Resource Curse in Reverse:
Globalization, Natural Resource Production, and Civil War

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Abstract: Studies of the natural resource-civil war relationship have failed to properly situate natural resource production in the global marketplace. By expanding the literature to consider the two-way relationship between natural resource production and civil war, this paper demonstrates the need to account for globalization's impact on both resource production and civil war onset. The effect of globalization works through two primary mechanisms: 1) the world price of a natural resource and 2) the state's share of the global production of a resource. Higher world prices for resources, such as oil, diamonds, and marine fish, tend to increase resource production. High resource prices also increase a state's risk for civil war onset because the resources are more valuable to the state and rebels seeking to capture the state. Additionally, the larger a state's share of global production of a natural resource, the higher its risk for civil war. Such states will be exceptionally dependent upon the resource politically and economically and a large resource base also represents a valuable prize for rebels to capture. While highly priced and domestically important resources may increase the risk for civil war, the experience of civil war simultaneously destroys the very resources governments and rebels are seeking to control. However, this reverse relationship is conditional on the characteristics of resources, with lootable, scarce resources like diamonds seeing increased production following civil war, and non-lootable and more abundant resources like oil and fisheries suffering from the occurrence of civil war.

A previous version of this paper was presented at the Globalization and Natural Resources Conference at the University of Pittsburgh, March 25-26, 2010. We thank Mark Axelrod, Nate Jensen, Nita Rudra, and Erik Wibbels for their detailed comments on previous drafts and the conference participants for their feedback.

Empirical studies have revealed many rich relationships between natural resources and conflict (Gleditsch 1998). Interstate conflict is more likely between states that share river borders, especially where fresh water is scarce (Lonergan 1997; Gleditsch et al. 2006; Brochmann and Hensel 2009). Conflicts also erupt between states competing for scarce fishery resources, as illustrated by the Cod Wars between Iceland and Great Britain (Bailey 1997; Hensel et al. 2008). The scarcity of several environmental resources has been positively linked to interstate conflict, including fresh water, fisheries, soil degradation, and population density and growth (Tir and Diehl 1998; Stalley 2003). On the civil war side, oil resources have been shown to increase the chances for domestic conflict (Fearon and Laitin 2003), while lootable resources, such as alluvial diamonds increase the onset (Lujala, Gleditsch, and Gilmore 2005) and duration (Ross 2004) of civil wars. Environmental degradation, such as deforestation, land degradation, and scarcity of freshwater supply, also increases the risks for civil war (Hauge and Ellingsen 1998). Gemstones have been linked to civil wars in Afghanistan, Cambodia, and Myanmar; several oil-producing states have experienced civil wars, including Angola, Colombia, Morocco, and Sudan; diamond-producing countries, such as the Democratic Republic of the Congo, Sierra Leone, and Liberia, have also experienced intrastate wars (Ross 2003). In short, there are many real world examples of countries with sizable natural resource exports experiencing frequent and bloody civil wars.

However, we believe this literature suffers from two central problems: 1) it fails to capture the endogenous relationship between natural resource production and civil war, and 2) it does not connect the production of states' natural resources to the global economy. First, most of this research treats natural resources as exogenous, independent variables to help explain the variance in conflict onset, duration, or intensity. In this paper, we consider the reverse relationship between conflict and resources by examining the effect of intrastate conflict on

natural resource extraction. Empirically, we consider the effects of civil war on the production of oil, diamonds, and marine fishery catches and vice versa. Second, much of the civil war onset literature focuses on causal forces inside the state, such as GDP per capita, education levels, regime type, state strength, or population size. A similar strategy is taken in studies focusing on natural resources as causes of intrastate conflict, as scholars often focus on the supply and lootability of such resources. This research strategy fails to consider the fact that natural resources are subject to the forces of the global marketplace. We expect higher world prices for resources, such as oil, diamonds, and marine fish, to increase resource production. High resource prices also increase a state's risk for civil war onset because the resources are more valuable to the state and rebels seeking to capture the state. Additionally, the larger a state's share of global production of a natural resource, the higher its risk for civil war. Such states will be exceptionally dependent upon the resource politically and economically and a large resource base also represents a prize for rebels to capture. Once we control for the endogenous relationship between natural resources and civil conflict and adopt a globalized perspective, we observe a more complicated causal pattern than is typically portrayed in the literature.

Our empirical analyses (1960-1999) suggest that oil production alone has no significant effect on civil war onset, although both diamond production and marine fish catches reduce onset. Yet in all three cases, the larger the state's share of the global market in a particular resource, the more likely it is to experience the onset of civil war. Higher global diamond prices seem to drive civil war onset, though the same is not true for the world prices of marine fish or oil. Civil wars also have differential effects on natural resources, significantly reducing oil and fisheries production, while at the same time increasing the production of diamonds. The latter result fits with views about the lootability of diamonds for the financing of rebel groups,

especially the ease with which rebels can mine alluvial or secondary diamonds (Lujala, Gleditsch, and Gilmore 2005). It also meshes with a globalization perspective on natural resources because relatively few countries produce diamonds (25 total), while oil and fisheries are produced by a large number of states (over 100). Multinational corporations can seek out alternate supply sources for resources that have many producers.

The remainder of the paper is organized as follows. First, we review the civil war literature that emphasizes natural resources as a potential risk for intrastate violence. Second, we discuss the importance of dealing with endogeneity in this relationship and thinking about how resources are situated in the global marketplace. This is followed by a description of the research design employed to capture endogeneity and globalization. We conclude by presenting empirical results and discussing several illustrative cases for the processes we describe.

