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Do natural resources matter for interstate and intrastate armed conflict?

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Abstract

This article reviews the existing theoretical arguments and empirical findings linking renewable and non-renewable natural resources to the onset, intensity, and duration of intrastate as well as interstate armed conflict. Renewable resources are supposedly connected to conflict via scarcity, while non-renewable resources are hypothesized to lead to conflict via resource abundance. Based upon our analysis of these two streams in the literature, it turns out that the empirical support for the resource scarcity argument is rather weak. However, the authors obtain some evidence that resource abundance is likely to be associated with conflict. The article concludes that further research should generate improved data on low-intensity forms of conflict as well as resource scarcity and abundance at subnational and international levels, and use more homogenous empirical designs to analyze these data. Such analyses should pay particular attention to interactive effects and endogeneity issues in the resource–conflict relationship.

Keywords

interstate conflict, intrastate conflict, resource abundance, resource scarcity

Introduction

Do natural resources lead to conflict, even full-scale wars? What types of natural resources are robust predictors for the onset, intensity, and duration of interstate and intrastate armed conflict? This article reviews the existing literature on the resource–conflict nexus in view of these and related questions. While from an empirical lens this literature is based on qualitative comparative and single case studies as well as quantitative research, it theoretically focuses on two causal mechanisms that may relate resources to conflict: resource scarcity for renewable resources and resource abundance in the context of non-renewable resources.

In this article, we follow this structure and start by discussing how the scarcity of renewable resources that tend to have a relatively low market value (e.g. cropland or water) may influence the onset, intensity, and duration of interstate and intrastate conflicts. This literature suggests that by depriving people of their livelihood, resource scarcity leaves them no choice but to fight for survival. However, while early empirical, mainly qualitative studies found a positive relationship between resource

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scarcity and conflict, the quantitative work has been unable to establish such a connection.[1]

We then elaborate on the problems of local abundance of non-renewable resources that tend to have a high market value (e.g. fossil fuels or gold). Studies focusing on this issue have developed several arguments about how non-renewable resources could affect conflict, primarily at the domestic level. For example, resource abundance might increase the value of the state as a target of violence. It could also reduce the opportunity costs for rebellion or increase grievances. Empirically, we find considerable evidence that natural wealth is indeed associated with certain types of conflict.

We review the existing research in each of these areas, and conclude by highlighting and assessing some of the theoretical and empirical problems in existing research and by pointing to avenues for further research.

Renewable resources, scarcity, and conflict: Theoretical arguments

Following a neo-malthusian line of reasoning, several researchers posit that increasing scarcity of and decreasing access to renewable resources raise frustration, which in turn creates grievances against the state, weakens it and civil society, and leads to opportunities for insurrection (e.g. Homer-Dixon, 1994, 1999; Bächler et al., 1996). Homer-Dixon (1999), for instance, identifies three ways[2] in which renewable resources can become scarce, and he asserts that resource scarcity is more likely to provoke internal conflict than interstate war. Kahl (2008: 50f) adds that elites may abuse their power over access to resources in situations of scarcity. By manipulating state policies in their favor, elites can limit access to resources, thus contributing to conflict.

Cornucopians or 'resource optimists' do not share the neo-malthusian view. Although they acknowledge that resource scarcity may put human well-being at risk, cornucopians claim that humans are able to adapt to resource scarcity through market mechanisms, technological innovations, social institutions for resource allocation, or any combination thereof (e.g. Lomborg, 2001). In the same vein, cornucopians criticize neo-malthusian arguments as overly deterministic and ignorant of economic (e.g. growth) and sociopolitical factors (e.g. political institutions) (e.g. Gleditsch, 1998; Theisen, 2008). Resource optimists instead suggest various causal mechanisms in which scarcity is just one of several factors in the overall relationship between natural resources and conflict. Even in instances of acute resource scarcity then, conflict does not appear to be the automatic outcome. And if conflict occurs, resource scarcity is unlikely to be the main cause, which is supported by recent research showing that economic and political factors are more important drivers of conflict than resource scarcity (e.g. Gartzke, 2012; Koubi et al., 2012; Buhaug, 2010).

Renewable resources, scarcity, and conflict: Empirical evidence

Much of the existing empirical work on the resource scarcity–conflict nexus relies on qualitative studies of specific countries or regions (e.g. Homer-Dixon, 1994, 1999; Percival & Homer-Dixon, 1998; Bächler et al., 1996; Kahl, 2008; Brown, 2010). This research identifies various cases in which resource scarcity seems to have contributed to violent conflict, mostly at local or national levels. However, social, economic, and political conditions, which may also affect conflict besides resource scarcity, vary considerably between different types of resources as well as areas of the world. Case studies of specific countries or regions can hardly account for these different conditions, and it is therefore difficult to generalize their results. Hence, we concentrate on the recent large-N research in the remainder of this section, and structure the discussion according to conflict types, that is, interstate vs. intrastate conflict and the kind of resource under study.

First, with regard to interstate conflict, extant quantitative work almost exclusively focuses on one specific type of renewable resource, namely water. Empirical analyses in this context suggest that states tend to cooperate rather than fight over shared water resources (Dinar et al., 2007; Brochmann, 2012) and that institutionalized agreements can reduce dispute risk (Zawahri & Mitchell, 2011; Tir & Stinnett, 2012). The theoretical underpinning of much of this research is that joint democracy and/or international water management institutions facilitate cooperative solutions to water problems even in situations of scarcity. Furthermore, side-payments,

[1] The resource scarcity–conflict nexus also features prominently in the debates on the sociopolitical implications of climate change. Space limitations prevent us from discussing the literature on climate change and conflict in detail. We refer readers to recent reviews by Theisen, Gleditsch & Buhaug (2013), Bernauer, Böhmelt & Koubi (2012), and Scheffran et al. (2012).

