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What Do We Know About Natural Resources and Civil War?*

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Since the late 1990s, there has been a flood of research on natural resources and civil war. This article reviews 14 recent cross-national econometric studies, and many qualitative studies, that cast light on the relationship between natural resources and civil war. It suggests that collectively they imply four underlying regularities: first, oil increases the likelihood of conflict, particularly separatist conflict; second, 'lootable' commodities like gemstones and drugs do not make conflict more likely to begin, but they tend to lengthen existing conflicts; third, there is no apparent link between legal agricultural commodities and civil war; and finally, the association between primary commodities – a broad category that includes both oil and agricultural goods – and the onset of civil war is not robust. The first section discusses the evidence for these four regularities and examines some theoretical arguments that could explain them. The second section suggests that some of the remaining inconsistencies among the econometric studies may be caused by differences in the ways they code civil wars and cope with missing data. The third section highlights some further aspects of the resource–civil war relationship that remain poorly understood.

Introduction

Since the late 1990s, many scholars have studied the relationship between natural resource wealth and civil war. Most have been motivated by a series of high-profile conflicts – in Angola, Colombia, the Democratic Republic of Congo, Liberia, Sierra Leone, and Sudan – that have captured the attention of both international organizations and the media. Influential studies by Keen (1998), Collier & Hoeffler (1998), Reno

(1995, 1998), Berdal & Malone (2000), and Klare (2001) have touched off new research by economists, political scientists, and geographers in both Europe and North America.¹

What can these studies tell us about the relationship between natural resources – including oil, gas, non-fuel minerals, gemstones, narcotics, timber, and agricultural products – and violent conflict? At first glance, the answer appears to be: not much. Table I summarizes the findings of 14 cross-national econometric studies of resources and conflict. There appears to be little agreement on the validity of the resource–civil war

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¹ Other scholars have pursued separate lines of research arguing that natural resources can produce international conflict (e.g. Galtung, 1982; Westing, 1986), and that resource scarcity can lead to violent conflict (e.g. Homer-Dixon, 1998). These other bodies of research are surveyed in Gleditsch (1998).

correlation. These and other, more qualitative studies reach varying conclusions on at least five aspects of the resource–conflict relationship:

- whether or not natural resources influence the onset of conflict;
- whether or not resources influence the duration of conflict;
- whether resources influence all types of civil wars or only a subtype, e.g. ethnic or separatist conflicts;
- whether all types of resources, or only a subset (e.g. oil, diamonds) are linked to conflict; and
- what causal mechanisms link resources to conflict.

Quantitative studies of natural resources and civil war have also been shadowed by concerns about misspecification and spuriousness. Most scholars measure a country's 'resource wealth' by using the ratio of its resource exports to its GDP. This opens the door to two problems. First, there is a danger that the causal arrow between natural resource exports as a fraction of GDP and the onset of civil war might run the other way: civil wars might cause resource dependence by forcing a country's manufacturing sector to flee while leaving its resource sector – which is location-specific and cannot easily move – the major force in the economy by default.² Using lagged independent variables does not eliminate the danger of reverse causality: civil wars can be preceded by years of low-level violence that drives off manufacturing firms, producing a higher level of

resource dependence before the conflict officially commences.

Second, the natural resource–civil war correlation could be spurious: both civil war and resource dependence might be independently caused by some unmeasured third variable, such as the weak rule of law. A state where the rule of law is weak might be unable to attract investment in its manufacturing sector, and hence would depend more heavily on resource exports; it might also face a heightened risk of civil war through a different process. The result could be a statistically significant correlation between resource dependence and civil war, even though neither factor would cause the other.

Because the rule of law – and other potentially significant missing variables, like the security of property rights – are so difficult to measure across countries and over time, it is hard to test this possibility statistically.

Despite these problems, a close look at both the quantitative and qualitative studies suggests four regularities – which could be characterized as two patterns and two conspicuous 'non-patterns'. The first pattern is that oil exports are linked to the onset of conflict; the second is that 'lootable' commodities like gemstones and drugs are correlated with the duration of conflict. The first non-pattern is that agricultural commodities seem to be uncorrelated with civil wars, and the second is that primary commodities – a category that includes oil, non-fuel minerals, and agricultural goods – is not robustly associated with the onset of civil war. Not every cross-national study fits these four regularities; still, they are the strongest findings to emerge so far from this rapidly growing field.

What causal mechanisms produce these outcomes? Several studies have emphasized that we still know little about the processes that tie natural resources to conflict (Ross, 2004a; Humphreys, 2003). Observers often

² The case of Angola illustrates this pattern. Until its civil war began, Angola's economy was relatively diversified and enjoyed high growth: from 1960 to 1974 the economy grew at almost 8% a year. When the war began in 1975, the country's economic structure collapsed – owing to both the conflict and the new government's socialist policies. Between 1973 and 1985, industrial output dropped by almost half – turning Angola into one of the most resource-dependent countries in the world (Minter, 1994).