Natural Resources and Civil War

The seminal civil war studies by Collier and Hoeffler (2004) and Fearon and Laitin (2003) establish two general lines of thinking about how natural resources directly influence the behavior of rebel groups and state governments. The first idea is that the presence of lootable natural resources for rebel groups reduces the opportunity costs for rebellion. The second idea is that resource dependency reduces the overall strength of the state by limiting the states' dependence on its citizens for revenue, which in turn reduces the government's ability to put down potential insurgencies. The state's extraction of oil also raises the value of center-seeking civil wars whose ultimate goal is the capture of the state or the value of peripheral areas for secessionist conflicts (Le Billion 2001). Natural resources have also been linked to civil war

onset more indirectly by their influence on reduced economic growth, increased poverty, reduced education, and the creation of more corrupt, authoritarian regimes.[1]

Collier and Hoeffler (2004) emphasize the opportunity costs for rebellion, focusing on productive economic activities individuals would have to forego in order to join a rebel group. Their primary empirical finding in a sample of country-year data from 1960-1999 is that states with higher average income levels experience significantly lower levels of risk for civil wars. Collier and Hoeffler (2004) also consider how natural resource dependency alters the opportunity costs for rebellion. They focus on primary commodity exports relative to a state's overall gross domestic product (GDP). They include the component and squared versions of this measure in their empirical models, finding an inverted U relationship between primary commodity exports and civil war onset. "At peak danger (primary commodity exports being 33% of GDP), the risk of civil war is about 22%, while a country with no such exports has a risk of only 1%" (Collier and Hoeffler 2004, 580). They also disaggregate resources into specific types (food, non-food agriculture, oil, etc.) and they find that the only significant difference in civil war risk occurs between oil producing and non-oil producing states.

The emphasis on oil is further articulated in Fearon and Laitin's (2003) study of civil war onset. Their theory emphasizes the importance of state strength, which influences the government's ability to handle potential insurgencies. Using a similar measure of income per capita, Fearon and Laitin also find that wealthier states have significantly lower risks for civil war. Theoretically, they argue that:

> The political and military technology of insurgency will be favored...when potential rebels...have... land that supports the production of high value, low-

[1] For reviews of this literature, see Ross (2003, 2006). Our paper focuses on the two primary explanations related to lootability and state strength, but in future work, we hope to explore the indirect effect of natural resources on other factors that promote civil war, such as regime type, education, and economic growth. For a more detailed discussion of possible causal mechanisms relating resources and civil war, see Humphreys (2005).

> weight goods such as coca, opium, diamonds, and other contraband, which can be used to finance an insurgency [and] a state whose revenues derive primarily from oil exports. Oil producers tend to have weaker state apparatuses than one would expect given their level of income because the rulers have less need for a socially intrusive and elaborate bureaucratic system to raise revenues...At the same time, oil revenues raise the value of the "prize" of controlling state power. (Fearon and Laitin 2003, 81)

The correlation between oil production and weak states comes from research in economics on the "Dutch" disease (Auty 1993; Karl 1997; Ebrahim-Zadeh 2003). In the 1970s, the discovery of oil in the North Sea provided a new source of income for the Netherlands (and other countries like Norway). However, as the Netherlands began extracting oil, their manufacturing sector experienced a steep decline. Economists attribute this decline to an appreciation of Dutch currency following the increased exportation of oil, which increased incentives for labor and capital to move from manufacturing sectors into the production of natural resources (Corden and Neary 1982).

More broadly, oil dependency creates a variety of problems for states. Oil producers often borrow money in bad economic times, which creates future debt problems. These recessionary cycles exist largely because of the inherent price instabilities of natural resources on the world market. There is also considerable variability in extraction rates and the timing of payments from multinational corporations (Humphreys, Sachs, and Stiglitz 2007, 6). The reduction in the manufacturing sector leads to less funding for quality education programs because there is a reduced demand for skilled workers[2]; this lack of quality education can further increase the risk for civil war (Lai and Thyne 2007). Oil rich states are less dependent on citizens for generating revenue, which often results in weaker bureaucratic structures (Karl 1997) As noted above, weaker states will face a harder time dealing with internal threats to the regime

[2] Oil, gas, and minerals are non-renewable resources, which makes them more like assets rather than as sources of income. They don't have to be produced, but rather simply extracted, which often separates these goods from most of the labor force and the manufacturing market in the rest of the country (Humphreys, Sachs, and Stiglitz 2007, 4).

because they lack the administrative structures for tracking and dealing with rebels. Oil states typically have less democratic regimes than non-oil regimes (Ross 2001) and they are more likely to experience state failure.

Natural resources can also raise the overall prize of capturing the state or parts of the state through secessionist conflict (Fearon and Laitin 2003). There are several good examples of areas rich in natural resources that have been at the heart of many civil wars. Both of Sudan's protracted civil wars have been fueled by the location of higher oil resources in the southern region of the country relative to the northern region. The discovery of valuable natural gas resources in 1971 and the subsequent political, economic, and demographic changes that occurred as a result served as a catalyst for the Aceh rebellion in Indonesia (Ross 2005). Civil war in the Congo in the early 1990s was driven in part by the significant rents the state captured from oil sales, with monthly petroleum revenues of $75 million per month (Englebert and Ron 2004, 66). The RUF in Sierra Leone was able to fund its operations through the capture of many alluvial diamond mining areas. Illegal cash crops, such as cocaine and opium, have also funded rebel movements in places like Colombia and Afghanistan (Collier et al. 2003).

However, not all primary commodities will increase the value of the state to capture through civil conflict. As Fearon (2005) notes, the broader measure of primary commodities (*sxp*) advocated by Collier and Hoeffler (2004) is not likely to be much of a prize, since rebels typically lack the kind of distribution system necessary to reap revenues from those resources. In this sense, resources that are more lootable in terms of ease of extraction, transport, and sale should increase the chances for civil war more strongly than other resources like timber or agricultural products. On the other hand, some studies that break apart broad measures of primary commodity exports question the robustness of the lootability connection between

resources and civil war, as most individual resources (e.g. oil, mineral rents, energy rents) do not have a significant effect on civil war onset (De Soysa and Neumayer 2007).