[2] Demand-induced scarcity, which is a consequence of population growth and/or increased consumption of resources per capita; supply-induced scarcity, which means reduced availability of a given resource when its degradation occurs faster than its regeneration; and structural scarcity, which is caused by unequal distribution of access to natural resources.

issue linkages, or economic and political ties between countries also prevent interstate conflict over water. While scholars do not fully rule out conflict over scarce water resources, they find that if conflict materializes then it occurs in the form of disputes and political tensions, but not in the form of armed hostilities or even 'water wars' (e.g. Gledisch & Hegre, 2000; Gleditsch et al., 2006; Hensel, Mitchell & Sowers, 2006; Brochmann & Hensel, 2009; Dinar, 2009).

Second, with regard to intrastate conflict, quantitative studies examining the effects of resource scarcity have generated a wide range of empirical findings, which, however, do not allow for a clearcut conclusion. For example, Hauge & Ellingsen (1998) find that land degradation, freshwater scarcity, and deforestation all have positive and significant effects on the incidence of armed conflict (see also Raleigh & Urdal, 2007; Gizelis & Wooden, 2010). Theisen (2008), however, shows – more convincingly than Hauge & Ellingsen (1998) – that only very high levels of land degradation increase civil conflict risk, while water scarcity has no effect at all. In contrast, Hendrix & Glaser (2007) report that land degradation has no impact, whereas more water per capita actually increases the risk of civil conflict in sub-Saharan Africa. Urdal (2005, 2008) finds that a combination of land scarcity and high rates of population growth increases the risk of civil conflict to some extent, and that scarcity of agriculturally productive land is positively correlated with civil conflict when agricultural wages decline. Østby et al. (2011) do not obtain evidence for an effect of land pressure on violence in Indonesian provinces. Similarly, Theisen (2012) does not find that land pressure affects civil conflict in Kenya. Finally, Meier, Bond & Bond (2007) report that increased vegetation rather than scarcity is positively associated with the incidence of organized raids.

In sum, this lack of robust statistical evidence supporting the scarcity argument led Theisen (2008: 810) to conclude that 'scarcity of natural resources has limited explanatory power in terms of civil violence'. We tend to share this assessment and Table I gives an overview of the different studies discussed in the previous paragraphs. As demonstrated there, quantitative research on the link between renewable resources and conflict does not provide robust evidence for the claim that resource scarcity leads to intra- or interstate conflict. Some large-N findings even strongly contradict common findings of earlier qualitative case studies. Essentially, these results point to a more complex relationship between resource scarcity and conflict than most resource scarcity theorists currently envision. By and large, this assessment is in line with Gleditsch (1998) and Theisen (2008) who point to several weaknesses of existing research, namely that it neglects the potential mediating roles of economic and political factors; it does not address issues of endogeneity; it selects on the dependent variable; and it is unclear about the appropriate level of analysis (individual, household, subnational, or national).[3]

Yet another problem is that empirical studies differ with regard to the measurement of conflict, which can be captured at any level (from local to international) in the form of onset, incidence, or intensity; the type of resource scarcity examined; the measurement of resource scarcity as such as well as datasets; country samples; and time periods. While we return to these issues below, it is, however, worth emphasizing already now that – with a view to the saying that 'absence of evidence is not evidence of absence' – we are reluctant to conclude that the neo-malthusian argument on resource scarcity is empirically false, and that, by implication, the cornucopians are right.

Non-renewable resources, abundance, and conflict: Theoretical arguments

Turning to the literature that deals with the abundance of non-renewable resources and inter- and intrastate conflict, note that access to non-renewable resources should in general lead to more economic output. Stylized facts show, however, that resource-rich countries have performed quite differently in this respect. For instance, Norway and Botswana do well economically, while Nigeria and Algeria have performed poorly despite their immense natural wealth. Extant research points to several potential explanations for this heterogeneity of economic outcome (see also van der Ploeg, 2011): while there are suggestions that resource wealth increases economic growth (Brunnschweiler, 2008; Alexeev & Conrad, 2009), there is also evidence that the effect of resource wealth on economic growth depends on the quality of institutions (e.g. Mehlum, Moene & Torvik, 2006; Robinson, Torvik & Verdier, 2006; Boschini, Pettersson & Roine, 2007; Bhattacharyya & Hodler, 2010; see also Andersen & Aslaksen, 2008). In particular, it is argued that resource-rich countries have dysfunctional political and economic institutions (Ross, 2001; Jensen & Wantchekon, 2004; Acemoglu & Robinson,

[3] This is important because scarcity does not usually affect an entire country in the same way.