Table I. Quantitative Research on Resources and Civil War

	<i>Coverage</i>	<i>Resource measure</i>	<i>Dependent variable</i>	<i>Finding</i>
Collier & Hoeffler (1998)	27 wars, 1960–92	Primary exports/GDP	War onset	Increases likelihood of war (curvilinear)
Collier & Hoeffler (2002a)	52 wars, 1960–99	Primary exports/GDP	War onset	Increases likelihood of war (curvilinear)
Collier & Hoeffler (2002b)	48 wars, 1960–99	Primary exports/GDP	War onset	Increases likelihood of separatist wars only (curvilinear)
Elbadawi & Sambanis (2002)	108 wars, 1960–99	Primary exports/GDP	War onset	Weak or no effect
Fearon & Laitin (2003)	97 wars, 1960–99	Primary exports/GDP	War onset	No significant effect
Fearon & Laitin (2003)	122 wars, 1945–99	Oil exporter (dummy)	War onset	Increases likelihood of war
Hegre (2002)	50 wars, 1960–97	Mineral exports/ total exports	War onset	No significant effect
Hegre (2002)	50 wars, 1960–97	Primary exports/GDP	War onset	Increases likelihood of war (curvilinear)
Humphreys (2003)	122 wars, 1945–99	Oil production	War onset	Increases likelihood of war
Humphreys (2003)	122 wars, 1945–99	Oil reserves	War onset	No significant effect
Humphreys (2003)	122 wars, 1945–99	Diamond production	War onset	No significant effect
Humphreys (2003)	122 wars, 1945–99	Diamond production	War duration	Reduces war duration
Reynal-Querol (2002)	91 wars, 1960–95	Primary exports/GDP	War onset and prevalence	Increases likelihood of non-ethnic wars only
Elbadawi & Sambanis (2002)	108 wars, 1960–99	Primary exports/GDP	War prevalence	Weak or no effect
Collier, Hoeffler & Söderbom (2004)	52 wars, 1960–99	Primary exports/GDP	War duration	No significant effect
Fearon (2004)	122 wars, 1945–99	Contraband (drugs, gems)	War duration	Increases duration of war
Doyle & Sambanis (2000)	124 wars, 1945–97	Primary exports/GDP	Peacebuilding success	Harms successful peacebuilding
de Soysa (2002b)	77 states, 1989–99	Natural resource stocks/ capita	Conflict onset (>25 deaths)	No significant effect
de Soysa (2002b)	77 states, 1989–99	Mineral stocks/ capita	Conflict onset (>25 deaths)	Decreases likelihood of conflict (curvilinear)
de Soysa (2002b)	138 states, 1989–99	Oil exporter (dummy)	Conflict onset (>25 deaths)	Increases likelihood of conflict
Buhaug & Gates (2002)	262 conflicts, 1946–2000	Mineral resources in conflict zone (dummy)	Size of conflict zone	Increases size of conflict zone

claim that resources have 'fueled' a given conflict but are vague about how this occurred. General, cross-national studies often suggest causal mechanisms but provide little evidence to back them up. Case studies tend to provide a wealth of data on causal links in specific conflicts, but are difficult to generalize. There are plausible theories behind each of the patterns, though efforts to test them are still in their infancy.

The first section of this article describes the initial results reported by Collier & Hoeffler (1998, 2002a) that inspired many of the studies reviewed here: that a country's dependence on primary commodities is strongly correlated with the likelihood of civil war. It points out that efforts by other scholars to replicate the primary commodities–civil war correlation have often failed, and suggests that one reason may be that the 'primary commodities' variable is overly broad, as it includes a wide range of raw materials, some of which may be uncorrelated with conflict.

It then shows that there is nonetheless strong evidence, from a wide range of quantitative and qualitative studies, to support two narrower claims: that oil is linked to the onset of civil war; and that lootable goods are associated with the duration of civil war. It discusses theories that could explain each of these patterns. It also notes the apparent absence of a link between legal agricultural commodities and conflict.

While most quantitative studies are consistent with these patterns, studies that employ different civil war databases sometimes report conflicting results on the resource–civil war relationship. The second section suggests that some of these differences may be caused by variations in the ways the databases code civil wars, and the different ways that scholars cope with missing data.

The third section highlights further aspects of the resource–conflict issue that

remain poorly understood and are ripe for further research. A brief conclusion summarizes the central themes.

Primary Commodities and Conflict

Collier & Hoeffler (1998, 2002a) report that primary commodity exports tend to increase the danger of civil war. Their most recent work covers up to 52 civil wars between 1960 and 1999, and suggests that a state's dependence on natural resources – measured as the ratio of primary commodity exports to GDP – has a significant influence on the likelihood that a civil war will begin over the next five years. Their data suggest that resource dependence has a non-linear effect: it increases the likelihood of conflict until the resource exports-to-GDP ratio is 32%; beyond this point it diminishes the likelihood of conflict. They also find this effect is substantial: when the other variables are held at their mean, a rise in resource dependence from zero to 32% increases a state's risk of civil war from 1% to 22%. Although their most recent work on this topic has not yet been published, it has been highly influential in both the academic and policy communities.

Fearon & Laitin (2003), Elbadawi & Sambanis (2002), and Hegre (2002) have all tried to replicate the Collier & Hoeffler findings on natural resources and civil war; their results vary. Each of these research projects uses a different database of civil wars.

The Fearon & Laitin study provides the sharpest challenge to the Collier & Hoeffler findings: the authors report that 'neither the share of primary commodity exports in GDP nor its square is remotely significant' in their model (Fearon & Laitin, 2003: 87). When they adjust their database to cover the same years as Collier & Hoeffler (1960–99), and group the data in five-year periods like Collier & Hoeffler, the coefficients on their

primary commodity variables are even farther from statistical significance.

The Elbadawi & Sambanis findings are more ambiguous: they report that a primary commodity exports variable is significant in some of their models but not others, depending on the procedure they choose to impute missing values, and how they operationalize civil war onsets. They conclude that the Collier & Hoeffler results appear 'fragile' and 'cautiously agree with Fearon and Laitin' that there is no significant relationship between civil war and natural resource dependence (Elbadawi & Sambanis, 2002: 324–325).

Research by Hegre (2002) has also produced mixed results, although his findings lend more support to the Collier & Hoeffler claim. Hegre finds that when he uses a very low threshold for defining conflict (25 deaths in a single year), primary commodity exports have no influence on the likelihood of civil conflict. When using the 1,000-death threshold employed by Collier & Hoeffler, and a civil war database similar to the Collier & Hoeffler database, his results match the Collier & Hoeffler findings – even though he employs a different set of control variables, finer time divisions, and a different statistical process. Hegre reports that the coefficients on his primary commodity variables turn out to be smaller than in the Collier & Hoeffler study, implying that primary commodities are somewhat less important than suggested by Collier & Hoeffler.

