Oil Discoveries, Shifting Power, and Civil Conflict*

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Abstract

Civil conflicts can begin when expectations of rising government strength render current bargains incredible and rebels prefer immediate war to the prospect of an intolerable future peace. We analyze a game-theoretic model of the commitment problem in bargaining between a government and a rebel group that emphasizes the role of expectations over future shifts in power and diminishing returns to increasing government power. To test the model’s main hypothesis, we leverage data on announced oil deposits as an indicator of the state’s expected future bargaining power and show that the expectation of increased future oil revenues leads to an increased probability of civil conflict, but only when announced oil reserves account for a sufficiently large increase over existing wealth.

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The bloody first phase of the South Sudanese civil war concluded with the signing of the Addis Ababa agreement of 1972. Under the accord, southern rebels received regional autonomy, state-sponsored Islamization of the south ceased, and rebel leaders agreed to demilitarize. This was the most tranquil period in post-independence Sudan, but the peace was short-lived. When Chevron struck oil in southern Sudan in 1978, southern secessionists quickly regrouped, and the promise of future oil wealth facilitated the formation of a united Sudan People's Liberation Army (SPLA), which dwarfed the loosely-organized groups that fought for southern interests in the previous phase of the conflict. Large-scale violence between the SPLA and the government was widespread by 1983, and the ensuing second phase of the war killed some 2 million Sudanese before the ratification of the 2005 Comprehensive Peace Agreement.\(^1\)

The case of Sudan suggests that oil can provide an impetus for civil conflict even before the commencement of oil production and the realization of the associated wealth. In fact, fighting preceded oil production by nearly twenty years.\(^2\) Memories of Sudan are often invoked after announcements of newly-discovered oil and gas deposits, most recently in places as diverse as Venezuela, Ghana, and Uganda.\(^3\) However, concerns over the attendant “resource curse” are not always justified. The majority of announced oil discoveries have not precipitated civil conflict, and the governments of many oil-rich countries have proven remarkably adept at avoiding domestic threats to their continued rule. Why might oil discovery cause conflict even before any oil is produced, and what distinguishes countries that discover oil and suffer conflict from those that discover oil and enjoy peace?

\(^1\)Daly and Sikanga (1993) and Deng (1995) provide a thorough discussion of the first phase of the war.\(^2\)Sudan did not produce more than 10,000 barrels of oil annually until 1999.\(^3\)Di John (2009) discusses Venezuelan stability following the find of major offshore oil deposits. Green (2008) and Rice (2009) assess the political effects of recent oil discoveries in these Ghana and Uganda, respectively. For a more general warning about oil and state failure, see Collier (2007).
To answer these questions, we develop an argument and empirical test that depart in notable ways from much of the extant literature on the oil-conflict nexus (see, *inter alia*, Collier and Hoeffler 2004, Fearon 2005, Ross 2004a,b). Whereas this research overwhelmingly emphasizes the effects of *oil production* on civil conflict, our research question calls attention to the role of *oil discovery*. We claim oil discovery can sometimes increase the likelihood of conflict because announcements of new oil deposits cause potential combatants to update their expectations over future state strength. This promise of increased relative bargaining power results in a commitment problem that prevents credible agreements between a government and its opponents (see also Fearon 2004), creating a strong incentive for rebels to fight before infrastructure construction enables states to profit from these newly-discovered sources of income.

In the following sections, we first place our study in the context of the previous research on the relationship between natural resource wealth and civil conflict. After arguing that oil discoveries should cause anticipation of increased state power, we analyze a stylized model of bargaining between a government and potential rebels in the shadow of shifting resource wealth. From this model we hypothesize that the discovery and announcement of new oil reserves creates an incentive for rebels to attack shortly after oil discoveries before the government can construct infrastructure and convert oil wealth into greater bargaining power. However, we also show that this relationship should be conditional upon the pre-existing strength of the state. The announcement of new proved oil reserves is most likely to precede conflict where states are weaker at the time of discovery, as weak states can anticipate a greater marginal increase in state strength following the discovery of new oil reserves.

We test the argument using oil and gas industry data on annual proved oil reserves for all states for which data are available, 1981-2007. This test provides a rare assessment of the com-
mitment problem logic that explicitly incorporates expectations over future strength and offers robust support for the hypotheses. We conclude that oil is linked to an increased risk of civil conflict even before production begins. This is especially true where states are sufficiently weak or discoveries are sufficiently great so that the new deposits are anticipated to drastically increase state strength in the future.

**Oil Discovery and Future State Strength**

The discovery of crude oil reserves should alter expectations over future state strength for three reasons. First, oil production offers the state an immobile and fixed source of income. Governments can use this income to increase state strength by investing in the military apparatus and by placating or repressing potential challengers. Second, states generally receive the income to be derived from recent oil discoveries only after constructing new infrastructure or expanding existing pipelines, refineries, and other facilities. Because production lags the initial discovery of crude oil reserves, we surmise that oil discovery affects expectations over future state strength without greatly altering state strength in the present. Finally, the discovery of new proved reserves is reported publicly by government and industry sources. Potential rebels are thus likely to be cognizant of significant oil finds and use them to form estimates of future state strength.