Table I. Resource scarcity

Author(s)	*Dependent variable(s)*	*Independent variable(s)*	*Sample*	*Estimation*	*Central finding(s)*
Hauge & Ellingsen (1998)	Incidence and intensity (number of battle related deaths relative to population) of civil war (1,000 battle deaths; COW dataset) and incidence of civil conflict (25 battle deaths; Wallensteen & Sollenberg (1997))	Land degradation, freshwater scarcity, and deforestation	Global sample in 1980–92	Logistic regression (incidence), OLS regression (intensity)	Positive and significant effects on the incidence and intensity of armed conflict, especially civil conflict
Urdal (2005)	Civil conflict onset (PRIO/ Uppsala data)	Land scarcity (population density with respect to land that is potentially suitable for food production) and population growth	Global sample in 1950–2000	Logistic regression	Land scarcity combined with high rates of population growth increases risk of civil conflict, but no robust relationship
Hendrix & Glaser (2007)	Civil conflict onset (PRIO/ Uppsala data)	Land degradation, overall ecological suitability for Eurasian agriculture, freshwater resources per capita, rainfall	Sub-Saharan Africa sample in 1981–2002	Logistic regression	No effect of land degradation, no robust effect of ecological suitability, rainfall in previous year decreases and more freshwater increases conflict risk
Meier, Bond & Bond (2007)	Pastoral violence (organized raids from Conflict Early Warning and Response Network (CEWARN) incident reports)	Vegetation (Normalized Vegetation Index (NDVI) quantifies the concentration of green leaf vegetation), precipitation	12 administrative units along the borders of Ethiopia, Kenya, and Uganda, monthly data in January 2004–December 2005	OLS regression	Higher vegetation cover increases the risk of organized raids but not number of deaths or livestock losses
Raleigh & Urdal (2007)	Civil conflict onset (disaggregated Uppsala/PRIO)	Land degradation and water scarcity	Global sample in 1990–2004, grid squares (100 km *100 km) and grid-square-years	Logistic regression	Both land degradation and water scarcity increase the risk of civil conflict
Theisen (2008)	Civil conflict onset (PRIO/ Uppsala data)	Land degradation, water scarcity (water per capita and drought)	Global sample in 1979–2001	Logistic regression	No effect of water scarcity, but high levels of land degradation increase conflict risk

(continued)

Table I. (continued)

Author(s)	*Dependent variable(s)*	*Independent variable(s)*	*Sample*	*Estimation*	*Central finding(s)*
Urdal (2008)	Civil conflict onset (PRIO/Uppsala data), count measure of political violent events (State Failure Task Force)	Index of rural per capita availability of productive land, agricultural yield, agricultural wages	Sample of 27 largest Indian states in 1956–2002	Logistic and negative binomial regression	Scarcity of agriculturally productive land is positively correlated with the risk of civil conflict when agricultural wages decline, when the rural population is growing at a high rate, and when the agricultural yield is low
Gizelis & Wooden (2010)	Onset of intrastate or internationalized intrastate conflict with 25 battle-related deaths (Uppsala Conflict Data)	Internally renewable freshwater resources per capita	Sample of 98 countries in 1981–2000	Simultaneous equation model	Water scarcity does not increase the probability of conflict, but water scarcity increases conflict risk if political institutions are bad
Østby et al. (2011)	Lethal episodic and routine violence with more than five deaths (dichotomous variables) (United Nations Support Facility for Indonesian Recovery (UNSFIR))	Land scarcity (region's population size divided by the total annual estimate of agricultural land in hectares)	Sample of 33 Indonesian provinces in 1990–2003	Logistic regression	Land scarcity generally seems to be negatively associated with both types of violence, and scarcity is significantly associated with a lower risk of episodic violence in some of the models
Theisen (2012)	Collective violence (conflict with at least 25 deaths) and conflictive events (dichotomous variables) (own coding)	Agricultural and cropland land pressure (share of cell with intensive agriculture/cropland divided by population), SPI6, rainfall deviation, temperature	Grid cells in Kenya (0.25° by 0.25° resolution) in 1989–2004	Fixed effects OLS regression and rare events logistic regression	No effect of land scarcity on violence, but previous drier years lead to less conflict

2006; Morrison, 2007; Aslaksen, 2010; Tsui, 2011)[4] and are prone to more rent seeking (Auty, 2001a,b; Torvik, 2002, 2009; Wick & Bulte, 2006; Mehlum, Moene & Torvik, 2006).[5] Resource-wealth countries also appear to experience more civil strife (Collier & Hoeffler, 2004; Fearon, 2005). Problems associated with abundance of non-renewable natural resources have thus been called the 'resource curse' and the 'paradox of plenty' (Karl, 1997).

Several links between resource abundance, dependence, and conflict have been advanced in the literature.[6] For instance, resource wealth could contribute to conflict by creating funding opportunities for rebels (Collier & Hoeffler, 2004, 2005; Collier, Hoeffler & Rohner, 2009). Similarly, natural resource wealth can either turn the state into a more attractive target for rebels because political power is associated with rents from resource extraction (Fearon & Laitin, 2003; Besley & Persson, 2011; Mitchell & Thies, 2012), or it can make separatism financially attractive for resource-rich regions (Collier & Hoeffler, 2005; Ross, 2006; Sorens, 2011).

Moreover, resource abundance or dependence may result in the weakening of state institutions since resource wealth typically relieves governments from establishing a socially intrusive apparatus for levying taxes. This in turn often implies a level of bureaucratic capacity that is too low to manage societal peace (Auty, 2001a,b; Torvik, 2002; Fearon & Laitin, 2003; Snyder & Bhavnani, 2005). Abundance of non-renewable resources has also the potential to make a country more dependent on global commodity markets, which are likely to be volatile. This makes resource-dependent states vulnerable to trade shocks, which in turn may increase the risk of conflict (Humphreys, 2005; Ross, 2006; Dal Bó & Dal Bó, 2011).