Thies (2010) examined the role that natural resources play in the relationship between state capacity and civil war onset. While much of the literature has focused on the opportunities that natural resources provide to rebels, Thies also highlights their importance as a source of revenue for the state. In fact, he argues that revenues from primary commodities will primarily benefit the state even as internal rivals seek to obtain such revenues for secession or capturing the state. While Thies does not find evidence that states with higher fiscal capacity reduce the onset of civil wars, he does find evidence that most types of natural resource revenue strengthen the capacity of the state. Most types of natural resources do not significantly increase the likelihood of civil war onset, with the exception of the Fearon and Laitin (2003) oil exporter dummy. These findings further support the conclusions of Smith (2004) and Morrison (2009) that oil revenues and nontax revenues may not necessarily be detrimental to state capacity, and may even strengthen it. Even among the set of oil producing states, those that are more corrupt may be better equipped to buy off potential rivals and pay off the military to put down insurgencies (Fjelde 2009).

The debate about the instability of oil regimes points to a broader issue. There are many countries with significant natural resource exports that are able to avoid civil wars. Even though Botswana had a similar GDP per capita to Sierra Leone in the early 1960s and sizable diamond production, it was able to utilize that production in a positive way to create significant economic growth, increasing its mean income per capita eight fold in just a few decades. This difference may have occurred because most of the diamonds in Botswana came from kimberlite mines, which were easier for the central government to control, in comparison to the diamonds in Sierra

Leone, which were often found in riverbeds (Collier et al 2003, 127). This example shows that conflict may be more likely based on certain characteristics of the natural resources under contention, such as the government's ability to control the resources and whether they are located in a few or many sites. Whether natural resources fuel civil conflict may also depend on their interaction with other factors that increase a state's risk for conflict. As noted above, Fjelde's (2009) study suggests that corrupt oil producing states can avoid civil war while non-corrupt oil producers face a higher risk for war. In this instance, natural resources increases civil war risk only when triggered by some other factor.

Theoretical Expectations

In order to understand the relationship between natural resources and civil war, we believe it is important to control for the endogenous relationship between these factors and to consider how the global market for resources influences states' risks for civil war. In this section, we also describe how the characteristics of natural resources may influence their relationship to civil war.

Modeling Endogeneity

Most empirical studies have focused on the effect of natural resources on civil war onset without considering the potential feedback effect of civil war occurrence on natural resource production. While the resource curse may put states at risk for civil war, there is also a reverse relationship whereby manufacturing companies may flee in anticipation of civil war and whereby the onset of violence may directly harm resource production as workers flee and rebel groups target resource production facilities. Ross (2004, 36) warns of the perils of ignoring endogeneity:

> The natural resource–civil war correlation, for example, might be the opposite of what it appears: civil wars might produce resource dependence by forcing a country's manufacturing sector to flee while leaving its resource sector—which is location-specific and cannot depart—as the major force in the economy by

> default. Even though most scholars employ lagged independent variables in their regressions, this method does not rule out reverse causality: because civil wars do not officially "begin" until they have crossed some threshold of violence, they might be preceded by years of low-level hostilities that drive off manufacturing firms, producing a higher level of resource dependence before the civil war is coded as commencing.

An exceptional study that looks at the two way relationship between resource extraction and civil war is conducted by Brunnschweiler and Bulte (2009). Once they control for the two-way relationship, they find evidence consistent with Ross' (2004) conjecture; war torn societies tend to become more dependent on natural resource production, which furthers their risk for civil war. Natural resources in more peaceful environments are actually boons for economic development. This is similar to discussions of the conflict trap, whereby countries that experience civil wars experience further declines in economic growth, education, health care, and infrastructure, which puts them at additional risk for recurrent conflicts (Collier et al. 2003).

We believe it is important to control for the potential endogeneity in the natural resource-civil war relationship. If two variables are endogenously related and the relationship is modeled in only one direction, the estimator is not consistent; parameter estimates are not near their true values in large samples (King, Keohane, and Verba 1994). If endogeneity is present, the relationship posited in a single equation analysis is biased because the covariance between the explanatory variable (e.g. oil production) and the residuals will be non-zero.

> If we have endogeneity bias, we are estimating the correct inference plus a bias factor. Endogeneity is a problem because we are generally unaware of the size or direction of the bias. This bias factor will be large or small, negative or positive, depending on the specific empirical example (King, Keohane, and Verba 1994, 188).

Thus, if the parameters are biased, we have no way of knowing in what direction. The effects of natural resources on civil war could be greater or smaller than we think. The disconnect between

the findings of large N empirical studies and qualitative case studies of resources and civil war could be explained by the failure of many large N studies to account for endogeneity.

There are suggestive parallels in other areas of conflict studies regarding the importance of modeling endogenous relationships. The literature on trade and conflict shows that investors are forward looking, thus they avoid trading in dangerous areas. In this sense, only unexpected conflicts are likely to have a significant effect on future trade or foreign direct investment (Li and Sacko 2002).[3] Democratic peace scholars have asserted that peace may be the "cart before the horse" (Gates, Knutsen, and Moses 1996; Thompson 1996; Maoz 1997), whereby democratic regimes are more likely to flourish in peaceful regions. At the global level, systemic war may promote democratization in the international system (Mitchell, Gates, and Hegre 1999). Gibler's (2007) work suggests that the resolution of border disputes may be a key part of this process as well, as democratic regimes are more likely to emerge once violent territorial disputes have been settled.

While endogeneity has not been the subject of a great deal of focus in civil war studies, initial examinations have shown why this omission may be problematic. Fearon and Laitin's (2003) study asserts that strong states are better able to avoid civil wars by having a wider variety of tools for combating insurgent groups. Yet, once we consider the endogenous relationship between state capacity and civil war, a different conclusion emerges. Thies (2010) finds that state capacity, in the form of superior tax extraction, has no effect on civil war onset. On the other hand, civil wars significantly reduce the strength of the state. When employing over a dozen distinct measures of state capacity, Hendrix (2009) comes to a similar conclusion, finding that state capacity has little to no effect on civil war onset. These results demonstrate the importance of considering endogeneity in civil war studies more carefully.

[3] For studies that discuss and empirically test the endogenous trade-conflict relationship, see Reuveny and Kang (1996, 1998), Morrow (1999), Morrow, Siverson, and Tabaras (1999), Reuveny (2001), Li and Sacko (2002), Kesch, Pollins, and Reuveny (2004), and Long (2008).