Development economists stress that oil reserves increase state strength not only because oil is a valuable commodity, but also because it is both immobile and untaxed. Whereas the leaders of aid-dependent regimes must meet conditions set by donors and regimes relying on foreign investment must be wary of capital flight, oil-endowed governments are relatively immune to these kinds of concerns. For this reason, the leaders of oil regimes are less constrained in their
spending and behavior. Oil-producing states are more likely to initiate interstate disputes (Colgan 2010), and military spending as a percentage of gross domestic product is as much as ten times higher in oil-rich states.\footnote{For more discussion of the effects of oil's immobility, see Collier (2000).} Under many conditions, oil wealth also strengthens states and makes them less susceptible to civil conflict.\footnote{There is a long debate about the relationship between civil war and oil wealth, but most work finds that oil wealth strengthens the state unless oil production is concentrated in a region that is already held by rebel forces (Fearon 2005, Le Billon 2001a, b, Lujala 2009, Lujala, Rod and Thieme 2007). This can facilitate “bunkering,” which occurs when rebels tap pipelines and sell oil on black markets. For reviews of the large body of work debating the existence of a relationship between oil wealth and civil war, see work by Ross (2004a, 2004b, 2006), Ron (2005), and Blattman and Miguel (2010). Le Billon (2001a) provides an account of oil strengthening the Angolan government during its long civil war.}

The immobile nature of oil reserves facilitates rapid and aggressive state-building, but states also benefit from oil because it provides a large source of untaxed income. States that collect rents from oil exports need not lean heavily on taxes. As seen in Saudi Arabia, Kuwait, and elsewhere, this unearned income allows governments to reduce or even eliminate taxes on their citizens. Ross (2001) and Smith (2004) link low tax rates to rebel recruitment, arguing that it is much more difficult for rebels to recruit where potential recruits are paying very low taxes.\footnote{Weinstein (2005) adds that oil wealth can actually hurt the rebel cause by encouraging opportunistic recruits who lack dedication to the cause and loyalty to the movement. For a more case-specific examination of rebel recruitment in oil-rich areas, see Oyefusi’s (2010) study of separatist recruitment in the Niger River Delta.} In a study of sub-Saharan regimes, Jensen and Wantchekon (2004) note that citizens facing lower tax rates are also less likely to demand regime change or press for democratic reforms. Accordingly, oil wealth offers leaders greater fiscal flexibility and is generally found to increase regime duration (Morrison 2009, Smith 2008, Ulfelder 2007).\footnote{Political scientists are increasingly concerned about the “perils” of unearned income (Fearon 2005, Smith 2008). Because leaders need not invest in the people to maintain strong economies, some studies find that oil regimes under-invest in institutions and thus fail to provide public goods and high opportunity costs for potential rebels. Others attribute poor decisions over public goods provision not to oil wealth, but to poor leadership (Dunning 2005, Smith 2008, Snyder and Bhavnani 2005).}

However, the discovery of new oil reserves should proxy expectations over future state capacity because the benefits of oil wealth are not realized immediately after discovery. Depend-
Figure 1: Oil Discovery and GDP Per Capita, Iran and Qatar

![Graph of Oil Discovery and GDP Per Capita for Iran and Qatar]

Figure 1 illustrates this lagged effect in Iran and Qatar. Both states saw a significant increase in proved oil reserves but neither of these states immediately experienced the corresponding increases in per capita gross domestic product. Iran’s proved oil reserves nearly doubled in 1988, but economic growth was slow until the early 1990s. After experiencing negative growth rates in the years immediately after the find, economic growth averaged more than 9% per year over the first part of the next decade. Qatar saw its reserves grow from roughly 4 billion barrels to almost 15 billion barrels in 2001, but the requisite boom in per capita income lagged a few years.

For a thorough discussion of the war and oil corporation strategies occurring in the interim between the discovery and production of Sudan’s oil, see Patey (2007).
years. The growth rate was negative in 2001 and less than 2% in 2002, but Qatar’s per capita GDP grew 24% annually between 2003 and 2007.

Of course, the discovery of new oil reserves should alter potential rebels’ expectations over state strength only when rebels are informed of these new discoveries. Surely small changes in reserves go unnoticed, but significant oil finds are widely reported by government and industry sources. Most of the sources used to compile the reserves estimates data that we use below are from reports published by state oil ministries. This is true even in non-democratic regimes that might be less forthcoming with sensitive state information. Examples of the sources used to estimate crude reserves include the China Energy Statistical Yearbook (published by the Chinese government) and the online dataset provided by the Saudi Ministry of Petroleum and Mineral Resources. While one might expect that governments, fearing an increased risk of civil war, might work to keep the most dangerous discoveries secret, we would then expect to see only an attenuated effect of those discoveries that are publicized; as we discuss below, this should bias our empirical results against finding a relationship, which provides a harder test of the hypotheses we drive in the next section.