Resource abundance and dependence may also aggravate grievances leading to conflict if a particular resource is controlled by only one group (Wick & Bulte, 2006), or if citizens perceive the distribution of resource rents to be unfair (Østby, Nordas & Rød, 2009; Murshed & Gates, 2005; Humphreys, 2005). Similarly, resource extraction might induce conflict if the local population becomes frustrated with negative externalities associated with the extraction process, such as pollution, land expropriation, or in-migration (Ross, 2004a; Humphreys, 2005).

In contrast, some scholars propose the 'rentier state' as a counter-argument, which suggests that governments use revenues from abundant resources to buy off peace through repression (Ross, 2001), patronage (Le Billon, 2003), or large-scale distributive policies (Le Billon, 2001; Basedau & Lay, 2009). Fjelde (2009), for example, argues that oil-rich governments can use political corruption to obtain support from key segments of the society, effectively outspending other entrepreneurs of violence. Consequently, rentier states tend to be politically more stable and less prone to conflict.

Non-renewable resources, abundance, and conflict: Empirical evidence

As noted above, the existing literature offers different and in part competing arguments on whether and how abundance of non-renewable natural resources may lead to conflict. A multitude of empirical studies has tried to identify whether and how natural resources may increase the risk of civil war onset, its duration, or intensity. Somewhat surprisingly, empirical studies on interstate conflict are rare and we return to this issue below.

Collier & Hoeffler (2004) find evidence for the hypothesized link between resource endowments and the risk of civil war. They report that rebellion is more likely to occur in countries with abundant natural resource deposits, and interpret this as evidence for the argument that resource abundance constitutes a financial opportunity for rebels. Subsequent studies have either supported (Ross, 2004a,b) or undermined this conjecture (Fearon, 2005; Humphreys, 2005; Hegre & Sambanis, 2006). In particular, Fearon (2005) and Humphreys (2005) argue more convincingly that their empirical findings provide stronger support for the weak state mechanism rather than the argument on greedy rebels.

Subsequent research also uses more specific measures for non-renewable resources to separate the effects of different resources on conflict risk. Examples include fuel such as oil (e.g. De Soysa & Neumayer, 2007; Aslaksen, 2010; Lujala, 2010), non-fuel minerals such as diamonds (Lujala, Gleditsch & Gilmore, 2005; Østby, Nordås & Rød., 2009), or forest resources (Buhaug & Rød, 2006; Rustad et al., 2007; see also Miodownik & Bhavnani,

[4] Haber & Menaldo (2011) challenge the finding that natural resources, in particular oil, hinder democracy.

[5] While space limitations prevent us from an in-depth analysis, also note theories of the determinants of compromise and its breakdown based on asymmetric information and commitment problems in this context (e.g. Dal Bó & Powell, 2009).

[6] Resource abundance differs from resource dependence. The former means that there is a high per capita production (extraction) of a resource, while the latter means that a large proportion of a given country's income derives from the extraction and export of a non-renewable resource.

2011). Research also examines the effects of natural and geographic characteristics of resources in the form of lootable versus non-lootable resources[7] (Le Billon, 2001; Lujala, Gleditsch & Gilmore, 2005; Lujala, 2009, 2010), physically diffuse and point resources,[8] and resources that are proximate to or distant from national capitals (Le Billon, 2005). These specific measurements of resource type appear useful since lootable, distant, and spatially diffuse resources are more difficult for governments to control (Buhaug & Lujala, 2005; Buhaug & Rød, 2006; Buhaug, Gates & Lujala, 2009). Hence, rebels may face fewer barriers in capturing and controlling such resources. Moreover, given that resources are not distributed uniformly across a country's territory and that a conflict may affect only some parts of a state's territory, recent research divides countries into geographic grid cells to study the resource–conflict nexus. Such disaggregated studies use measures of the location of resources in a conflict zone (e.g. Buhaug & Gates, 2002; Lujala, Rød & Thieme, 2007), the location of a rebellion (e.g. Østby, Nordås & Rød, 2009), and the remoteness of the location (e.g. Buhaug & Lujala, 2005).

The general picture emerging from existing studies shows that the empirical evidence supports a relationship between resource wealth and conflict. However, there is still some debate regarding the type and location of the resource as well as the characteristics of the conflict. With regard to oil, Humphreys (2005) shows that a country's yearly oil production is positively linked to civil war onset. Similarly, Ross (2006) reports that oil and gas rents are robustly related to conflict risk in the post-1970s period. De Soysa & Neumayer (2007) find that energy rents from oil are linked to civil conflict, but not to large-scale civil war, that is, at least 1,000 battle-related deaths. On the other hand, Østby, Nordås & Rød (2009) and Thies (2010) employ dichotomous variables for an oil producer and an oil exporter, and find only weak support for the claim that oil influences the onset of civil conflict. Finally, Brunnschweiler & Bulte (2009) find that resource dependence does not influence civil conflict and that resource abundance is associated with a reduced probability of conflict onset when controlling for endogeneity. However, their measure of 'subsoil assets' is disputed in the literature (see discussion below).

Ultimately, we conclude that there is agreement on the significance of oil. This is supported by Ward, Greenhill & Bakke (2010: 369ff) in their assessment of the predictive power of covariates on civil war onset: although other factors like income or ethnic fractionalization seem to play a more important role in this regard, the variables on oil and commodity dependence substantially increase a model's in-sample or out-of-sample predictive power. For example, the oil variable in Ward, Greenhill & Bakke's (2010: 371) replication of Fearon & Laitin's (2003) work has a higher predictive power than democracy.