The Effect of Civil War on Natural Resource Production

Our first general expectation is that the occurrence of civil war in a country will harm the production of natural resources. Kelly (1991-92, 922) points to several historical examples of environmental destruction caused by war including the poisoning of wells and destruction of farmland in the Punic Wars of the third century B.C., destruction of dikes by the Dutch in the Franco-Dutch war of 1672-1678, the destruction of major dams during the Sino-Japanese war of 1937-1945, in the Ruhr Valley in Germany in World War II, and in the Vietnam war, as well as the use of "herbicides and defoliants to clear the jungle and reduce food supplies" in the Vietnam war (Kelly 1991-92, 923). More recently, scholars have examined the environmental consequences of the Persian Gulf War in the early 1990s. Iraq set fire to over 600 oil wells and refineries in Kuwait, which created a serious environmental disaster and wreaked widespread destruction on agricultural areas. There were also serious oil spills in the Persian Gulf, amounting to close to three million barrels, which killed tens of thousands of marine animal species (Kelly 1991-92, 926). The use of war machinery, such as heavy tanks, ammunition, and mines, also has negative environmental consequences including soil damage, erosion, compaction, loss of forage/shrubs, habitat destruction, and loss of insect fauna (Brauer 2000, 4).

Just as the effect of natural resources on civil war is likely to depend on the characteristics of the resources and the overall context within which they are produced, the reverse relationship is also likely to be conditioned by these same factors. Ross (2002, 10-11) points to three key features of resources that may be relevant: 1) lootability: "the ease with which [a resource]...can be extracted and transported by individuals or small teams of unskilled workers, 2) obstructability: whether "transportation can be easily blocked by a small number of individuals with a few weapons"; this depends on the value to weight ratio and whether goods

can be moved easily out of a country by air or not, and 3) whether the good is legally traded. Illegal goods should be easier for rebel groups to maintain, especially if they are produced in peripheral regions. The manner in which goods are produced is likely to matter as well, as resource and civil war onset studies have suggested: "The nature of violence may change whether resources involve production or extraction. With extracted resources (e.g. minerals), violence is most likely to take a physical form to achieve territorial or state control, as was the case of Congo Brazzaville over oil rents in 1997. With produced resources (e.g. crops), violence usually takes a more structural form, such as coercive forms of labour or controls over trade" (Le Billon 2001, 568).

The importance of lootability has been examined in detail in the work relating diamonds to civil war onset. Lujala, Gleditsch, and Gilmore (2005) argue that secondary (or alluvial) diamonds are more likely to be associated with the onset of civil wars due to the ease with which rebels can gain access to these resources and extract them. Secondary diamonds are also more likely to be located at farther distances from the center, which makes it more difficult for the government to monitor their production. They find empirically that secondary diamonds have increased the risk for civil war onset, especially in the post Cold War era. In a global sample going back to 1960, Humphreys (2005) also finds that diamond production per capita is positively and significantly related to civil war onset.

Location from center matters as well, with proximate resources being easier for governments to control than distant resources (Le Billon 2001, 570). Resources close to a capital city are less likely to be captured by rebels in comparison to resources that are located in peripheral regions, as the cases of Aceh, Sierra Leone, and Sudan illustrate. Point resources like kimberlite diamond mines, oil wells, and gemstone mines, are easier for the state to control,

while more diffuse resources like alluvial diamonds, agriculture, timber, and fisheries, are more difficult for the government to control and monitor. Le Billon (2001) argues that point/proximate resources are most likely to be associated with center seeking civil wars, while point/distance resources will be associated with secessionist wars. Warlords are likely to operate in countries where there are diffuse resources that are distant from the state capital, in such countries as Afghanistan (opium), Angola (diamonds), Burma (opium, timber), Cambodia (gems, timber), Colombia (cocaine), Peru (cocaine), and the Philippines (marijuana, timber) (Le Billon 2001, 573). Civil wars could wreak havoc on point or diffuse resources, but their effects should be more pronounced in the case of diffuse resources, such as marine fisheries production. However, point resources could be at risk for destruction in the context of civil wars, especially if they are located far away from the capital city.

Diffuse resources such as agriculture, timber, and fisheries are also likely to suffer on the production side disproportionately in civil war environments because these resources are fairly labor-intensive. As farmers and fishermen are drafted or recruited into the fighting efforts, they will have less time to devote to productive economic activities. These effects were observed in many real world cases, including the decline in fishing catches in the North Atlantic during World War I, a loss of 25% marine fish catches during the Sri Lankan civil war, and a 50% reduction in marine fish catches during the Lebanese civil war (1975-1990) (Hendrix and Glaser 2009, 1-5). Beyond the redeployment of labor, diffuse natural resources like fisheries are also likely to suffer declining production in civil war due to the displacement of the local population fleeing war zones (Hendrix and Glaser 2009). The perils of civil war make it more difficult for citizens to engage in normal economic activities, reducing the overall production and extraction

of natural resources. This suggests that longer and more deadly wars should have more devastating effects on natural resources and the environment.

Globalization and Natural Resource Production

In addition to these general theoretical claims in the literature, we also believe that civil war studies positing an important role for natural resources should properly situate those resources in a global context. While much debate exists between neo-Malthusians who warn of resource depletion as a potential source of civil war and neoclassical economists who warn of natural resource abundance as a curse, we need to delineate more carefully between local and global supplies (Kahl 2006). Non-renewable resources that are locally abundant, but globally scarce, such as diamonds and other gemstones, are much more likely to be contested violently. The supply and demand of resources like oil, diamonds and marine fish are not purely a function of the domestic contexts within which they are produced.[4] Rather, global markets drive the prices of these goods, which in turn drive their value to both states and rebels. Higher prices may prompt the state to more closely guard the revenue generating resources under their control, but they may also stimulate rebels who want either an increased share of those revenues or to capture the state outright (Le Billion 2001). Higher prices should also stimulate production in a perfect market, though we know that this simple expectation is complicated by the cartelization of some of the key resources suspected of fostering civil war, including oil and diamonds. Both OPEC and the firms engaged in diamond production actively manipulate production to meet price goals set for a variety of reasons. In general, we would expect higher prices to promote civil war onset and stimulate production.