Two quantitative studies have also looked at the influence of primary commodity exports on the length of civil wars; their conclusions differ.³ Collier, Hoeffler & Söderbom (2004) report that primary commodity exports are not significantly correlated with civil war duration, based on their study of 55 civil wars between 1960 and

1999.⁴ Doyle & Sambanis (2000), however, find that primary commodity exports are negatively associated with the success of peacebuilding efforts in 124 wars between 1945 and 1997. Since wars are generally lengthened when peacebuilding efforts fail, their findings imply that primary commodity exports tend to increase war duration.

Several studies suggest that primary commodities may only be correlated with a subset of conflicts. Reynal-Querol (2002) divides civil wars into 'ethnic' and 'non-ethnic' – using the coding of the State Failure Task Force – and finds that primary exports are correlated only with the onset of non-ethnic wars. Yet Sambanis (2001) also examines the causes of ethnic and non-ethnic civil wars, using a different set of coding rules; he finds that primary commodities have no consistent effect.⁵

In a separate paper, Collier & Hoeffler (2002b) examine the causes of separatist conflicts and find that a state's dependence on primary commodity exports is strongly correlated with the likelihood it will have a separatist civil war. The impact of primary commodity exports is three times as large in separatist conflicts as in non-separatist conflicts. For non-separatist civil wars, the influence of primary commodity dependence is not significant at the 5% level ($p = .182$). As in their earlier studies, the relationship between primary commodity exports and the onset of civil wars is curvilinear, decreasing at exceptionally high levels.

What accounts for the conflicting results of these studies? One source of variation may be the differences in the civil war databases they employ; this issue is discussed in a separate section below. Another reason may

³ Also see the discussion of Fearon (2004) below, on the influence of resource contraband on conflict duration.

⁴ They do find evidence, however, that a drop in primary commodity prices tends to shorten conflicts; they suggest this occurs because it weakens the financing of commodity-dependent rebel groups.

⁵ Sambanis, personal communication, September 2002.

be that the 'primary commodities' variable and the 'civil war' variable are overly broad. The primary commodities variable includes commodities that, according to other studies described below, appear to be strongly linked to conflict (e.g. oil) and those that do not (e.g. agricultural goods). If only a subset of commodities is associated with conflict, then the broad correlation between the primary commodity variable and conflict may be weak or unstable. Similarly, the civil war variable measures all types of internal conflicts that cause a given number of fatalities. But if natural resources are linked to a subset of internal wars – such as ethnic or separatist wars – again the broader civil war variable may show only a weak or unstable relationship with natural resources.

How should we assess these disparate findings? The Collier & Hoeffler (2002a) study linking primary commodities to civil war appears to be robust only when scholars use Collier & Hoeffler's own list of civil wars, or something close to it. Both Hegre (2002) and Humphreys (2003) have successfully replicated the Collier & Hoeffler estimations using versions of the Collier & Hoeffler civil war database, and the latter notes that the correlation is robust to the exclusion of outliers. Yet scholars have found no significant correlation between primary commodities and violent conflict when using alternative lists of civil wars, including those compiled by Fearon & Laitin, Sambanis, and Gleditsch et al. (2002). Moreover, there are reasons to suspect that the Collier & Hoeffler database may be biased in a way that overstates the impact of primary commodities (see below). As a result, the claim that primary commodity exports are linked to civil war appears fragile and should be treated with caution.

Oil and the Onset of Conflict

Both quantitative and qualitative studies suggest that the production of oil is associ-

ated with the onset of conflict, particularly separatist conflict. Although quantitative studies have generally not explored the role of non-fuel minerals, qualitative studies imply that they, too, might be correlated with conflict.

Fearon & Laitin (2003) report that a dummy variable for oil exporters is correlated with the initiation of civil war.⁶ They report that the oil dummy is not acting as a proxy for either the Middle East–North Africa region or the presence of a large Muslim population.⁷ Similarly, de Soysa (2002b) finds that an oil exports dummy is significantly linked with the likelihood of conflict – even though his study covers fewer states and a briefer span of time.

In several of their papers, Collier & Hoeffler also highlight the role of oil exports. In Collier & Hoeffler (2002b), they disaggregate their primary commodities variable into five categories of goods and find that only oil is significantly linked to civil war in their baseline regression. Collier & Hoeffler (2002b) suggests that oil is particularly salient in secessionist civil wars, showing that an oil dummy can help predict the *type* of war (secessionist vs. non-secessionist), once primary commodity exports have been controlled for.⁸ Overall, there is good quantitative evidence that oil exports are significantly associated with either the full set of civil war onsets (Fearon & Laitin, de Soysa) or a

⁶ The dummy variable denotes states that derive at least one-third of their export revenues from oil. Since the authors lacked data on oil exports for the years between 1945 and 1960, they set the values for these years equal to the values for 1960.

⁷ Humphreys (2003) replicates the Fearon & Laitin estimation, using the same dataset, and reports that the correlation is not robust: the oil dummy loses significance if countries such as Russia and Indonesia are dropped, or if the pre-1965 cases are dropped. Yet Humphreys also finds that when he employs a lagged measure of crude oil production in place of the oil dummy, oil once again becomes significantly associated with the onset of civil war.

⁸ The results are sensitive to the way that secessionist wars are defined: the coefficient on the oil dummy is significant at the 5% level in just one of four alternative codings of war types.

