output in bust periods • γ: 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 μ_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 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 τ^*_s and τ^*_w represent equilibrium choices. If $\mu_t = \mu^0$, then τ_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 τ_t. Formally, $\alpha : \{\mu^s\} \times [0, 1] \to [0, 1]$, and α^* 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 $\left\{\tau_s^*, \tau_w^*, L_s^*, L_w^*, L_0^*, \alpha^*\right\}$ 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:

$$L^*(\tau_t) \in \arg\max_{L_t \geq 0} \; (1-\tau_t)\cdot\theta(L_t) - \kappa(L_t)$$

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 (which can easily be verified by computing the second derivatives), 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 τ_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 text 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:

$$\max_{L_i \geq 0} \; (1-\tau_t)\cdot\left(\frac{L_i + \sum_{N\setminus\{i\}} L_j}{N}\right)^{\eta} - \frac{\omega}{1+\omega}\cdot\left(\frac{L_i + \sum_{N\setminus\{i\}} L_j}{N}\right)^{\frac{1+\omega}{\omega}}$$

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:

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

■

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 τ 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 $\tau \in (0,1)$. ■

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

$$\overline{\tau} \in \arg\max_{\tau_t \in [0,1]} \; \tau_t \cdot \theta\big(L^*(\tau_t)\big)$$

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:

$$\overline{\tau} \in \arg\max_{\tau_t \in [0,1]} \; \tau_t \cdot \Big[(1-\tau_t)\cdot\eta\Big]^{\frac{\omega\cdot\eta}{1+\omega\cdot(1-\eta)}}$$

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 τ_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, $\overline{\tau} < 1$. ■

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 δ because none of the optimal choice variables included in Definition A.1 are a function of δ.

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 τ_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)**.**

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

The proof of Lemma 3 begins by defining C's optimal acceptance function and G's optimization problem for τ_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 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 τ_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 τ_s^* because τ_s^* is assumed 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 λ, the first-order condition enables implicitly solving for τ_s^*:

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

This term is nearly is identical to Equation A.2. The difference arises from the multiplier λ, 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:

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

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 τ_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. λ^*, as defined in KKT condition 1, is a strictly decreasing function of τ_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 τ_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 Ψ^* strictly decreases in τ_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. $\Psi^*(\overline{\tau}) < 0 < \Psi^*(0)$. 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 τ_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 τ_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 continuous in L_t. Therefore, $\Psi^*(\cdot)$ is continuous in τ_s^*.

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

Part 2. Follows immediately from Equation A.3 and from defining τ_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 τ_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 τ_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 σ. 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 σ

Furthermore, because $\Phi(\cdot)$ strictly increases in σ, $\overline{\sigma}$ 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 τ_t in a strong period. Because C fights in response to any offer, G's utility is not a function of τ_t.

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

A.2 Comparative Statics

Proof of Lemma 4. $-\frac{d\overline{\tau}}{d\eta} = \frac{\omega}{1+\omega} > 0$ 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^{β}, for some $\beta\in(0,1)$. Here, α is labor-supply elasticity and β 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.3. *For a generic parameter ϵ, 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 ϵ 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:

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

The strict positivity of the term in brackets follows because C's consumption function strictly decreases in τ_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 Lemmas 4 and A.3, 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 3 except in the substantively uninteresting case in which G's budget is large enough to prevent fighting for all parameter values. 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 σ, G would not be able to buy off C in a strong period.

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 $\underline{\hat{\tau}}$.*

1. *G's tax offer:*
   (a) *If $\tau_j \leq \underline{\hat{\tau}}$ for all $j \in \mathbb{W}$, then $\tau_t = \underline{\hat{\tau}}$.*
   (b) *If $\tau_j > \underline{\hat{\tau}}$ 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 $\tau_j \leq \underline{\hat{\tau}}$ for all $j \in \mathbb{W}$, then C accepts $\tau_t \leq \underline{\hat{\tau}}$ and fights otherwise.*
   (b) *If $\tau_j > \underline{\hat{\tau}}$ 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, whereas 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 τ_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 σ if G taxed at 0 in strong periods and at a rate in weak periods that satisfies Equation 7 with equality (which will exceed $\underline{\hat{\tau}}$). 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 σ 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, part a.

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

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

into Equation 7 and re-arranging yields C's indifference condition:

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

Applying the intermediate value theorem demonstrates the existence of at least one $\underline{\hat{\tau}} \in (0, \overline{\tau})$ 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 continuous functions of τ_t, which implies $\chi(\cdot)$ is continuous in $\underline{\hat{\tau}}$.