[4] For a nice discussion of how state ownership of natural resources, the availability of other export revenue sources, and strong domestic institutions influence the resource curse, see Luong and Weinthal (2006).

Setting natural resources in a global context helps us to better understand the rentier state hypothesis. We argue that it is not just production of a natural resource and the rents derived from it that are problematic for state strength and civil society in such countries, but rather it is the extent of the dependence of the state on resource production. We capture this in a global context by considering a state's share of total global production of a resource. The larger the share of the world market occupied by a state, the more dependent it is on that resource politically and economically. It also means that the state becomes more of a prize for rebels to capture. Global consumers of the resource also have fewer substitute producers to turn to, even if the situation in a country appears to be degenerating toward civil war. These three mechanisms suggest that the larger the share of global production a state's natural resource production comprises, the more likely it is to experience civil war onset.

Angola provides a good example of how the global market for natural resources influences civil conflict. Oil production increased seven-fold from 170,000 barrels of oil produced per day in 1977 to 735,000 barrels per day in 2000. Seven major oil firms competed for oil production in Angola. Over 90% of the government's total export revenue in natural resources was coming from oil (Frynas and Wood 2001, 594). The government used much of the profits from oil sales to buy military goods in its fight against rebel groups, such as UNITA, in the civil war that ensued between 1975 and 2002 (Collier et al 2003, 105). The increased share of global oil production throughout the civil war raised the stakes for the government and rebel groups to be successful in the civil war and increased the war's severity by providing the government with access to more sophisticated weaponry, such as jets, helicopters, and tanks (Frynas and Wood 2001).

Angola also experienced significant increases in diamond production during the civil war, which further fueled each side's ability to continue the fight. In our dataset, for example, Angola's world share of diamond production increased by a magnitude of 475% between 1977 and 1999. While its share of the world diamond market was larger than its share of the overall market for oil, Angola also experienced a rapidly increasing global market share in oil as well, with a 299% increase from 1977-1999. If we look at the ten countries with the largest shares of world diamond production from 1960 to the present, we find many states that have experienced intrastate armed conflicts with 25 or more battle deaths (Uppsala/PRIO Armed Conflict Dataset, Version 4-2009): Central African Republic, Congo, Cote D'Ivoire, Lesotho, Oman, and Sierra Leone. A sizable subset of the ten largest oil producers has also experienced intrastate conflict: Gabon, Iraq, Oman, Saudi Arabia, and Venezuela. In short, states that are locally dependent on natural resources that are globally scarce face higher risks for civil war. Contestation over these resources produces weaker, predatory states and fuels underlying grievances in society.

Research Design

We turn now to a description of the research design we employ to evaluate our central theoretical claims: 1) *Endogeneity:* civil wars are likely to harm natural resource production, and 2) *Globalization:* states' larger global shares of resource production should increase their risk for civil war onset. We also expect to find variation across different resources due to the varied characteristics of the goods, such as lootability, point/diffuse location, and the number of states producing the same resource. There are two endogenous equations in this model representing civil war onset and natural resource production. We use the technique developed by Maddala (1983) and practically implemented by Keshk (2003) to analyze this system of equations.

This method is designed for simultaneous equation models where one of the endogenous variables is continuous (natural resources) and the other is dichotomous (civil war onset). This two-stage estimation technique creates instruments for the endogenous variables and then substitutes them for their endogenous counterparts in the structural equations. The continuous variable is estimated with OLS and the dichotomous variable with probit. This technique has previously been applied to studies of trade and conflict (Keshk et al. 2004), democracy and conflict (Reuveny and Li 2003), and state capacity and civil war onset (Thies 2010). There are 157 countries included in the data set with a maximum number of 5269 observations during the years 1960-1999. The introduction of economic measures reduces the maximum number of observations to 4413, as can be expected in a pooled analysis of developing and developed states. Data for the control variables comes from the World Bank (2001), unless otherwise specified.

The Civil War Equation

The civil war equation starts with the model developed by Fearon and Laitin (2003), which is often used as a baseline for studies that have offered conceptual or methodological innovations in the study of civil war onset (Humphreys 2005; Lujala et al. 2005; Thyne 2006; Cederman and Girardin 2007; Thies, 2010). ***Civil war onset*** is coded dichotomously according to whether violent civil conflicts meet the following criteria (Fearon and Laitin 2003, 76):

> (1) They involved fighting between agents of (or claimants to) a state and organized nonstate groups who sought either to take control of a government, to take power in a region, or to use violence to change government policies. (2) The conflict killed at least 1,000 over its course, with a yearly average of at least 100. (3) At least 100 were killed on both sides (including civilians attacked by rebels). The last condition is intended to rule out massacres where there is no organized or effective opposition.

The control variables used in this equation are identical to those used in Fearon and Laitin's (2003, 76) basic model. ***Prior war*** is a dichotomous control variable that indicates

whether or not a civil war was ongoing in the previous year. ***Per capita income*** is measured in thousands of 1985 U.S. dollars and lagged one year. ***Population*** is the logged population size, which is lagged one year. ***Mountainous terrain*** is measured as the logged share of a state's terrain covered by mountains. ***Noncontiguous state*** is a dichotomous variable that captures the effect of having noncontiguous territory, such as islands or enclaves. ***New state*** is a dichotomous variable marking the first and second years of a state's independence. ***Instability*** is a dummy variable that indicates whether the state had a change of three or greater in the Polity IV regime index in any of the prior three years. ***Polity2*** is a lagged Polity IV value derived from the polity2 score that varies between –10 (most autocratic) and +10 (most democratic). ***Ethnic fractionalization*** is represented by the commonly used ELF index of ethnolinguistic fractionalization, which ranges from 0 (complete ethnic homogeneity) to 100 (complete ethnic heterogeneity) by measuring the probability that two randomly chosen individuals belong to different ethno-linguistic groups. ***Religious fractionalization*** is a measure that Fearon and Laitin (2003) construct along similar lines to the ELF index to represent religious diversity.