It seems, additionally, that the specific location of oil within a country matters for the type of conflict (secessionist vs. governmental conflict) as well as its duration and intensity. For instance, Lujala (2010) finds that oil production increases the risk of conflict onset when such production is located onshore, whereas offshore production does not have any effect. Lujala (2009, 2010) also reports that the location of oil production inside a conflict zone is associated with longer and more intense conflicts. Sorens (2011) finds evidence that a measure of local mineral resource production, which includes oil, is positively related to secessionist and territorial conflict. However, he notes that it is the total value of mineral production that matters and not specific types of minerals. Lujala, Rød & Thieme (2007) show that overlapping conflict and oil areas are associated with longer governmental conflicts, but not with territorial ones.

Turning to the counter-arguments on the resource abundance–conflict nexus, recent studies produced evidence that some of the rentier mechanisms are present in oil-producing states. Fjelde (2009) finds that the interaction of high levels of corruption and appropriable resources (such as oil) reduces the conflict proneness of a country by offsetting the destabilizing effect of resource abundance. According to Collier & Hoeffler (1998, 2004) and, more recently, Basedau & Lay (2009), oil dependence has a U-shaped impact on the risk of civil war with large resource wealth per capita – i.e. abundance – linked to less violence. This finding is in line with the argument that resource wealth can be used to engage in large-scale redistribution and to establish an effective security apparatus. Thies (2010) observes that almost all primary commodities, including oil, tend to strengthen state capacity.

Diamonds, another natural resource, have also received lots of attention in the extant literature. Lujala, Gleditsch

[7] Lootable resources can be extracted and transported relatively easily by small groups of unskilled workers (Ross, 2004b).

[8] Diffuse resources are spread over wide areas and are extracted by a large number of small operators, whereas point resources are concentrated in small areas and are in the hands of a few producers.

& Gilmore (2005) explore the impact of two types of diamonds[9] on conflict. They find that diamonds matter for civil war incidence, but they are unlikely to affect conflict onset. When disaggregated, however, secondary diamond production tends to promote the outbreak of ethnic civil war especially after the end of the Cold War. Similarly, Østby, Nordås & Rød (2009) report that secondary diamond deposits positively affect conflict onset. Ross (2006) also obtains evidence that rents from secondary diamond production are related to separatist civil war, while not affecting conflict duration. Moreover, Humphreys (2005) finds that the volume of diamond production is positively associated with civil war. He also observes that diamond abundance tends to result in shorter wars by facilitating military victories by one side or the other. In contrast, Lujala (2009, 2010; see also Buhaug & Lujala, 2005) finds that secondary diamonds and lootable gemstones in a conflict zone increase both the duration and intensity of conflict, and Bellows & Miguel (2009) report that chiefdoms with diamond mines in Sierra Leone witnessed significantly more attacks and battles.

Table II gives an overview of the different studies discussed. Arguably, these 16 studies look at different dimensions of the abundance issue; however, most of them support some version of the link between resource abundance and conflict. Exceptions are, first, Fearon (2005) who criticizes the use of primary commodity exports divided by GDP as a valid proxy of resource abundance as used in Collier & Hoeffler (2004) and, consequently, the succeeding literature generally refrained from using this measure as a proxy for resource abundance. And second, Brunnschweiler & Bulte (2009) show that, when controlling for endogeneity, natural resources no longer affect civil conflict onset.

However, despite this general agreement, this body of research still suffers from a few shortcomings that should be addressed in the future. First, studies differ in how they measure civil war, either in the form of onset (e.g. Østby, Nordås & Rød, 2009; Lujala, 2010; Basedau & Lay, 2011), duration (e.g. Lujala, 2009), severity (e.g. Sorens, 2011), or recurrence (Rustad & Binningsbø, 2012). While this diversity actually constitutes a strength to the extent that more than one aspect of the resource–conflict nexus is covered, this diversity nevertheless makes comparison, for example between conflict onset and duration, rather difficult. Arguably, these concepts are interrelated, but yet they are different.

Second, existing studies differ with regard to sample coverage both in space and time. While some scholars use global data (Humphreys, 2005; Ross, 2006; Lujala, 2009, 2010), others focus on specific regions (e.g. Østby, Nordås & Rød, 2009) or countries (Bellows & Miguel, 2009). Similarly, the time span differs substantially, with some studies covering 10 to 20 years (Fjelde, 2009; Bellows & Miguel, 2009) while others analyze 40 years or more (Brunnschweiler & Bulte, 2009; Thies, 2010; Sorens, 2011).

Third, the existing work differs with regard to how it measures resource abundance and dependence. Some analyses rely on dichotomous variables indicating whether or not a country (or a region therein) has natural resources such as oil or diamonds (e.g. Snyder & Bhavnani, 2005; Østby, Nordås & Rød, 2009; Sorens, 2011). Other scholars use the export value of natural resources or specific resource types and normalize this with respect to the size of the economy or total exports (Ross, 2004a; Brunnschweiler & Bulte, 2009), or create a dummy variable for countries whose resource exports score above a specific cutoff point (Fearon & Laitin, 2003). Some work uses measures of resource production as a ratio of GDP or population (e.g. Basedau & Lay, 2009; Fjelde, 2009); others use measures pertaining to the total value or rents from fuel and diamond production or reserves (Humphreys, 2005; De Soysa & Neumayer, 2007).