A Model of Bargaining in the Shadow of Oil

To better understand how the announcement of new oil discoveries might alter the likelihood of conflict, we construct and solve a bargaining model of the interaction between a government and a rebel group. Suppose that a government, $G$, and a rebel group, $R$, bargain over the division

\[\text{A complete list of the government, industry, and private reports used to compile the US Energy Information Administration’s estimates of worldwide crude oil reserves is available online at www.eia.doe.gov/cfapps/ipdbproject/docs/sources.cfm. The Saudi site mentioned here is accessed at www.mopm.gov.sa.}\]
of the rents of governance, \(g\), which depend on the country's resources in a given period, \(r_t\) where \(t = \{1, 2\}\). While resources are \(r_1 = \bar{r}\) in the first period, there is some probability \(\phi\) with which they increase to \(r_2 = \bar{r}\), where \(\bar{r} > r\), in the second period. Otherwise, with probability \(1 - \phi\), the country's resources remain unchanged, or \(r_2 = r\). As we show below, it is this potential for changes in relative bargaining power than can lead to war, because governments are unable to commit not to exploit newfound strength in the second period.

The rebel group may desire a larger share of some good like autonomy or political rights, while the government wishes to grant as few concessions as possible. We fix the per-period value of the benefits at \(g(r_t) > 0\). In each period, the government proposes some division of these benefits, \(x_t \in [0, 1]\), which would transfer \(g(r_t)x_t\) to the rebels and let the government keep \(g_t(r_t)(1 - x_t)\) for itself. Since governments generally set the status quo that rebels wish to see changed, it makes sense that the government makes proposals first, so we adopt a simple ultimatum bargaining protocol (Feason 2004). The rebels can accept or reject the government's proposal, where acceptance implements the proposed division of benefits for the current period only. Rejection, on the other hand, leads to some costly conflict that gives the victor total control over the contested rents at some cost, \(c_i\) where \(i = \{G, R\}\). War, whether it occurs in the first or the second period, ends the game and locks in a division of the benefits, and both players value second-period payoffs at the common rate \(\delta \in (0, 1)\).

While the rebels are free to reject government proposals in any period as long as a war has not previously occurred, the probability with which they win a war against the government also changes as a function of the country's resources. Let the rebels win a conflict with probability \(p(r_1 = \bar{r}) \in (0, 1)\), or simply \(p(\bar{r})\), in the first period, as well as \(p(r_2 = \bar{r})\) in the second period as long as no new resources have been discovered. However, if new resources are discovered
between periods such that $r_2 = \tau$, which occurs with probability $\phi \in (0, 1)$, there are two effects: first, controlling the government becomes more valuable, and, second, the military balance shifts in the government’s favor.

To formalize the effects of new resources, let the benefits *increase* from $g(r)$ to $g(\tau)$, and the rebels’ probability of defeating the government *decrease* from $p(r)$ to $p(\tau)$. In each case, there are diminishing returns for new resources relative to existing resources: for example, the discovery of 10 million barrels of oil represents a more substantial increase in the benefits of governance—and a more substantial decrease in the rebels’ chances of victory—when existing resource levels or overall government wealth are already low. On the other hand, 10 million more barrels has a relatively smaller impact on governance rents and the distribution of power when it represents only a small fraction of existing resources or wealth. Formally, the rents of governance increase in resources, $\partial g(r_t) / \partial r_t > 0$, and the rebels’ probability of winning decreases in them, $\partial p(r_t) / \partial r_t < 0$. However, we specify $\partial [g(\tau) - g(r)] / \partial g(r) < 0$ and $\partial [p(\tau) - p(r)] / \partial p(r) < 0$, such that increases in resources of the same amount have smaller effects as they represent ever smaller portions of existing resources.

This specification ensures that bargaining in the first period occurs in the shadow of a possible shift in the distribution of power that will favor the government over the rebels. Should power shift in the government’s favor for the second period, no mechanism exists by which it can credibly promise to uphold the previous agreement, which may create for the rebels a fear that, no matter how generous today’s bargain, tomorrow’s may be substantially worse. While our model shares important characteristics with other models of the commitment problem, where shifts in power alter war payoffs and war can lock in shares of the benefits (see Powell 2004), we also introduce two changes. First, since the announcement of oil discoveries and
their exploitation can take an uncertain amount of time, we introduce probabilistic increases in resources. Second, increases in resources affect both military power and the total size of the pie, allowing us to consider the effects of both factors on the probability of war.

We turn now to the implications of this commitment problem for the possibility of reaching peaceful settlements in the first period. Since we have a game of complete information, the appropriate solution concept is Subgame Perfect Equilibrium, which stipulates that strategy profiles constitute Nash equilibria in every proper subgame. In other words, players behave optimally at every choice node, and they cannot promise \textit{ex ante} to take an action that they would have no interest in taking when given the opportunity.