We add several measures designed to capture the effects of natural resource production on civil war onset. First, we replace the oil exporter variable used in the Fearon and Laitin (2003) model with three measures of natural resource production (oil production, diamond production, and marine fish catch) generated for the second equation (described in detail below). In the model of oil production, we include a dichotomous measure of ***OPEC*** membership, the log of the average ***world oil price***[5], and the state's ***world oil market share***[6]. In the diamond

[5] World oil price is measured as the log of U.S. dollars per barrel for Arabian Light posted at Ras Tanura (1945-1985) and Brent spot (1986-1999) from British Petroleum.
[6] World oil market share is calculated as a state's oil production in barrels divided by total world oil production in barrels using data from Humphreys (2005).

production model, we include a measure of the log of the ***world diamond price***[7] and the state's ***world diamond market share***.[8] In the marine fish catch model, we include a measure of the log of average ***world fish price***[9] and the state's ***world fish market share***.[10] Second, we include a measure of state fiscal capacity to more properly gauge the Fearon and Laitin (2003) weak state argument (Thies, 2010). The ***tax ratio***, measured as tax revenue as a percentage of GDP, is the conventional gauge of the state's extractive capacity (Campbell 1993; Cheibub 1998; Fauvelle-Aymar 1999; Thies 2005). The tax ratio variable is from an ongoing data collection effort by Johnson and Rabinowitz (2005).

The models are identified by the exclusion condition (Gujarati 2003). There are eight variables that are unique to the civil war equations, including prior war, polity2, mountainous terrain, noncontiguous state, ethnic and religious fractionalization, new state, and the measures of world market share. We also employ the technique developed by Beck, Katz and Tucker (1998) to address the problem of serial correlation. The civil war equations are estimated with a counter for the number of years that a state has been at peace and three cubic splines to account for the effect of autocorrelation. Their inclusion has no appreciable effect, similar to what Fearon and Laitin reported (2003: 83), but we include them for consistency with previous civil war models.

Natural Resource Production Equation(s)

[7] World diamond price is calculated based on data provided by the Antwerp World Diamond Center for the average price of a one carat premium cut diamond. Actual price data is available only at decade intervals, so the annual data is linearly interpolated. Data on rough cut diamonds is not available. While we wish we had diamond price data more comparable to that provided by the oil markets, these are the best rough estimates publicly available for diamonds.

[8] World diamond market share is calculated as a state's diamond production in carats divided by total world diamond production in carats using data from Humphreys (2005).

[9] World fish price is calculated as the log of the dollar value per metric ton of U.S. fish product exports based on data from the FAO Fisheries and Aquaculture Statistics.

[10] World fish market share is calculated as a state's marine fish catch in metric tons divided by the total world marine fish catch in metric tons based on data provided by Hendrix and Glaser (2009), also derived from the FAO Fisheries and Aquaculture Statistics.

We use three different measures of natural resource production that are tested in separate models: oil production, diamond production, and marine fish exports. These measures provide us with ample variance in resource types, as diamonds are much cheaper to transport and easier to loot than oil or fisheries. Diamonds and fisheries are typically more diffuse resources relative to oil facilities, especially if they are owned by the state (e.g. Angola). The number of states producing these resources varies considerably as well: diamonds (25), oil (114), fisheries (123).

We employ Humphreys' (2005) measure of ***oil production*** in barrels per capita per day.[11] This continuous measure of oil production is expected to be positively related to civil war onset according to the conventional wisdom in the civil war literature. On the other hand, civil war is expected to reduce oil production due to the destruction of oil facilities during the war and because of the difficulties conflict poses to oil producers seeking to move their products safely out of the country. We also include ***OPEC*** membership and the log of the ***world oil price*** in the resource production model as both should positively affect oil production.

Along with oil, diamond production has drawn a lot of attention, especially with regard to the "conflict diamonds" that are thought to contribute to the onset and duration of African civil wars. We use Humphreys' (2005) measure of ***diamond production*** in carats per capita, which he demonstrates is positively related to civil war onset. Diamonds are on average easier to loot and move out of the country, thus civil conflict should increase diamond production. We include our measure of ***world diamond price*** as well. Ideally, we would have measures for primary and secondary diamond production for a more nuanced test, but these data do not exist.[12]

[11] Substituting Fearon's (2005) measure of fuel exports as a percentage of GDP produces largely the same results in the model.

[12] Lujala et al. (2005) have dichotomous variables that indicate the presence or absence of primary and secondary diamond production in a country, but not continuous data on production in carats.

Finally, we include a measure of the log of ***marine fish catch*** in metric tons provided by Hendrix and Glaser (2009), and based on the FAO Fisheries and Aquaculture Statistics Collection Global Production Tables. While Hendrix and Glaser (2009) are interested in the effects of civil war on marine fish catch growth, our interest is in the production of marine fish catch as another type of natural resource. Hendrix and Glaser (2009) find that civil war onset reduces the growth of marine fish catch, though they do not directly test its effects on the level of production. We also include the log of ***world fish price*** in our model to see if production responds to increased global prices.

We predict variation in these measures of natural resource production using a very general set of independent variables, including the tax ratio, GDP per capita, population, and instability measures from the aforementioned civil war onset model. We also include ***GDP growth***, ***trade openness*** (imports + exports divided by GDP), and ***population growth*** as general factors that affect natural resource production. The natural resource production equations are identified by the exclusion criterion (Gujarati 2003): the GDP growth, trade openness, and population growth measures are unique to this equation.

Empirical Analyses

The use of the two-stage estimation technique modeling civil war onset and natural resource production generates some interesting results. In the models, the instrumented variables produced in the first stage estimation exhibit relatively good fit as indicated by high R^2 values (Staiger and Stock 1997), though there is some variance across the models. More importantly, the instrumented variables are also relatively highly correlated with the original variables, which should alleviate fears of weak instruments. The quality of these instruments is also reinforced by

the fact that there is little difference between the standard errors produced by the Maddala (1983) procedure in the second stage of estimation or if we obtain White (1980)/Newey and West (1987) robust standard errors at the conclusion of the first stage.[13] We only present the results from the Maddala (1983) procedure produced in the second stage of the estimation procedure in the tables discussed below.