Fourth, data on natural resource wealth used in earlier research were of rather low quality (Humphreys, 2005). This quality has improved in recent years with the development of new datasets on diamond deposits, oil and gas reserve locations, and mine production volumes, sometimes supplemented with more disaggregated spatial data (e.g. Flöter, Lujala & Rød, 2005; Gilmore et al., 2005; Lujala, Rød & Thieme, 2007; De Soysa & Neumayer, 2007; Thieme, Rød & Lujala, 2007; Sorens, 2011; Østby et al., 2011). Consequently, results of earlier studies may differ from those in later studies simply because of changed data quality.

Discussion of potential shortcomings and avenues for further research

We can learn from the existing literature that it is resource abundance rather than scarcity that is linked to conflict. However, the literature also tells us that natural resources seem to be part of a more complex set of

[9] Primary diamonds are extracted from deep-shaft mines and are usually controlled by large firms or governments. Secondary diamonds are found near the surface and are commonly mined by small teams of unskilled workers.

Table II. Resource abundance

Author(s)	*Dependent variable(s)*	*Independent variable(s)*	*Sample*	*Estimation*	*Central finding(s)*
Collier & Hoeffler (2004)	Incidence of civil war (1,000 battle deaths, COW data)	Primary commodity exports divided by GDP and square term	Global sample in 1960–95	Logistic regression	Primary commodity exports increase conflict risk
Fearon (2005)	Incidence of civil war (1,000 battle deaths, COW data)	Primary commodity exports divided by GDP and square term, fuel exports as percentage of total exports	Global sample in 1960–95	Logistic regression	Relationship found by Collier & Hoeffler (2004) not robust: if there is any connection between primary commodity exports and civil conflict, it must be due to fuel exports
Humphreys (2005)	Incidence of civil war (1,000 battle deaths; Fearon & Laitin, 2003) and duration of civil war (Fearon & Laitin, 2003)	Diamond production per capita, oil production, and oil reserves per capita	Global sample in 1960–99	Rare events logistic regression (conflict onset), multinomial logistic regression (duration analysis)	Past oil and diamond production increases conflict risk and natural resources are associated with shorter wars
Lujala, Gleditsch & Gilmore (2005)	Incidence of civil war (1,000 battle deaths; Fearon & Laitin, 2003) and civil conflict onset (PRIO/ Uppsala data)	Diamond deposit, diamond production, and dummy variables for primary and secondary deposit and production	Global sample in 1945–99 and 1946–2002	Logistic regression	Production of secondary diamonds increases the risk of ethnic war, but no other types of war; secondary diamonds are associated with the incidence of civil war, especially in countries divided along ethnic lines, while primary diamonds make ethnic war onset and incidence less likely; impact of diamonds has been much stronger in post-Cold War era
Ross (2006)	Incidence of civil war (Fearon & Laitin, 2003; Sambanis data; PRIO/ Uppsala data), duration of civil war (Fearon, 2004)	Fuel onshore and offshore, rents from fuel minerals (oil, gas, hard coal, and lignite) and rents from non-fuel minerals (all other) per capita, primary and secondary diamond production per capita, contraband	Global sample in 1960–2002 (onset) or 1960–99 (duration)	Rare events logistic regression (conflict onset) and hazard model (duration analysis)	Diamond production robustly related to civil war onset, oil and other minerals tend to foster conflict, only contraband is associated with the duration of conflicts (longer)
De Soysa & Neumayer (2007)	Incidence of civil war (1,000 battle deaths; COW and Fearon & Laitin, 2003) and civil conflict onset (PRIO/Uppsala data)	Major oil exporter, mineral and energy rents (price minus average extraction cost, multiplied by the amount of resource extracted)	Global sample in 1960–99	Logistic regression	Energy rents are linked to small-scale civil conflict, but not to large-scale civil wars

(continued)

Table II. (continued)

Author(s)	*Dependent variable(s)*	*Independent variable(s)*	*Sample*	*Estimation*	*Central finding(s)*
Lujala, Rød & Thieme (2007)	Civil conflict duration split according to territorial and governmental conflicts (PRIO/Uppsala data)	Diamond deposit, diamond production, and dummy variables for primary and secondary deposit and production (DIADATA data by Gilmore et al., 2005)	Global sample in 1946–2001	Weibull survival analysis	Oil and gas located in conflict areas lengthen governmental conflicts, but not territorial conflicts
Basedau & Lay (2009)	Incidence of civil war (1,000 battle deaths; COW data) and civil conflict onset (PRIO/Uppsala data)	Oil production and oil reserves per capita, primary commodity exports divided by GDP and square term, interaction between oil production and commodity exports	Global sample in 1960–95	Logistic regression	Inverted U-shaped relationship with no conflict in highly dependent oil exporters, high resource wealth is associated with smaller risks of conflict onset than is low and medium resource wealth
Bellows & Miguel (2009)	Number of reported attacks and battles within chiefdom	Number of diamond mines in chiefdom	152 chiefdoms in Sierra Leone in 1991–2002	OLS regression	Chiefdoms with diamond mines witnessed significantly more attacks and battles
Brunnschweiler & Bulte (2009)	Incidence of civil war (1,000 battle deaths; COW data) and civil conflict onset (25 battle deaths; PRIO/ Uppsala data)	Primary exports divided by GDP, net present value of rents in USD per capita of a country's total natural capital stock disaggregated measures for subsoil assets (fuel and non-fuel minerals) and land	Global sample in 1960–2004	Instrumental variable (IV) probit and panel data IV regression	When controlling for endogeneity, resource dependence no longer influences civil conflict while resource abundance is associated with a reduced probability of conflict onset
Fjelde (2009)	Incidence of civil war (Fearon & Laitin, 2003) and civil conflict onset (PRIO/Uppsala data)	Oil production per capita	Global sample in 1985–99	Rare events logistic regression	Oil production per se increases the risk of conflict, whereas higher levels of corruption dampen the harmful impact of oil on civil war
Lujala (2009)	Combat death data (Lacina & Gleditsch, 2005) combined with civil conflict onset (PRIO/ Uppsala data): total number of combat deaths accumulated during the conflict and average daily death rate over the whole conflict (intensity)	Hydrocarbon (crude oil and natural gas) production: variables for in and outside of conflict zone, dummy for country with production, secondary diamond and other gemstone mining: variable for in-conflict zone, dummy for country with production	Global sample in 1946–2002	OLS regression	Gemstone mining and oil and gas in the conflict zone production increase the severity of conflicts