To highlight the role of commitment problems, we begin in the second period, where the government’s available resources are $r_2$, such that $r_2 = \underline{r}$ if no new resources have been discovered and $r_2 = \overline{r}$ if new resources have been discovered. Should the rebels reject the government’s proposed division of the benefits, they receive $p(r_2)g(r_2) - c_R$, and they will accept any proposal $x_2$ that guarantees them at least as much as they can get by fighting, or

$$x_2 \geq p(r_2) - \frac{c_R}{g(r_2)}.$$  \hspace{1cm} (1)

The government, wishing to save the costs of war and make as few concessions as possible, will propose $x_2^* = \max[p(r_2) - c_R / g(r_2), 0]$, keeping the rebels just indifferent over accepting and rejecting. As shown in Inequality (1), the rebels will accept increasingly smaller concessions as government resources increase from $\underline{r}$ to $\overline{r}$, because their military prospects diminish and because the overall value of the pie, $g(\overline{r})$, has increased. However, while the second period is guaranteed to end in peace, the prospects that the rebels will be forced to take a bad deal if
resources have increased to $\bar{\tau}$ can have a substantial effect on first-period behavior.

When the rebels consider the government’s first-period proposal, they do so in anticipation of the probability that new resources will be converted into a greater military advantage for the government. Since the government will be unable to commit not to take advantage of newfound power in the future, deals reached in the first period are inherently incredible, and the rebels know that, with probability $\phi$, any deal from the first period will be revised in the government’s favor and to their own disadvantage. The government, for its part, would like to be generous to the rebels in order to placate them in the first period, averting a war that might prevent it from enjoying the benefits of increased future power. The most that the government can promise the rebels in the first period is $x_1 = 1$, or all of the present benefits, but even this will be insufficient to prevent the rebels from fighting a war in order to prevent power from shifting against them when $EU_R(\text{reject}_1) > EU_R(\text{accept}_1)$, or

$$p(\tau) \left( g(\tau) + \delta [\phi g(\bar{\tau}) + (1 - \phi) g(\bar{\tau})] - c_R \right) > g(\tau) \times 1 + \delta [\phi x_2^* g(\bar{\tau}) + (1 - \phi) x_2^* g(\tau)].$$

As stated in Proposition 1, the rebels will opt for war when the probability of power shifting in the government’s favor is sufficiently large, or when $\phi > \phi^\dagger$, regardless of the generosity of the government’s first-period concessions.

**Proposition 1.** For sufficiently large $\delta$, the rebels will reject any first-period proposal $x_1 \in [0, 1]$ in any Subgame Perfect Equilibrium iff

$$\phi > \frac{g(\tau) (1 - p(\tau)) + (1 - \delta) c_R}{\delta g(\bar{\tau}) (p(\tau) - p(\bar{\tau}))} \equiv \phi^\dagger. \quad (2)$$
Otherwise, when \( \phi \leq \phi^\dagger \), there is sure to exist some proposal \( x_1 \in [0,1] \) that the rebels will accept in lieu of war. See appendix for proof.

Thus, when the rebels are sufficiently confident that the government will be stronger in the second period, they will be increasingly difficult to satisfy in the first period. Rather than accept a deal that will be overturned once the government gains strength, they opt instead for a costly war that allows them to take a chance at locking in the rents of governance at a relatively favorable distribution of power. Equation (2) also shows that the rebel’s war constraint becomes easier to satisfy as the absolute size of the shift grows larger, or as the difference between the rebel’s first- and second-period chances of victory, \( p(r) - p(\bar{r}) \), increases. Further, as the size of the pie increases as a function of increases in resources, or \( g(\bar{r}) - g(r) \), the war constraint also becomes easier to meet; thus, expected increases in the size of the pie encourage war in the present, concurrent with the effects of increased resources via the distribution of power. Thus, Proposition 1 highlights the importance of the rebels’ expectations over future government strength—not merely current government strength—in determining whether war occurs. As we discuss in the following section, testing arguments about shifting power and conflict requires some measure of expectations over future levels of power.

Finally, as stated in Proposition 2, there is an interactive effect between the size of an anticipated increase in resources, \( \bar{r} - r \), and the initial level of resources, \( r \).

**Proposition 2.** For a fixed increase in resources, \( \bar{r} - r \), war is possible for ever lower probabilities of a shift in power as initial resources \( r \) decrease.

Recall that, as \( r \) increases while the difference \( \bar{r} - r \) remains the same, power shifts relatively less against the rebels, due to the extent of the pre-existing disadvantage. The rents of
governance also increase at a lower rate, given their already large value. Therefore, Inequality (2) becomes more difficult to satisfy as the differences $p(r) - p(\bar{r})$ and $g(\bar{r}) - g(r)$ decrease, with the former shrinking the denominator and the second ensuring that the whole expression $\phi^\dagger$ approaches one. Intuitively, this means that heightened expectations over increased government strength will be most likely to cause war when they represent large increases relative to existing resources. Specifically, a major new oil find in an oil-rich or otherwise wealthy country will imply a smaller shift in power than a find of similar size in a poor country. This allows us to state our two key hypotheses.