Oil Production/Fuel Exports

Table 1 present the results from the simultaneous equation model of civil war onset and oil production. The top half of Table 1 shows the first part of this model by demonstrating the effect of oil production on civil war onset. Oil production does not significantly affect civil war onset. Neither membership in OPEC, nor the world price of oil significantly affect civil war onset. The size of a state's share of the world oil market is positively related to civil war onset. This should help bring some clarity to the mixed findings regarding oil in the civil war literature—oil production *per se* is not a curse, but as a state becomes an increasingly larger producer, there is greater likelihood for internal conflict. In these situations, the economy and the political system become highly dependent on oil and the control of such resource wealth may motivate rebels. The more direct measure of the strength of the state, as proxied by the tax ratio, fails to exert a significant effect on civil war onset in either model. The lack of significance of the oil production measure and the tax ratio replicates the results in Thies (2010). The control variables from the original Fearon and Laitin (2003) model perform largely as expected with GDP per capita significantly reducing civil war onset, and mountainous terrain, new state, and instability increasing the likelihood of civil war onset. The only major difference in findings

[13] CDSIMEQ does not allow the generation of robust standards errors at the conclusion of the second stage of the estimation procedure. Keshk et al. (2004, 1169-1170) compare the Maddala standard errors and the White/Newey and West standard errors via the same procedure. They also find little difference between the two techniques.

from the Fearon and Laitin civil war onset model is the insignificance of the population and noncontiguous variables in our estimation.

The bottom half of Table 1 demonstrates that civil war onset significantly reduces oil production. This is consistent with our hypothesis that civil wars destroy the production of natural resources. Membership in OPEC increases oil production as expected, but the world oil price does not appear to drive production. The tax ratio is negatively related to oil production, which is supportive of the rentier state hypothesis. Instability, population growth, and GDP per capita spur oil production, while size of population and trade openness reduces production. These results show the importance of controlling for endogeneity, as oil production itself has no discernable impact on civil war onset once we control for the two-way relationship.

On the other hand, the destruction of oil production in civil war makes sense in light of the historical case studies discussed earlier, such as the Persian Gulf War. Rebels often sabotage oil wells and refineries as part of their war fighting strategy. For example, in August 2001, rebels attacked the facilities at the Heglig oil fields in southern Sudan (Washington Post 8/16/2001). In January 1991, members of the Colombian National Liberation Army (ELN) kidnapped four French oil workers and destroyed $2.5 million worth of equipment on an oil pipeline (Miami Herald 1/19/1991). Multinational corporations may also temporarily cease drilling operations as the risks to their personnel in war zones increase. In the aftermath of attacks on its employees in the mid-1980s, Chevron ceased its oil drilling operations in Sudan (Washington Post 8/16/2001).

Diamond Production/Primary Commodity Exports

Table 2 moves our attention to diamond production, which clearly demonstrates the importance of the global economy in civil war onset. A state's diamond production significantly

reduces its risk for the onset of civil war (top half of the table). Yet, the story is more complicated, since both the world diamond price and the state's share of the world diamond market both positively affect civil war onset. Thus diamond production alone is not necessarily a curse; in fact, it appears to be a blessing except when a state becomes a very large producer and the price of diamonds is high. These findings may help make sense of some of the inconsistent findings across the literature. Lujala, Gleditsch, and Gilmore (2005) found a positive relationship between (secondary) diamonds and civil war onset, yet their results were sensitive to model specification and temporal period. Humphreys (2005) found a positive relationship between diamond production and civil war onset, though Thies (2010) found no relationship. Diamond production must be properly located in a global context, which means that the production of diamonds is driven by a global marketplace and a state's excessive dependence on that resource may have negative consequences. The fact that six of the ten largest global diamond producing states in our sample have experienced intrastate conflict is consistent with the large N pattern. States with higher fiscal capacity as measured by the tax ratio are unable to deter civil war onset, much as with the previous model.

The bottom half of Table 2 produces one particularly intriguing finding. Civil war onset seems to spur diamond production. States with higher fiscal capacities are also likely to have increased levels of diamond production. The finding for increased diamond production in the context of war is consistent with the characteristics of diamonds in war zones, namely that they are likely to be located far away from the central government's control and that they are diffuse and fairly easy to extract with minimal economic inputs. A good example of this process occurred during the Angola civil war, when the Canadian-based company DiamondWorks Ltd. more than doubled its diamond production from 74,600 carats in 1998 to 150,000-200,000 carats

in 1999 (National Post (Canada) 5/28/1999).[14] Because diamonds can be produced and transported cheaply and because the small number of producers (25 countries) results in global price increases when civil wars occur, diamond companies take advantage of higher prices, doing business in these dangerous zones.

Marine Fishery Catches

We also examine the effect of marine fish catches on civil war onset in Table 3. Increases in marine fish catches significantly reduce the likelihood of civil war onset, which could reflect a state's overall economic capacity, as large scale fishery operations require very capital-intensive and expensive equipment. The dangers of becoming too dependent on one resource are still evident even with marine fish, as a larger share of the world market increases the likelihood of civil war onset. On the other hand, the onset of civil war significantly reduces the levels of marine fishery catches, consistent with our expectations and prior results (Hendrix and Glaser 2009). Fishing is more of a distant, diffuse resource and it is more likely to be directly affected by war due to population displacement from fighting, which leads to a reduction of labor in the local fishing industry. A good example of the former process occurred in the Lebanese civil war, when insurgent groups regularly attacked fishing villages. In July 1990, for example, the fishing village of Al Ghaziye was attacked, resulting in 20,000 people fleeing the area (New York Times 7/24/1990). Sri Lankan fishing communities, such as Valvedditturai, also found themselves caught in the conflict between the government and the Tamil separatist guerrillas, many of the village's citizens the victims of aerial bombings (New York Times 6/6/1987). In short, the displacement and destruction caused by civil wars harms the day to day

[14] We should point out that the Kimberley Process has made it more difficult for diamond producers to extract diamonds from conflict zones, although the process has been criticized in terms of its overall effectiveness (Collier et al. 2003).

operations of many fishing communities and often wreaks long term environmental damage on marine animal populations.