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

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

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 σ.

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:

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

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

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

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

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

which solves to:

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

Therefore:

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

Because Equation B.8 is continuous and strictly increases in δ, 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:

$$\frac{\underline{\underline{\delta}}_C}{1-\underline{\underline{\delta}}_C\cdot(1-\sigma)}\cdot\Bigg[p\cdot E\big[U_C(\tau_t=0)\big]+(1-p)\cdot E\Big[U_C\big(\tau_t=\hat{\underline{\tau}}(\underline{\underline{\delta}}_C)\big)\Big]-(1-\sigma)\cdot E\big[U_C(\tau_t=\overline{\tau})\big]\Bigg]$$
$$=E\big[U_C(\tau_t=0)\big] \quad \text{(B.10)}$$

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

B.2 Comparative Statics

The proof of Proposition 3 uses the following lemma.

Lemma B.1. *For a generic parameter ϵ, 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 ϵ 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:

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

■

Proof of Proposition 3. Because $\frac{d\underline{\hat{\tau}}}{d\overline{\tau}} = 0$, it follows that $\frac{d\hat{\sigma}}{d\overline{\tau}} = \frac{\partial\hat{\sigma}}{\partial\overline{\tau}} + \frac{\partial\hat{\sigma}}{\partial\underline{\hat{\tau}}}\cdot\frac{d\underline{\hat{\tau}}}{d\overline{\tau}} = \frac{\partial\hat{\sigma}}{\partial\overline{\tau}}$. Therefore, for parts a and b, because of Lemmas 4 and B.1, it suffices to demonstrate $\frac{\partial\Omega(\hat{\sigma})}{\partial\overline{\tau}} = -(1-\delta)\cdot\theta(\overline{L}) < 0$. ■

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 Indirect: ST for C
Benefit of fighting	LT for C	Direct: ST for G Indirect: LT for C
Effect of δ	Higher δ causes fighting	Direct: higher δ prevents fighting Indirect: higher δ causes fighting

The constant-tax SPNE features countervailing direct and indirect effects. The direct effect of higher δ creates opposing incentives for G compared to 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 δ in the constant-tax SPNE resemble those from the MPE because higher δ 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 C is sufficiently patient. This implies that the anti-folk theorem result from the MPE is necessary to generate the negative direct effect of δ on $\hat{\sigma}$ in the SPNE by enforcing G's cooperation.[22] Proposition B.2

[22]If instead the players had different discount factors, δ_G and δ_C, then higher δ_G would unambiguously

formalizes these claims.[23]

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

Part a.
$$\frac{d\overline{\sigma}}{d\delta} > 0$$

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

Proof of Proposition B.2, part a. Given Lemma A.3, 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.

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

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

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

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 δ 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 $\frac{\partial\hat{\sigma}}{\partial\hat{\underline{\tau}}} < 0$, a higher regional autonomy tax rate increases G's opportunity cost to deviating to a high tax rate, generating a smaller range of σ values in which G deviates. For $\frac{d\hat{\underline{\tau}}}{d\delta} < 0$, higher δ increases the value of C's war option, which lowers the tax rate that makes C indifferent between accepting and fighting.

make peace more likely in the constant-tax SPNE because the direct effect works solely through δ_G and the indirect effects solely through δ_C.

[23] 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 (because G consumes more in period t if a war occurs than if it offers 0 taxes to C), so Proposition 4 only holds for δ 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.3 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.3 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.

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

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 σ values small enough that fighting occurs.*

- *If p is sufficiently large, then the probability of winning multiplied by prize of winning effect, $p \cdot \frac{\delta}{1-\delta} \cdot (1-\sigma) \cdot \left[\theta(L_0^*) - (1-\overline{\tau}) \cdot \theta(\overline{L})\right]$, 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 σ 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.3, 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 (by providing revenues to the government) suggest that oil-rich regions often do not exhibit the parameter values in which the overall prize effect is conflict-inducing. 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 γ, the less that the volatility parameter b affects future-period considerations. If γ 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:

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

The continuation values are defined as follows:

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

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

Substituting Equations C.5 and C.6 into Equation C.4 and finding a σ 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 σ values small enough that fighting occurs if $\gamma > \tilde{\gamma}$, for $\tilde{\gamma} < 1$ defined the proof, and strictly decreases this range of σ 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

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

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

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

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

The claim $\tilde{\gamma} < 1$ follows because the second term on the right-hand side of the inequality is strictly positive. ■

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.

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