**Hypothesis 1.** Expected increases in government strength increase the probability of civil conflict.

**Hypothesis 2.** The effect of expected increases in government strength are greater in poor countries than in rich countries.

Thus, while the model leads us to predict a relationship between expectations over future strength and civil conflict, it also implies that the strength of this relationship depends on the interaction of these expectations and pre-existing government strength. After illustrating the logic of our model, and demonstrating its empirical plausibility, with the Bougainville War in Papua New Guinea, we turn in the remaining sections to specifying and conducting a quantitative test of these hypotheses.

**Illustration: The Bougainville War**

Before discussing our quantitative tests, we first illustrate the empirical plausibility of our theoretical mechanism with a brief examination of the Bougainville War. In the mid-1980s, Chevron
sought oil in Papua New Guinea and discovered the country’s first major oilfield at Kutubu near the center of the state’s primary island. The discovery of more than 200 million barrels pales in comparison to the hundreds of billions of barrels of crude reserves located in the Persian Gulf, but the find was sufficiently large for a few foreign companies to begin building oil facilities in the island’s rural and rugged interior. Industry outlets like *Oil and Gas Journal* announced the find and major regional newspapers including the *Sydney Morning Herald* were soon reporting that the World Bank pledged more than $600 million USD to fund the pipeline that would transport the oil to the island’s coast for export.\(^\text{10}\) Construction began and in 1990 the government signed a lucrative contract that promised it a 22.5% share in the endeavor and a 1.25% royalty on the crude it produced (Fagan N.d.). Papua New Guinea began exporting oil in late 1992, six years after the initial discovery at Kutubu. Between 1992 and 1999 per capita GDP soared from $1279 to $2120 (Heston, Summers and Aten 2009).

Nearly 600 miles to the northeast, the remote island of Bougainville twice took advantage of this six-year lag between oil discovery and oil production. This copper-rich area had a secessionist movement dating back to the state’s independence in 1975, but the movement turned to mass violence in 1989 and again in 1992. The ensuing “Coconut Rebellion” killed nearly 8000 people—roughly 5% of the island’s population.\(^\text{11}\)

The war was largely attributed to growing discontent with the mining practices in place on Bougainville, but these were well-timed conflicts that occurred as foreign observers, the government, and Papua New Guinean citizens anticipated a major boost to the country’s struggling economy. The 1989 war followed shortly after the World Bank announced it would fund

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\(^{10}\)See, for example, “Exploration Efforts Fan Out in Papua New Guinea.” *Oil and Gas Journal*, 13 October 1986, pg. 94 and “World Bank Offers to Fund PNG Oil Pipeline.” *Sydney Morning Herald*, 22 March 1988, pg. 28.

the pipeline and the 1992 conflict occurred as developers were working to finish the necessary infrastructure and initiate production. Figure 2 illustrates this dynamic. The conflicts, marked by stars, occurred after the major oil discovery but before production helped the economy to grow. Had the Bougainville Revolutionary Army initiated its campaign a decade later, it would have faced a state whose income had grown by more than 75% in only ten years.

There are certainly better-known civil conflicts linked to oil discoveries, including the long war in South Sudan and the secessionist movement in the Cabinda exclave of Angola. However, the Bougainville War illustrates this phenomenon even where oil discoveries are relatively small. Rebels face a strong incentive to respond to oil discoveries by initiating conflict against the state before it receives the oil spoils that can so quickly increase the capacity of the state. In the next section, we use aggregate data on proved oil reserves as a proxy for expectations over future
state strength to uncover the same relationship in the historical record and in the presence of several important control variables.

**Research Design**

To uncover the aggregate relationship between oil discovery and civil conflict, we analyze a dataset covering all states for which data are available, 1981-2007. The dependent variable, *Civil War*, is drawn from the Uppsala Conflict Data Program. This dichotomous indicator equals 1 only for country-year observations in which fighting between the government and a non-state actor resulted in at least 25 battle deaths. For complete coding rules for this variable, see Gleditsch et al. (2002). Civil conflict is not a rare event in this sample, occurring in nearly 20% of the country-year observations included in our data. This frequency does vary dramatically by region, and civil wars are nearly ten times more prevalent in Asia than they are in Western states. Civil war scholars note the many regional causes of war stemming from refugees, lawless border areas, and illicit arms networks (Gleditsch 2007, Salehyan 2007, Salehyan and Gleditsch 2006), and we account for these with regional control variables in all of our models.\(^{12}\)

The primary independent variable is the *Annual Change in Oil Reserves*, which is estimated using data collected by the United States Energy Information Administration (EIA), which falls under the administration of the Department of Energy. This organization collects oil and gas industry reports to record each country’s proved crude oil reserves each year. Estimates are in billions of barrels and positive or negative changes of more than one million barrels are re-