Table II. Mineral Resources and Secessionist Movements

<i>Country</i>	<i>Region</i>	<i>Duration</i>	<i>Resources</i>
Angola	Cabinda	1975–	Oil
Burma	Hill tribes	1949–	Tin, gems
Democratic Republic of Congo	Katanga/Shaba	1960–65	Copper
Indonesia	West Papua	1969–	Copper, gold
Indonesia	Aceh	1975–	Natural gas
Morocco	West Sahara	1975–88	Phosphates, oil
Nigeria	Biafra	1967–70	Oil
Papua New Guinea	Bougainville	1988–	Copper, gold
Sudan	South	1983–	Oil

subset of civil war onsets (Collier & Hoeffler).⁹

There is also a wealth of case study evidence linking oil and other minerals to separatist conflicts: Table II lists nine separatist conflicts in regions with significant mineral wealth. Important ground-level research on the links between mineral wealth and secessionist movements has been carried out in the conflict over the Western Sahara issue in Morocco (Hodges, 1983), the struggle over Cabinda in Angola (Hodges, 2001), the many independence movements in Burma (Lintner, 1999; Sherman, 2003), the Katanga rebellion in the Democratic Republic of Congo (Gibbs, 1991), the Aceh conflagration in Indonesia (Robinson, 1998; Ross, 2003b), the West Papua independence movement, also in Indonesia (ICG, 2002), the Bougainville rebellion in Papua New Guinea (Wesley-Smith, 1992; Regan, 1998), and the rebellion in the south of Sudan (O'Balance, 2000; Anderson, 1999).

Why should oil exports lead to civil war? Many scholars have sketched out incentive-based theories of oil and war, arguing that

the rents available from oil (and sometimes, other minerals) give actors a financial incentive to initiate conflict. Some focus on separatist conflicts, while others look at non-separatist conflicts.

Collier & Hoeffler (2002b), Le Billon (2001b), and Ross (2003a) have developed overlapping theories to explain the links between oil and other minerals, and the likelihood of separatist conflict. Collier & Hoeffler (2002b), drawing on Buchanan & Faith (1987), suggest that the 'allure of claiming ownership of a natural resource discovery' gives populations in peripheral regions an incentive to establish sovereign states. They suggest this incentive is often less rational than it appears, since people tend to exaggerate the value of the resource rents available for capture. The likelihood of resource-based secessions is therefore higher when the economic value of the resource is more difficult to estimate – as is the case with oil and gas – and when the population is less educated.

Le Billon (2001b) gives this argument further nuance, suggesting that secessionist movements are more likely when a resource is physically concentrated, appropriated by locals, and requires foreign investment – since locals can attract this investment only if their territory achieves recognition as a sovereign state. If the resource is not

⁹ There is little evidence that oil has a consistent influence on the duration of conflicts; the case of Colombia may be an important exception (Dunning & Wirpsa, 2002). But there may be an indirect connection: oil may increase the hazard of a secessionist war, and Fearon (2004) finds that secessionist wars tend to last much longer than other types of internal conflicts.

geographically concentrated and requires little or no foreign investment – such as alluvial diamonds – locals may have an incentive to back a local warlord instead of fighting for outright independence.

Ross (2003a) adds a further claim, suggesting that resources are more likely to provoke separatist rebellions if they are extracted through a capital-intensive process, which offers fewer benefits to local, unskilled workers and more benefits to the state and large extraction firms. Resources that can be extracted through labor-intensive methods – such as alluvial diamonds, timber, and agricultural goods – produce greater benefits to the local economy in poor regions and are therefore less likely to induce secession.

There is less agreement over why oil might lead to non-secessionist civil wars – if indeed it does. Several scholars again argue that the economic allure of oil rents is at fault. Le Billon (2001b), Fearon & Laitin (2003), and others suggest that oil wealth may increase the value of controlling the state, hence producing civil wars. Ross (2004a) contends that oil and other mineral wealth may encourage foreign parties to start or support a ‘civil war’ – because mineral wealth either increases the benefits of intervention (e.g. the Liberian leader Charles Taylor’s 1991 support for the Revolutionary United Front in Sierra Leone) or reduces its cost (e.g. the Rwandan government’s ‘self-financing’ incursion into the Democratic Republic of Congo in 1998).

Others suggest that civil war is due to the hardships caused by oil wealth, not the benefits. Switzer (2001), Klare (2001), and others points out that the extraction process itself can lead to community-level grievances, and contend that these may lead to larger violent conflicts. Fearon & Laitin (2003) argue that oil wealth leads to state weakness, which in turn causes civil war. Humphreys (2003) notes that resource-dependent countries are more susceptible to

trade shocks, and suggests that trade shocks may lead to civil war. He also hypothesizes that mineral dependence might reduce a country’s level of internal trade, which in turn could diminish the conflict-alleviating properties of commercial interaction.

Many of these arguments are, at a minimum, underspecified. The process of resource extraction sometimes leads to low-level violence (e.g. in Papua New Guinea, Indonesia, and Ecuador); but Ross (2004a) suggests that these low-level conflicts rarely lead to larger civil wars. Resource rents may increase the desire of nascent rebels to capture the state, but not their ability to do so – or even to initiate a civil war. Rebel groups often face credit constraints: just because the value of victory is high does not mean rebels can raise more money for arms and men.¹⁰ A resource-rich government may also be better able to suppress rebellions; Ross (2001b) shows that both oil dependence and non-fuel mineral dependence tend to increase government spending on the military.

Gemstones, Drugs, Timber, and Conflict

In the case-study literature, and the popular media, civil wars are commonly linked to gemstones, drugs, and timber – what Le Billon (2001b) and others call ‘lootable’ commodities. Between 1990 and 2000, civil wars occurred in five diamond-producing states, three opium-exporting states, three major cannabis-exporting states, and two leading coca-exporting states (Table III). The partial influence of these commodities on civil war is difficult to test, however, owing to a shortage of reliable data. Most evidence thus far suggests that gemstones and narcotics are linked to the duration of conflict, but surprisingly not to the initiation of

¹⁰ Only in exceptional circumstances should this be possible: when rebels can raise funds by selling future rights to war booty, or ‘booty futures’. On the small number of cases where this has occurred, see Ross (2002).