Conclusion

In this paper, we examine the endogenous relationship between the production of natural resources and civil war. We also consider states' share of resource production globally, as states that face higher resource dependency experience greater risks for civil conflict. We focus on several prominent natural resources that have received a great deal of attention in the civil war literature including oil, diamonds, and marine fishery catches. We demonstrate that there is an important two-way relationship between these factors, which has been largely ignored in previous studies (c.f., Thies, 2010). Civil wars tend to wreak havoc on the production of natural resources, significantly reducing oil production and fisheries production. On the other hand, resources that are easy to loot and move out of the country, such as alluvial diamonds, actually experience increased production in civil war environments. Our findings suggest that civil war might not only fuel a development trap, but that these countries may also find themselves in a natural resource trap, as civil war moves more economic activity into this arena. At the same time, the occurrence of civil war reduces the resources that are available for production or extraction, which further disadvantages the state.

We can understand the resource-civil war relationship more clearly by focusing on the forces of globalization. The production of certain resources like oil and diamonds does not necessarily put states at higher risks for civil war. Rather, it is the overall market share of a state's resource production that matters, with high levels of global dependence increasing the risk for civil war. We can use this knowledge to focus conflict management strategies on the largest

global producers of primary commodities, especially those that have other risk factors for civil war, such as weak institutions, low economic growth, and previous civil war experience.

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Table 1: The Simultaneous Effects of Civil War Onset and Oil Production

	(Civil War Onset)	
Variable	Coefficient	Std. Error
Oil Production(barrels/pc)	–.673	.845
OPEC	.240	.286
World Oil Price (log)	.114	.085
World Oil Market Share	3.817*	2.044
Tax Ratio	–.803	.711
War (lag)	.029	.146
GDP per capita (log)	–.121***	.044
Population (log)	.055	.044
Polity2	.008	.011
Mountainous Terrain	.071*	.043
Noncontiguous	.092	.161
Ethnic Fractionalization	.090	.206
Religious Fractionalization	.198	.281
New State	.514*	.314
Instability	.304***	.121
Peace Years	–.004	.052
Spline 1	.000	.001
Spline 2	–.000	.001
Spline 3	.000	.000
Constant	–2.964***	.522
First Stage Pseudo-R^2	.12	
LR Chi2	72.59***	

	(Oil Production)	
Variable	Coefficient	Std. Error
Civil War Onset	–.107***	.031
OPEC	.275***	.024
World Oil Price (log)	.001	.001
Tax Ratio	–.147*	.086
GDP per capita (log)	.013***	.005
GDP growth	–.001	.001
Trade openness	–.078***	.026
Population (log)	–.019***	.006
Population growth	4.192***	.377
Instability	.056***	.016
Constant	–.159	.110
First Stage Adj. R^2	.60	
F	559.35***	
N	4359	

Note: Two-tailed test, *p<.10, **p<.05, ***p<.01.

Table 2: The Simultaneous Effects of Civil War Onset and Diamond Production

	(Civil War Onset)	
Variable	Coefficient	Std. Error
Diamond (carats/pc)	–1.466*	.836
World Diamond Price (log)	.447***	.171
World Diamond Mkt. Share	9.388**	4.833
Tax Ratio	–.245	.848
War (lag)	.234	.204
GDP per capita (log)	–.145***	.037
Population (log)	–.005	.062
Polity2	.026	.024
Mountainous Terrain	.038	.051
Noncontiguous	.183	.165
Ethnic Fractionalization	–.028	.218
Religious Fractionalization	.136	.287
New State	.312	.397
Instability	.139	.146
Peace Years	.004	.056
Spline 1	.000	.001
Spline 2	–.000	.001
Spline 3	–.000	.000
Constant	–5.921***	1.384
First Stage Pseudo-R^2	.12	
LR Chi2	73.12***	

	(Diamond Production)	
Variable	Coefficient	Std. Error
Civil War Onset	.586***	.184
World Diamond Price (log)	–.059	.092
Tax Ratio	1.193***	.475
GDP per capita (log)	.053**	.024
GDP growth	.019***	.006
Trade openness	.215	.151
Population (log)	–.102***	.033
Population growth	2.414	2.020
Instability	–.180**	.088
Constant	2.395**	1.129
First Stage Adj. R^2	.19	
F	20.93***	

N	4358

Note: Two-tailed test, *p<.10, **p<.05, ***p<.01.

Table 3: The Simultaneous Effects of Civil War Onset and Marine Fisheries Production

	(Civil War Onset)	
Variable	Coefficient	Std. Error
Marine Fish Catch (log)	–.396**	.183
World Fish Price (log)	.220	.392
World Fish Market Share	20.820*	11.815
Tax Ratio	1.881	1.379
War (lag)	–.195	.190
GDP per capita (log)	–.043	.042
Population (log)	.497***	.186
Polity2	.027	.022
Mountainous Terrain	–.223	.145
Noncontiguous	1.143**	.514
Ethnic Fractionalization	.553*	.301
Religious Fractionalization	–2.061*	1.092
New State	.407	.361
Instability	.268	.137
Peace Years	–.017	.058
Spline 1	–.000	.001
Spline 2	.000	.001
Spline 3	–.000	.000
Constant	–4.748	3.187
First Stage Pseudo-R^2	.12	
LR Chi2	73.02***	

	(Marine Fish Catch)	
Variable	Coefficient	Std. Error
Civil War Onset	–3.336***	1.096
World Fish Price (log)	.316	1.227
Tax Ratio	5.290**	2.626
GDP per capita (log)	–.074	.144
GDP growth	–.052	.038
Trade openness	.255	.786
Population (log)	1.854***	.194
Population growth	–8.558	11.532
Instability	.748	.509
Constant	–19.494**	10.298
First Stage Adj. R^2	.41	
F	160.49***	

N	4362

Note: Two-tailed test, *p<.10, **p<.05, ***p<.01.