\(^{12}\)The excluded category in every model is “Western” and the regional variables are *Eastern Europe, North Africa and the Middle East, Latin America, Sub-Saharan Africa*, and *Asia*. Selection into these regions is mutually exclusive.
ported annually. Because we are interested in the change in reserves and not simply the absolute number, we transform the raw reserves estimate as follows. First, we divide the proved reserves estimate for a given country-year by its one-year lag.\textsuperscript{13} We then estimate the natural log of this change so that the magnitude of additional oil discoveries diminishes with the size of the discovery. This transformation allows the difference between a 10% increase and 20% increase in oil reserves to be more relevant than the difference between a 110% increase and 120% increase in oil reserves. Because the natural log of 1 is 0, states with no change in proved oil reserves receive a value of 0. All country-years with more oil reserves than in the previous year receive a positive number while all observations with less proved reserves than the previous year score a negative value. The mean value is .009, which equates to a 1% annual increase in proved reserves. The minimum is -2.30 (90% decrease in reserves) while the maximum is 3.61 (37× increase in reserves). Overall, proved oil reserves decreased in 13.4% of observations, increased in 16.0% of observations, and experienced no annual change in 70.6% of observations.

As we argue above, the marginal effect of changes in proved oil reserves on civil war initiation should be conditional on the pre-existing strength of the state. Where states are already weak, the discovery of new reserves is likely to bring a substantial increase in state capacity in the future. Conversely, states with greater pre-existing capacity are expected to be less vulnerable to conflict when new proved oil reserves are reported; for if state strength already renders a rebel challenge unviable, then signs of increased state strength in the future should not create an impetus for civil war in the short-term. Accordingly, the destabilizing effects of oil discovery should decrease as states become stronger. For this reason, it is necessary to interact the annual

\textsuperscript{13}Because we cannot divide by zero, we also force any observation for which no oil existed in year $t$ and year $t - 1$ to be equal to 1 (signifying no change). We find only one case where a country with zero proved oil reserves discovered oil during our sample (Thailand 1983), so we drop this single country-year observation rather than bias our results with an arbitrary value.
change in proved reserves with a measure of state strength in the current year.

We capture state strength with logged per capita gross domestic product. Wealthier states have greater capacity because they have more resources to invest in either repressing or appeasing potential dissidents. This assertion is supported by the robust negative correlation between per capita GDP and civil war onset (Collier and Hoeffler 2004, Fearon and Laitin 2003) and numerous thorough theoretical explorations of the link between rebel recruitment and the low opportunity costs present in impoverished societies (Collier, Hoeffler and Rohner 2009, Collier et al. 2003, Grossman 1991, Humphreys and Weinstein 2008). Our measure of per capita GDP is drawn from the Penn World Tables (version 6.3) and it is reported in constant 2005 United States dollars (Heston, Summers and Aten 2009). This variable is logged and ranges from 4.77 ($115) to 11.56 ($105,000) with a mean of 8.34 ($4200).14

Our base model controls for a number of other well-known correlates of civil conflict. Previous Conflict, derived from the Uppsala Conflict Data Program, is a dichotomous indicator that is equal to 1 if civil conflict occurred in the previous year (Gleditsch et al. 2002). Lagged Proved Reserves is included so that we can isolate the effect of oil discovery from other long-debated effects of oil wealth.15 Following the literature on insurgency, we control for factors that offer rebels a military advantage versus the state. From Fearon and Laitin's (2003) study, we add controls for Mountainous Terrain, Population, and Institutional Durability.16 Institutional Durability is the “durable” variable in the Polity IV dataset (Marshall and Jaggers 2002). This variable counts the number of years that have passed since government institutions were re-

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14For more on how the effects of oil wealth are conditional on state income, see Humphreys (2005).
15This variable is also logged so that where $r$ indicates proved oil reserves, this variable is $\ln(r_{t-1})$. We also estimate the model without this variable and the results are included in Table 1.
16Mountainous Terrain is the logged percentage of a state's territory that is mountainous (see Fearon and Laitin, 2003). Population is also logged.
placed or reformed to the extent that the reforms resulted in a change in polity index score of at least three points. We account for demographic factors by controlling for Ethnic Fractionalization and Religious Fractionalization.\textsuperscript{17} Hegre et al. (2001) and others find evidence to suggest that semi-democratic regimes are more prone to civil war than more democratic and more autocratic regimes. We control for this effect by adding Polity Index Score and its multiplicative term Polity Squared to the model. The multiplicative term will take high values for the most and least democratic regimes and take low values for semi-democratic regimes around the median value of zero. Thus, we expect a negative relationship between Polity Squared and Civil War. For more on the polity index score, please see Marshall and Jaggers (2002).

Because the dependent variable is dichotomous, we estimate the model using logistic regression. Additionally we test the sensitivity of the results by subjecting the same models to probit regression and a binomial general estimating equation (GEE) model.

**Results**

**Table 1: Models 1-4**

Table 1 provides the results of four logistic regressions. Each model is estimated with Huber-White robust standard errors and the results for the region control variables are suppressed. Across the entire series of models, these results offer robust support for our hypotheses. GDP per capita maintains a negative effect on civil war onset across all of the models, while the logged annual change in proved oil reserves is positively correlated with civil war onset. The negative interaction term suggests that the effect of changes in oil reserves is conditional upon

\textsuperscript{17}see Alesina et al. (2003) for an extensive discussion about the creation of these measures.
GDP per capita. As expected, the positive relationship between oil discovery and civil conflict has a greater magnitude where per capita income is low.