Table III. Gemstone and Drug Producers that had Civil Wars in the 1990s

<i>Country</i>	<i>Gemstones/Drugs</i>
Angola	Diamonds
Democratic Republic of Congo	Diamonds
Liberia	Diamonds
Russia	Diamonds
Sierra Leone	Diamonds
Afghanistan	Opium, cannabis, gems
Burma	Opium, gems
Cambodia	Cannabis, gems
Colombia	Opium, coca
Peru	Coca

conflict. Little research has been done on the role of timber.

Just one quantitative study of diamonds and the onset of conflict has been carried out to date. Humphreys (2003) develops a measure of diamond production and places it in a civil war model based on the work of Fearon & Laitin; he finds no significant relationship.

This finding matches closely the conclusion of the qualitative analysis in Ross (2004a). This study looks at most of the civil wars in the 1990s that occurred in gemstone-producing states – including Afghanistan, Angola, Burma, Cambodia, Democratic Republic of Congo, Liberia, and Sierra Leone – and finds that in either five or six of these seven cases, the gemstone trade appears to be causally unrelated to the initiation of conflict.¹¹ It argues that the lure of gemstone wealth may have motivated rebels in Sierra Leone, and possibly in the Democratic Republic of Congo, but in the other cases gemstones only became salient years after the conflicts began. In most cases, causality ran

¹¹ Sierra Leone was a clear exception; diamonds may have also played a tangential role in the initiation of war in the Democratic Republic of Congo. Russia was the only other diamond-producing country in the 1990s to have a civil war. In this case, too, the civil war (in Chechnya) had no obvious link to the diamond trade.

in the opposite direction: the conflict helped cause the rebel groups to become dependent on gemstone sales, since in countries devastated by war (Afghanistan, Angola, Burma, Cambodia, and Liberia) these were among the few remaining products that rebels could use to raise money.

It also suggests that a similar pattern holds for the production of opium and coca: after examining the four civil wars in the 1990s that occurred in major opium- and coca-exporting states (Afghanistan, Burma, Colombia, and Peru), it concludes that narcotics had little to do with the initiation of these conflicts. In each of these countries, the rebel movements had no role in the drug trade when the war began. It again contends that in several cases (Burma and Colombia) the causal arrow ran in the opposite direction: the civil war led to drug production by creating a region that fell outside the government's control for a series of consecutive growing seasons. In the two other two cases (Afghanistan and Peru), both drug production and civil war seemed to be independently associated with the weakness of the state's jurisdiction in remote rural areas.

Even if gems and drugs are not linked to the initiation of conflict, there is good evidence that they tend to lengthen pre-existing conflicts. Fearon (2004) finds that the availability of contraband resources (generally drugs or gemstones) in a conflict zone tends to lengthen civil wars. He notes that these resources are often found in a special class of separatist conflicts (which he and Laitin dub 'sons of the soil' conflicts) that tend to last much longer than other types of civil wars.

This finding is consistent with a wide array of case studies. Ross (2004a) covers ten civil wars between 1990 and 2000 in states that produced either gemstones, opium, or coca; it finds that these resources lengthened seven of the ten conflicts, principally by allowing the weaker party to raise money and

hence continue fighting. In a study of 16 efforts to implement peace accords between 1987 and 2000, Stedman (2001: 2) found that 'no peace agreement has been successfully implemented where there are valuable, easily marketable commodities such as gems or timber' – implying that lootable goods tend to prolong conflicts.¹² In general, these studies show how the sale of gems or drugs allowed the weaker party to a conflict – usually but not always the rebel group – to finance itself, and hence continue fighting instead of being crushed or forced to the negotiating table. In several cases, lootable resources have also made conflict so profitable that one or more combatants lose their incentive to reach a peace settlement.¹³

Still, the claim that gems and drugs tend to lengthen conflicts cannot be considered settled. Humphreys (2003), employing a unique database on diamond exports, finds that diamonds tend to *shorten* civil wars – although by facilitating military victories, not negotiated settlements. Given the difficulty of assembling accurate data on the diamond trade – and, more importantly, the gemstone trade – this issue would profit from further scrutiny.¹⁴

¹² Other studies that describe how the export of gems and narcotics has lengthened civil wars include Reno's (1998) analysis of conflicts in Sierra Leone, Liberia, and the Democratic Republic of Congo; reports by United Nations Panels of Experts (2000, 2001, 2002) on Sierra Leone and the Democratic Republic of Congo; studies of the conflicts in Cambodia and Angola by Le Billon (2000, 2001a); research on the Peruvian conflict by Palmer (1994); and a study of the Colombian conflict by Reyes (1994).

¹³ Several scholars have argued that alluvial diamonds are more hazardous than kimberlite diamonds. Alluvial diamonds are found near the earth's surface and can be extracted by artisanal miners. Kimberlite diamonds, by contrast, are buried deep in volcanic rock and can only be extracted by large-scale industrial mining. Case studies of countries with valuable alluvial gemstones sometimes link these deposits to state weakness, noting that they commonly lead to corruption, the fragmentation of state authority, and the rise of private predation. See, for example, Reno (1995); Richards (1996); MacGaffey & Bazenguissa-Ganga (2000).

¹⁴ On the paucity of accurate data on the diamond trade, see Smillie (2002).

Although the role of timber has not yet been explored statistically, case studies suggest that timber exports may have influenced the duration (though not the initiation) of three recent civil wars: Cambodia, Liberia, and the Democratic Republic of Congo (Global Witness, 2002). Because this issue has not been explored statistically, we cannot know if these are isolated cases or part of a larger pattern.