(continued)

Table II. (continued)

Author(s)	*Dependent variable(s)*	*Independent variable(s)*	*Sample*	*Estimation*	*Central finding(s)*
Østby, Nordas & Rød (2009)	Civil conflict onset (PRIO/Uppsala data)	Existence of diamonds, oil production	354 regions (first-level administrative units) in 22 countries in sub-Saharan Africa for 1986–2004	Logistic regression	Combination of natural resources and relative deprivation regarding household assets increases risk of conflict onset
Lujala (2010)	Civil conflict onset and duration (PRIO/Uppsala data)	Hydrocarbon (crude oil and natural gas) reserves and production: variables for onshore and offshore production and reserves, secondary diamond production	Global sample in 1946–2003	Logistic regression (onset) and Weibull survival analysis (duration)	Oil production increases risk of conflict onset when located onshore, while duration of conflict is doubled when resources are located inside actual conflict zone
Thies (2010)	Incidence of civil war (1,000 battle deaths; Fearon & Laitin, 2003)	Major oil exporter, diamond production per capita and fuel exports as percentage of total exports, oil production per capita, variables for primary and secondary diamond production, mining as percentage of GDP	Global sample in 1960–99	Simultaneous equation model	No robust relationship between primary commodities and civil conflict, only oil exporter dummy may be associated with higher risk of civil war onset, most measures of resource abundance are connected to an increase in state capacity
Sorens (2011)	Civil conflict duration split according to territorial and governmental conflicts (PRIO/Uppsala data)	Total value of mine production of raw metal ores, diamonds, hydrocarbons per capita, secondary diamond deposits per capita	Global sample in 1950–2006	Multinomial logistic regression, rare events logistic regression, probit selection model	Local mineral production leads to less governmental conflict among ethnoregional groups, but to more secessionist or territorial conflict, total value of mineral production matters (not specific types of minerals such as oil or diamonds)

factors that can predispose a state or subnational region to armed conflict, but whose combined effects may not yet be fully understood. In the following, we focus on persistent challenges and shortcomings that are characteristic of the studies discussed.

First, it seems that the causal mechanisms underpinning the resource–conflict relationship are for the most part underspecified and, from an empirical standpoint, inadequately tested. Whether scarcity or abundance of natural resources affects the risk of conflict is likely to depend on intervening factors that make a state more or less vulnerable. One such factor could be the performance of political and economic institutions, since they influence the distribution of, access to, and management of resources (Acemoglou & Robinson, 2006; Robinson, Torvik & Verdier, 2006). Snyder & Bhavnani (2005) were among the first to emphasize that institutional quality is more important than material incentives for rebels. This proposition is supported by Besley & Persson (2011) who show that larger natural resource rents increase the likelihood of civil war unless political institutions are consensual. Similarly, Gizelis & Wooden (2010) find that democratic institutions can effectively alleviate grievances and help societies adapt to resource scarcity (see also Dunning, 2008; Cabrales & Hauk, 2011). Yet, not all institutions are created equal. Institutions that are deficient in terms of enforcement and property rights may even increase the impact of resource abundance on conflict. For instance, conflict is more probable in resource-wealthy countries with less secure property rights and where the enforcement of law is weak (e.g. Grossman 1991, 2001; Hotte, 2005; Garfinkel & Skaperdas, 2007; Skaperdas, 2008). Consequently, future research should focus on the role of institutions in mediating the effect of resource scarcity or abundance on conflict, while taking into account that institutions might be endogenous to resources.

Second, much of the literature adopts a state-centric focus by studying resource scarcity, abundance, and conflict at the country level. Natural resources, however, are not distributed homogeneously across a nation's territory. For example, using aggregated measures for resources, such as oil production as a ratio of GDP or the value of primary commodity exports as a share of GDP, does not allow for an accurate understanding of the role of resources in conflict. On the contrary, such aggregation could oversimplify the meaning of resource scarcity or abundance for conflict. Hence, standard national-level or between-country comparisons are likely to be too general to enable a deep assessment of the roots of conflict. The analysis of disaggregated data that are also able to capture the location and spatial aspects of resources clearly seems to be the most effective approach for addressing this challenge. Moreover, future research should also look at the individual and household levels. After all, individuals are affected by resource scarcity or abundance, and it is they who ultimate decide to participate in a rebellion (Deligiannis, 2012).