To determine whether this interactive effect is robust, it is necessary to estimate marginal effects across the range of per capita GDP (Brambor, Clark and Golder 2006). If the hypotheses are correct, then these marginal effects will demonstrate a strong positive relationship between the change in proved oil reserves and the probability of civil war among the poorest states. As per capita GDP increases, the magnitude of this effect should diminish and perhaps become statistically insignificant.

We produce point estimates with confidence intervals while holding per capita GDP at $100, $1000, $10,000, and $25,000. The results are illustrated in Figure 3. For states with a per capita GDP near $100, it is clear that an increase in proved oil reserves greatly increases the likelihood
of civil war onset. With all other variables held at their means, these states face a .20 probability of conflict given no annual change in oil reserves. A 50% increase in proved reserves raises the probability of conflict to .30 and a discovery that doubles proved oil reserves raises this probability to approximately .45. Major finds that quadruple proved oil reserves raise the probability of civil war to greater than .70.

The destabilizing effect of oil discovery also threatens regimes with per capita incomes of around $1000. With no annual change in proved oil reserves, these states face a .10 probability of civil war in a given year. A discovery that doubles proved reserves raises the risk of conflict by 50%, and a discovery that triples proved reserves doubles the probability of conflict to .20. As expected, the magnitude of this marginal effect is less than that for the poorest regimes, and we attribute this waning magnitude to the fact that oil finds are likely to more drastically affect state capacity among states that are presently very weak.

Among the strongest states, the models predict no statistically significant effect between oil discovery and civil conflict. Because states with a per capita GDP of more than $10,000 are already relatively strong, the threat of increased state strength in the future is insufficient to
cause potential rebels to raise arms against a strong state. The slightly negative slopes of the corresponding lines on Figure 4 are not statistically significant.

**Table 2: Probit and GEE Results**

We test the sensitivity of the results by rerunning the models using different estimators. The results for the full models are reported in Table 2. The interaction and its components maintain their previously reported effects on civil conflict, and marginal effect estimation supports the robustness of the results presented above. Logistic regression, probit regression, and general estimating equations confirm that oil discovery is especially destabilizing for weaker states, *ceteris paribus*.

**Conclusion**

Where most research on the connection between oil and civil conflict focuses on oil production and realized levels of wealth, we argue that oil discovery can also play a significant role in the strategic decisions of governments and rebels by affecting expectations over the future distribution of power. Since oil wealth is realized only some time after new reserves are discovered, newly announced proved reserves create a window of opportunity for rebels in which they can lock in a favorable division of the benefits before power shifts even further in the government’s favor and peaceful deals reached in the present are rendered obsolete. In fact, our empirical analysis shows that when increases in proved reserves can have a significant impact on the government’s relative power—i.e., in relatively poor states—then the discovery of new oil reserves exercises a positive and statistically significant impact on the probability of civil conflict.
Among the poorest states, for example, a major find that doubles proved oil reserves nearly doubles the probability of civil conflict, raising it from roughly 0.2 to 0.45. Among wealthy states, however, increases in proved reserves do little to alter a distribution of power that already favors the government, and there is no discernible effect on the probability of civil conflict.

By focusing on oil discovery rather than oil production, we both elucidate a new mechanism by which resources can affect civil conflict and execute a test that more directly captures that mechanism than extant studies. Proved but unexploited reserves are an unusually direct proxy for expectations over future state strength, and their effect diminishes as pre-existing state strength increases, which we would not expect to be the case if oil discovery affected the calculations of rebels and governments though a different mechanism. If, on the other hand, the effect of discovery were not conditional on pre-existing state strength, we would expect that a different mechanism might be at play. These results also suggest a new mechanism by which state strength—often proxied through national wealth—can affect the probability of civil conflict: when the state is very strong, it is increasingly resistant to changes in relative power, deterring challenges from rebels that would otherwise occur in weaker states where power shifts in the government’s favor can be more substantial. Likewise, our results may also help explain when state weakness contributes to civil conflict—i.e., when rebels believe that weakness will soon change to strength—which should increase the predictive power of empirical models of civil conflict. In Papua New Guinea, for example, our model explains why, despite the state’s consistent weakness through the 1980s, civil wars erupted in 1989 and 1992 but not before.

Our theoretical and empirical approach also allows us to test more directly hypotheses about shifting power and commitment problems that, while common in the literatures on both interstate and civil war, have often eluded direct testing thanks to a general absence of good mea-
sures of expectations over future strength. Measuring realized shifts in power can indirectly capture expectations over future strength to the extent that increases in one side's power today imply further shifts tomorrow, but shifts large enough to cause war will be strategically censored out of observational data, which restricts variation on a key independent variable and may attenuate the estimated effect. However, we identify the source of contemporaneous expectations over future government strength by leveraging data on oil discovery that was publicly available to the actors under study, which provides a more direct and faithful test of the underlying theoretical mechanism in our formal model. Thus, the largest expected shifts in power will not be censored out of the sample, and such expectations indeed increase the chances of civil conflict, but only when those shifts in power will be meaningful, or when the state whose proved reserves increase is not already wealthy, an expectation derived directly from our theoretical model that helps increase confidence that our proposed mechanism is at play in the historical record.