Timber had the clearest effect in Cambodia. Between 1989 and 1995, the rebel Khmer Rouge was able to maintain its viability as a military force owing to its sales of both timber and gemstones; when this revenue dropped off after 1995, the Khmer Rouge gradually fell apart, and by 1998 it had collapsed. The sale of timber may have lengthened the conflict by several years (Le Billon, 2000; Brown & Zasloff, 1998).

In the other two civil wars, timber played at most a small role in perpetuating the conflict. In Liberia, rebel forces led by Charles Taylor raised money from the sale of timber, but this was part of Taylor's well-diversified portfolio of booty, which included virtually everything that could be sold.¹⁵ His most egregious misuse of forest resources came after the civil war ended, when he used timber sales to consolidate his regime. In the Democratic Republic of Congo, the Kabila government offered timber concessions to Zimbabwe in exchange for Zimbabwe's military assistance, but it is unclear whether any timber was actually harvested (Global Witness, 2002).

Agricultural Commodities and Conflict

Collier & Hoeffler (2002b) find that a state's dependence on agricultural commodities does not influence its civil war risk. None of the other major studies report tests of the agriculture–civil war relationship; still, the

¹⁵ As noted above, what matters most is whether a rebel group relied disproportionately on any given economic sector.

Collier & Hoeffler study is consistent with many civil war case studies.

Even though most rebellions occur in poor countries, and most poor countries are overwhelmingly agricultural, it seems to be rare for rebel forces to receive a disproportionate fraction of their income from the agricultural sector.¹⁶ In several civil wars – in Liberia, the Democratic Republic of Congo, and Indonesia (Aceh) – rebels have received part of their income from the agricultural sector; but in each case, this was apparently due to rebel fundraising efforts that cut across all sectors of the rural economy (Ellis, 1999; UN Panel of Experts, 2001, 2002; Ross, 2003b). Since most rebel groups operate in rural – and hence, primarily agricultural – regions, we should expect them to raise at least part of their income from taxes on agricultural goods. But there is little evidence so far that agricultural commodities, other than opium and coca, are significantly associated with either the onset or duration of civil wars.

How Different Civil War Databases May Produce Different Results

Why do some of the quantitative studies of civil war disagree over the role of natural resources? One reason may be that they use different datasets. Recent studies have drawn upon four civil war datasets: Collier & Hoeffler (2002a), Fearon & Laitin (2003), Elbadawi & Sambanis (2002), and Gleditsch et al. (2002, also known as the Uppsala dataset).¹⁷ These datasets, in turn, draw on the pioneering ‘Correlates of War’ civil wars dataset compiled by Singer & Small (1994). Since there is no consensus definition of a civil war, and information on civil wars is

generally poor, it is hard to differentiate among these datasets by quality.¹⁸

There are at least three consequential differences among these datasets. First, they use somewhat different criteria for determining when a civil war has occurred. Between 1960 and 1999, Gleditsch et al. observe 111 civil wars, Collier & Hoeffler 78 civil wars, Fearon & Laitin 97 wars, and Elbadawi & Sambanis 108 wars. If these scholars each employ their own coding rules consistently, and if natural resources affect all types of civil wars equally, this should make no difference. But this might not be the case. Imagine, for example, that natural resources tend to have a strong effect on large conflicts but no influence on small ones; and further, that one dataset uses narrow coding rules that classify only large conflicts as ‘civil wars’, while another uses broader rules that also classify both large and small conflagrations as civil wars. In this case, natural resources might be significantly associated with civil wars in the first dataset but not the second, even though both datasets apply their coding rules faithfully and consistently.

Second, different scholars use different strategies for coping with missing data. Of the four studies, only Collier & Hoeffler use listwise deletion, dropping civil wars from their estimations when data is missing on one or more of the variables in their models. The other three use either imputation or interpolation to fill in missing values for the needed variables, so that data-scarce civil wars can still be used in their estimations. Because Collier & Hoeffler use listwise deletion, their regressions can employ no more than two-thirds (52 of 78) of the civil wars in their dataset. Listwise deletion can produce biased inferences if the missing observations are non-random. A glance at the Collier & Hoeffler list of civil wars suggests that the

¹⁶ The Casamance rebellion in Senegal, which received much of its funding from the region’s cashew crop, may be an exception. See Humphreys & Mohamed (2002).

¹⁷ Hegre (2002) employs the Gleditsch et al. (2002) database.

¹⁸ For helpful discussions of the differences among the datasets, see Sambanis (2001) and Gleditsch et al. (2002).

deleted conflicts tend to be less dependent on primary commodity exports than the included conflicts: for their 46 civil wars with complete data on the major variables, the mean primary exports-to-GDP ratio is .167; for the civil wars they drop, it is .118.¹⁹ The deletion of these cases should raise the mean primary exports-to-GDP ratio for the remaining civil wars. If we assume that any non-wars that are dropped are randomly distributed with respect to primary commodities, the result could be a spurious correlation between primary commodity exports and the likelihood of conflict.

Finally, the datasets differ in how they determine when a war has ended. This may produce some slippage between the correlates of war onset and the correlates of war duration. In some resource-dependent countries, such as Afghanistan, Angola, Burma, and the Congo, conflict has fluctuated in intensity over several decades. Some observers might code these conflicts as many civil wars of brief duration; others interpret them as a small number of civil wars of long duration. Those who code these as many brief wars may subsequently find that a variable that is common to these countries is positively correlated with the onset of war (since this handful of countries has produced many war onsets) and negatively correlated with war duration (since all these wars are brief). Yet those who code them as wars of long duration may find the same variable is not significantly correlated with the onset of war (since these countries would be coded as producing only a small number of wars), but positively correlated with the duration of war (since these wars are now long). These coding differences could explain why the databases have widely varying estimates of the number of civil wars for the same periods.