Third, another challenge is that resources may be endogenous with respect to armed conflict (Ross, 2006; Lujala, 2009; Brunnschweiler & Bulte, 2009; Koubi et al., 2012; Mitchell & Thies, 2012; van der Ploeg & Rohner, 2012). The majority of empirical studies in fact rely on indicators that are likely to be endogenous to armed conflict as well as other types of human activity, such as economic and political factors (Torvik, 2009; Aslaksen, 2010; van der Ploeg & Poelhekke, 2010).[10] For instance, Lujala (2009) mentions that armed conflict is likely to increase resource dependence, because incumbent leaders have an incentive to increase extraction for financing the military or for personal gains. Similarly, Torvik (2009) argues that natural resource reserve or deposit measures are not exogenous, since countries with good institutions are likely to have explored and found more of their resources. Hence, the effect of natural resources, particularly measures of natural resource reserves, on armed conflict, as estimated in most of the existent studies, may be biased upward in more peaceful countries with good institutions (Ross, 2012). If this applies, the net effect of resources on conflict is actually biased toward zero in studies that rely on measures of reserves (e.g. Brunnschweiler & Bulte, 2009). Future research must deal systematically with such endogeneity issues, regardless of the type of resource in question.

Fourth, the literature primarily focuses on how resources are associated with armed conflict utilizing the UCDP/PRIO Armed Conflict Dataset (Gleditsch et al., 2002) or the Correlates of War data (Singer, 1972). It is unlikely, however, that civil conflict and civil war are the only types of violence – and they may not even be the predominant types – that may be associated with resource scarcity and wealth. Other types of conflictive events include, for example, demonstrations, riots, or communal violence not involving state actors. Moreover, violent conflicts, as measured by existing data on civil

[10] As recent exceptions, note Lei & Michaels (2012) and Cotet & Tsui (2013) who address the endogeneity problem by exploiting randomness in the success of oil explorations.

war, are rare events. Hence, there is a problem of overdetermination, which makes it difficult to statistically isolate and identify potential effects that natural resources may have on conflict, besides the many other factors that also influence the onset, intensity, or duration of civil war. Fortunately, datasets on conflicts other than civil war are currently being developed or have recently been released. The Armed Conflict Location and Event Data (ACLED) provide information on low-intensity conflict events for Africa in 1997–2010 (Raleigh et al., 2010). Similarly, the Social Conflict in Africa Database (SCAD) offers information on low levels of violence in 47 African countries for 1990–2010 (Salehyan et al., 2012). Bernauer et al. (2012) have coded data on water-related conflict and cooperation events in 35 Mediterranean, Sahel, and Middle East countries between 1997 and 2009. These datasets constitute important steps in the right direction.

Fifth, interactive effects, between natural resources and grievances, for example, should be studied more explicitly. For instance, Østby, Nordås & Rød (2009) use spatially disaggregated data for 22 countries in sub-Saharan Africa for 1986–2004. They report that civil conflict is more likely in geographic areas where the presence of natural resources coincides with relative deprivation of the local population. Likewise, Hoelsche, Miklian & Vadlamannati (2012) analyze district-level data on the Maoist conflict in India. They find that conflict is more likely in those places where mining activities coincide with stronger grievances related to socio-economic exclusion of some local group(s). More generally, it seems plausible, but remains to be examined thoroughly, that conflict is more likely in areas where ethnic groups are excluded from state power and resource wealth or scarcity is present.

Finally, our review indicates that research heavily focuses on intrastate conflict. Only few large-N studies examine the role resource scarcity or abundance may play in interstate conflicts and most of the existing work of this nature concentrates on water resources. Perhaps surprisingly, only very few studies on interstate conflict concentrate on the role of other types of natural resources such as oil (e.g. De Soysa, Gartzke & Lie, 2009; Colgan, 2010; Caselli, Morelli & Rohner, 2013), although there is a rich qualitative literature on this subject (Kaldor, Karl & Said, 2007; Klare, 2001; Westing, 1986; for an overview, see e.g. Caselli, Morelli & Rohner, 2013). Among the most recent studies, Acemoglu et al. (2011) develop a dynamic model of resource wars to study the interaction between resources and the incentives for war in the presence of limited commitment. They show that if the demand for a worldwide scarce resource such as oil is inelastic, war incentives increase over time and conflict may become inevitable. Colgan (2010) focuses on how oil influences the policies of producer states and shows that petrostates led by revolutionary leaders launched more militarized interstate disputes than other kinds of states between 1945 and 2001. Ultimately, the nexus of resources and international conflict is a fruitful area for future research.

Concluding remarks

While theoretical arguments linking resource scarcity or abundance with conflict abound, the empirical evidence particularly for resource scarcity is hardly (if ever) given in the literature. On the other hand, our review of the literature suggests that there is some evidence on the association of resource abundance and conflict.

Hence, many empirical studies show that resources *can* play a role in armed conflict, most likely with regard to abundance (see Table II). They also suggest, however, that neither the specific contexts – particularly with regard to scarcity – in which natural resources may affect conflict onset, intensity, and duration, nor the direction of causality are entirely clear. In addition, heterogeneity with respect to conceptualizations and measurement of resource scarcity and abundance, as well as conflict and country samples, or time periods makes it difficult to compare findings across studies. These problems can, in principle, be solved by means of large-scale research efforts that generate improved data on low-intensity forms of conflict as well as resource scarcity and abundance at subnational and international levels, and that use more homogenous empirical designs to analyze these data.

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