Finally, our results suggest that policymakers should be wary of the promise of oil discoveries—or any other fixed-asset sources of wealth—in otherwise poor or weak states where, in principle, increased national wealth ought to be welcomed. Absent the ability to credibly promise not to use its increased leverage to press its advantage in the future, the state in control of these assets faces an increased risk of civil conflict by rebels who both fear future concessions and wish to capture an increasingly valuable state apparatus. Once oil resources are converted into a stronger state, we should expect the risk of war to diminish, but the period between discovery and exploitation may be a particularly dangerous one, where policy remedies that can credibly commit the government to particular deals in the future may be the most effective way to avoid a tragic and costly civil war in the present. Third parties, for example, may be able to lever-
age the threat of some international sanction or rewards during this window of opportunity, insulating governments from challenge until they can convert discoveries into wealth and the chances of civil war once again diminish.

Appendix: Proofs

Proof of Proposition 1. We begin by characterizing optimal behavior in the second period, where resources are \( r_2 = \{ r, \bar{r} \} \). \( R \) accepts any share \( x_2 \) that satisfies

\[
u_R(\text{accept}_2) \geq EU_R(\text{reject}_2) \Leftrightarrow x_2 g(r_2) \geq p(r_2) g(r_2) - c_R,
\]

which creates a range of acceptable proposals defined by \( x_2 \geq p(r_2) - c_R / g(r_2) \). Should it make an acceptable proposal, \( G \) will keep as much of the rents for itself as possible, such that its equilibrium proposal in the second period will be \( x_2^* = \max\{ p(r_2) - c_R / g(r_2), 0 \} \), where \( r_2 = \underline{r} \) if no resources were discovered and \( r_2 = \bar{r} \) if resources were discovered. To simplify the presentation of results below, we let \( x_2^*_\underline{r} \) denote the equilibrium proposal when \( r_2 = \underline{r} \) and \( x_2^*_\bar{r} \) denote the equilibrium proposal when \( r_2 = \bar{r} \). For any \( r_2 \), \( G \) will strictly prefer proposing \( x_2^* \) to attack (or, equivalently, making an unacceptable proposal) when

\[
u_G(x_2^*) > EU_G(\text{attack}_2) \Leftrightarrow (1 - x_2^*) g(r_2) > (1 - p(r_2)) g(r_2) - c_G,
\]

which is strictly true since \( c_G > 0 \).

To show that no \( x_1 \in [0,1] \) can induce \( R \)'s acceptance in the first period when \( \phi > \phi^\dagger \), we set
\(x_1 = 1\) and solve \(EU_R(\text{reject}_1) > EU_R(\text{accept}_1)\), or

\[p_R \left( g_R + \delta(\phi g_R + (1 - \phi) g_R) \right) - c_R > g_R \times 1 + \delta[\phi x^*_2 g_R + (1 - \phi) x^*_2 g_R],\]

which is true iff

\[
\phi > \frac{g_R(1 - p_R) + (1 - \delta)c_R}{\delta g_R(p_R - p_R)} = \phi^*.
\]

To show that there will exist an acceptable proposal that \(G\) is willing to make when \(\phi \leq \phi^*\), we first solve \(R\)'s acceptance constraint, \(EU_R(\text{reject}_1) > EU_R(\text{accept}_1)\), or

\[p_R \left( g_R + \delta(\phi g_R + (1 - \phi) g_R) \right) - c_R > g_R x_1 + \delta[\phi x^*_2 g_R + (1 - \phi) x^*_2 g_R],\]

for \(x_1\) to yield a range of acceptable proposals

\[x_1 \geq \left( g_R p_R + \delta \phi g_R(p_R - p_R) - c_R(1 - \delta) \right) / g_R = \hat{x}_1.\]

Again, since \(G\) will take as much for itself as possible in any peaceful bargain, it proposes \(x^*_1 = \max \{\hat{x}_1, 0\}\) when \(EU_G(x^*_1) > EU_G(\text{attack}_1)\), or

\[(1 - x^*_1)g_R + \delta \left( \phi(1 - x^*_2)g_R + (1 - \phi)(1 - x^*_2)g_R \right) > (1 - p_R) \left( g_R + \delta(\phi g_R + (1 - \phi) g_R) \right),\]

which is strictly true, ensuring peace in the first period, as long as \(c_G > 0\) and \(\phi \leq \phi^*\). \(\square\)
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Log-likelihood  -627.816  N/A
χ²  1286.29  419.79
Degrees of Freedom  17  17

Significance levels: †: 10%  *: 5%  **: 1%
References