¹⁹ This mean is derived from the 26 dropped observations for which data on primary exports is available. Six other observations were also dropped: Azerbaijan 1990, Bosnia 1990, Georgia 1990, Tajikistan 1990, Yemen PR 1985, and Yugoslavia 1995.

This problem may also help explain why two major research projects have come to divergent conclusions: Collier & Hoeffler find that resources are associated with the onset of civil war but not its duration, while Fearon finds that some resources are linked to the duration of conflict, but Fearon & Laitin find that resources (except for oil) are uncorrelated with civil war onsets.

Some Poorly Understood Issues

Many dimensions of the resource–conflict relationship are still unclear. This article has already highlighted four nagging sources of ambiguity: the problems of endogeneity and misspecification in the resource–conflict correlation; the question of whether oil wealth only triggers separatist conflicts, or all types of conflicts; the question of causal linkages; and possible slippage between conflict onset and conflict duration. Below are some additional questions that, if thoughtfully pursued, could significantly advance our understanding of the resource–conflict relationship.

Why Have Quantitative Studies Produced Varying Results?

The major quantitative studies of civil war have produced different findings about the role of natural resources; these differences were presumably caused by differences in the underlying databases, models of civil war, estimation procedures, and techniques for handling missing data. Reconciling these findings – and identifying the factors that have produced the differences in the findings – would help us identify which of the resource–conflict relationships are truly robust.

Has the Role of Natural Resources Changed Over Time?

It should not be surprising that the resource–conflict question gained broad attention in the late 1990s: many of the

decade's civil wars occurred in countries that depend heavily on oil and mineral exports. But is the resource–conflict association a recent phenomenon?

There are several hints in the qualitative literature that it is. Keen (1998) and others have suggested that the end of the Cold War turned natural resources into an important source of rebel funding; indeed, there is strong evidence that longstanding rebel groups in Angola and Cambodia began to rely on resource-looting after the Cold War's end caused them to lose their superpower funding (Le Billon, 2003b). Several long-running civil wars in mineral-dependent states – like those in Sudan and Aceh, Indonesia – seemed to grow more serious in the 1990s.

If this is true, it should be reflected in the quantitative studies: a dummy variable for the post-Cold War era, or even the decade of the 1990s, should be highly significant when interacted with measures of natural resources. None of the major studies have yet reported any temporal changes in the significance of their resource measures. In fact, Humphreys (2003) reports that in the Fearon & Laitin model, the 'oil exporter' dummy loses significance when observations prior to 1965 are dropped from the estimations – which is the opposite of what we would expect if natural resource exports have grown more salient over time.

What Is the Role of Non-Fuel Minerals?

The link between non-fuel minerals and civil war is ambiguous, in part because mineral wealth has received less scrutiny than oil wealth. While the distinction between oil and non-fuel minerals may seem intellectually trivial, it could have huge policy consequences for mineral firms and mineral-exporting states.

Both Collier & Hoeffler (2002b) and Fearon & Laitin (2003) look at how oil influences the likelihood of civil war, but

they offer no test of non-fuel minerals. Hegre (2002) and de Soysa (2002b) both place non-fuel minerals and oil in a single category, but do not test them separately. As a consequence, we do not know if non-fuel minerals pose the same problems as oil and gas.

Which Dimensions Are Dangerous?

It is not yet clear what specific qualities make natural resources likely to ignite or prolong conflicts. Many have made plausible arguments; none has been carefully tested. It is not obvious, for example, whether resources must be exported to be hazardous. Almost all quantitative research on resources and conflict measures natural resource exports, not natural resource production.²⁰ Is resource production as dangerous as resource exports?

Some scholars suggest that resources are harmful because they produce rents (Torvik, 2002). If true, this should be possible to observe. Different types of resources produce different levels of rents; even the same quantity of the same resource can produce different quantities of rents in different countries, owing to differences in production costs and quality. Testing the impact of rents separately from resource production or exports could illuminate many untested hypotheses about rent-seeking and open up new avenues of research.

Snyder (2003) argues that the key variable is the ruler's ability to control the extraction process: lootable resources only breed disorder, he suggests, when a ruler lacks this control. Other studies have implied that local politics around the mine site – including relations between the extraction firm and local communities – determines whether or not a country's mineral wealth will lead to violence (Switzer, 2001; Swanson, 2002).

²⁰ De Soysa (2002a) and Humphreys (2003) are important exceptions.

These hypotheses have powerful policy implications and should be tested.

Several scholars have suggested that the physical qualities of a resource, and its geographic location, influence the likelihood it will produce conflict; these have not been carefully tested, however. Le Billon (2001b), drawing on Auty (2001), makes two key distinctions among resources: between those that are proximate to a national capital (and hence easier for governments to capture) and those that are distant (and hence easier for rebels to hold); and between 'point source' resources, which are concentrated in a small area (and therefore more easily controlled by a single group) and diffuse resources, which are scattered over a larger area (and hence harder for any single group to capture). These two categories, Le Billon suggests, yield a fourfold typology of conflict: point-source resources near the capital create violent incentives to control the state, and hence produce coup d'états; point-source resources that are far from the capital produce secession movements; diffuse resources near the capital lead to rebellions and rioting; and diffuse resources far from the capital lead to 'warlordism', areas of de facto political autonomy. Auty (2004) largely concurs with Le Billon, and adds that the dangerousness of a resource is correlated with its value-to-weight ratio. Those with higher ratios, like diamonds and drugs, are likely to pose greater hazards than those with low ratios, like agricultural commodities.

Ross (2003a) develops an alternative theory based on whether or not resources are 'lootable' and 'obstructable'. Resources are lootable if they can be easily appropriated by individuals or small groups of unskilled workers. It suggests that lootable resources – such as diamonds and drugs – pose little danger of igniting *separatist* conflicts, since they provide many benefits to the local economy; but they make *non-separatist* conflicts harder to resolve, since they offer

greater marginal benefits to weaker combatants, who might otherwise be forced to surrender, and because they tend to create discipline problems within the armies themselves. It also argues that unlootable resources – like oil, natural gas, and deep-shaft minerals – tend to produce separatist conflicts, since they provide relatively few benefits for the local economy, but that they seldom influence non-separatist conflicts. Finally, it contends that when a resource is easily 'obstructable' – that is, its transportation can be easily blocked by a small number of individuals with relatively inexpensive weapons – it will tend to increase the duration and intensity of conflicts, again by offering the weaker party an advantage.

Each of these typologies is plausible, but speculative. All can and should be tested, either with quantitative or qualitative data.

How Is the Resource–Civil War Issue Linked to the Resource Curse?

The effect of natural resource dependence on conflict may be part of a larger phenomenon: the resource curse. States that depend heavily on the export of oil, gemstones, and minerals tend to suffer from a variety of problems, including:

- slow economic growth (Sachs & Warner, 1995, 1999, 2001; Gylfason, 2001; Leite & Weidmann, 1999; Doppelhofer, Miller & Sala-i-Martin, 2000);
- high poverty rates (Ross, 2003c);
- high corruption levels (Sachs & Warner, 1999; Leite & Weidmann, 1999; Collier & Gunning, 1999; Marshall, 2001; Schloss, 2002); and
- authoritarian governance (Ross, 2001a; Wantchekon & Lam, 1999; and de Soysa, 2002a).

It would be remarkable indeed if these patterns were unrelated to civil conflict. But how? Many studies tie at least one of these

phenomena to the incidence of civil war: slow economic growth (Collier & Hoeffler, 2002a; Elbadawi & Sambanis, 2002), high poverty rates (Collier & Hoeffler, 2002a), regime type (DeNardo, 1985; Muller & Weede, 1990; Hegre et al., 2001), or somewhat obliquely, corruption (Reno, 1995; Fearon & Laitin, 2003; Le Billon, 2003b). There may also be indirect links. Countries with large resource exports tend to tax their population less heavily; Fearon & Laitin (2003) argue that low taxes lead to state weakness, which in turn increases the likelihood of conflict, and Ross (2004b) suggests that low taxes tend to impede democracy. Both Gylfason (2001) and Ross (2001a) find that states with large resource sectors tend to have lower education rates, and Collier & Hoeffler (2002a) contend that low education levels boost the risk of civil war.²¹

All of these studies suggest ways that civil wars in resource-exporting states may be linked to other elements in the resource curse. A comprehensive model that incorporates these disparate findings – and more carefully specifies their relationships – would be an important advance.

What Are the Appropriate Policy Interventions?

There has been much scientific research on how resources influence conflict, but little on what can be done about it. This schism reflects the larger disjuncture between the academic and policy communities on the problem of civil wars (Mack, 2002).

In many ways, the policy world has been ahead of the academic world. The UN Security Council has taken measures against the sale of natural resources by rebel forces in Sierra Leone, Liberia, the DRC, and Angola. A major effort to restrict the trade in 'conflict

diamonds' was launched in May 2000, at a conference in Kimberley, South Africa; the 'Kimberley Process' entails an agreement by the diamond industry to trade only diamonds that can be certified as originating from legitimate sources (Le Billon, 2003a). Scholars have also produced papers that discuss policy options on resources and conflict, including a study by Switzer (2001), reports commissioned by Fafo's 'Economies of Conflict' project, a book authored by Le Billon (2003b) for the International Institute of Strategic Studies, and a book produced by the World Bank (Collier et al., 2003).²² While many of these papers have well-reasoned arguments about what can and should be done to sever the link between commodities and conflict, in general their arguments can and should be strengthened by systematic testing.

Some of these papers have ambiguous or contradictory arguments about the mechanisms that link resources to conflict, which can lead to conflicting policy recommendations. For example, Switzer (2001) suggests that mining causes conflict because it produces grievances over environmental degradation and access to jobs; in this case, the solution might be greater community involvement by mining firms. But if conflicts occur because mining provides extortion opportunities for rebel groups and warlords – as Collier & Hoeffler (2002a) suggest – then the solution might be stricter mine site security and *less* community involvement. Progress in understanding which dimensions of resources are harmful, and what the causal mechanisms are, could therefore give scholars a sounder footing for their recommendations.

Conclusion

Over the last five years there has been a wealth of new scholarship on the relationship

²¹ Stijns (2001), however, finds that resource rents are positively correlated with education rates, perhaps because they generate higher levels of government revenue.

²² The Fafo papers are available at www.fafon.no/piccr/ecocon.htm.

between natural resources and civil war. The weight of the evidence available so far suggests four regularities:

- (1) oil dependence appears to be linked to the initiation of conflict, but not conflict duration. There is some evidence that oil dependence (and possibly mineral dependence) is more strongly associated with separatist conflicts than other types of conflicts.
- (2) Gemstones, opium, coca, and cannabis do not seem to be linked to the initiation of conflict, but they do seem to lengthen pre-existing wars. Timber's role remains untested.
- (3) There is no statistical evidence – and very little case study evidence – that links agricultural commodities to either the initiation or the duration of civil war.
- (4) The claim that primary commodities are associated with the onset of civil war does not appear to be robust.

Research on resources and conflict has developed remarkably fast; almost all of the studies described here have been carried out since the 1998 publication of Collier & Hoeffler's seminal article. Yet events in the policy world have developed even more quickly. If scholars wish to produce research that contributes to better policies, they must think carefully about testing their ideas; sharing data; speaking a common conceptual language; and drawing together the findings of disparate research projects – both qualitative and quantitative – that cast light on the determinants of civil war.

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