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The Geography of Inter-State Resource Wars

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Abstract
We establish a theoretical as well as empirical framework to assess the role of resource endowments and their geographic location for inter-State conflict. The main predictions of the theory are that conflict tends to be more likely when at least one country has natural resources; when the resources in the resource-endowed country are closer to the border; and, in the case where both countries have natural resources, when the resources are located asymmetrically vis-a-vis the border. We test these predictions on a novel dataset featuring oilfield distances from bilateral borders. The empirical analysis shows that the presence and location of oil are significant and quantitatively important predictors of inter-State conflicts after WW2.

Keywords: conflict, natural resources, territorial war, energy economics
JEL Classifications: Q34

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1 Introduction

Natural riches have often been identified as triggers for war in the public debate and in the historical literature.[1] The contemporary consciousness is well aware, of course, of the alleged role of natural resources in the Iran-Iraq war, Iraq's invasion of Kuwait, and the Falklands war. At the moment of writing, militarized tensions involving territorial claims over areas known, or thought, to be mineral-rich exist in the South China Sea, the East China Sea, the border between Sudan and South-Sudan, and other locations. But the historical and political science literatures have identified a potential role for natural resources in dozens of cases of wars and (often militarized) border disputes, such as those between Bolivia and Peru (Chaco War, oil, though subsequently not found), Nigeria and Cameroon (Bakassi peninsula, oil), Ecuador and Peru (Cordillera del Condor, oil and other minerals), Argentina and Uruguay (Rio de la Plata, minerals), Algeria and Morocco (Western Sahara, phosphate and possibly oil), Argentina and Chile (Beagle Channel, fisheries and oil), China and Vietnam (Paracel Islands, oil), Bolivia, Chile, and Peru (War of the Pacific, minerals and sea access).[2]

However, beyond individual case studies there is only very limited systematic formal and empirical analysis of the *causal* role of resources in conflict, and of the underlying mechanisms. This paper aims to begin to fill this gap.

The key idea of the paper is to relate the likelihood of conflict between two countries to the *geographical location* of natural-resource deposits vis-a-vis the two countries' bilateral

[1] E.g. Bakeless, 1921; Wright, 1942; Westing, 1986; Klare 2002; Kaldor, Karl, and Said, 2007; De Soysa, Gartzke, and Lie, 2011; and Acemoglu et al., 2012.

[2] References for these conflicts include: Price (2005) for Nigeria-Cameroon, Franco (1997) for Ecuador and Peru, Kocs (1995), for Argentina and Uruguay and Algeria and Morocco, BBC (2011) for Algeria and Morocco, Anderson (1999) for China and Vietnam, Carter Center (2010) for the War of the Pacific. Other examples of (militarized) border disputes over areas (thought to be) rich in oil and other resources include Guyana-Suriname, Nicaragua-Honduras, Guinea-Gabon, Chad-Libya, Bangladesh-Myanmar, Oman-Saudi Arabia, Algeria-Tunisia, Eritrea-Yemen, Guyana-Venezuela, Congo-Gabon, Equatorial Guinea-Gabon, Greece-Turkey, Colombia-Venezuela, Southern and Northern Sudan (cf. Mandel, 1980; McLaughlin Mitchell and Prins, 1999; Carter Center, 2010).

border. The reasoning is simple: reaching, seizing, and holding on to areas belonging to another country is progressively more difficult and costly the further away these areas are from the border. The further an advancing army has to go, the more opportunities the defender has to stop the advance, the longer and more stretched the supply lines become, the greater the likelihood that the local population will be hostile, etc. Therefore, if countries do indeed engage in military confrontations in order to seize each other's mineral reserves, as hypothesized in the case-study literature, they should be relatively more tempted when these reserves are located near the border. Accordingly, we ask whether countries are more likely to find themselves in conflict with countries with mineral deposits near the border than with countries with minerals far away from the border.

As a preliminary check on the plausibility of this, Figure 1 presents a simple scatterplot which suggests that the geographic location of oil deposits could be related to cross-country conflict. Each point in the graph is a country pair. On the vertical axis we plot the fraction of years that the pair has been in conflict since World War II, while on the horizontal axis we measure the (time average of) the distance to the bilateral border of the closest oil field. (Clearly only country pairs where at least one country has oil fields are included).[3] The graph clearly shows that country pairs with oil near the border appear to engage in conflict more often than country pairs with oil far away from the border [the correlation coefficient is -.11 (p-value: 0.01)].

The crude correlation in Figure 1 could of course be driven by unobserved heterogeneity and omitted variables. For example, it could be that some countries that have oil near the border just happen to be more belligerent, so that country-pairs including such countries spuriously fight more often. Hence, the rest of the paper engages in a more careful, model-based empirical investigation that controls for omitted factors, including country fixed effects, and is sensitive to the issue of border endogeneity.

To see the benefit of focusing on the geographical location of resource deposits, contrast our approach with the (simpler) strategy of asking whether countries are more likely to

[3]Note that for visual convenience we have trimmed both axes, removing the 1% outliers with highest levels on the axes. The data in the figure is described in detail in Section 3.1.

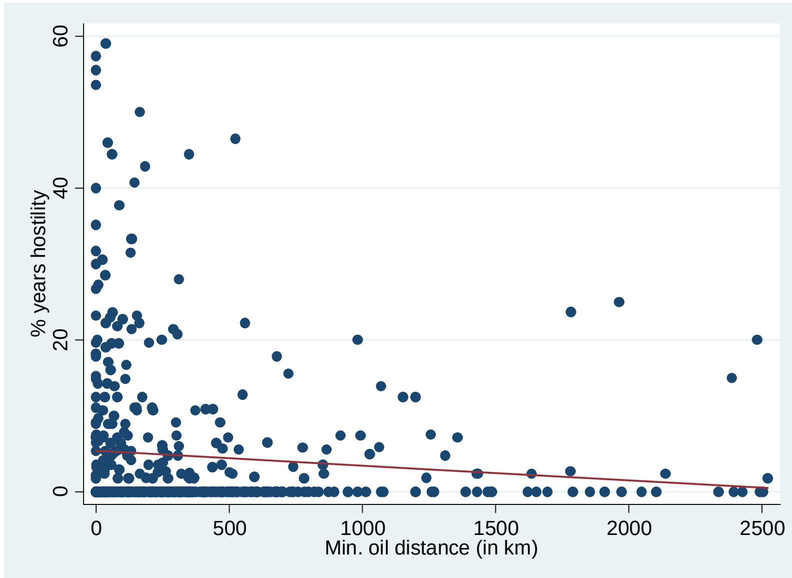

Figure 1: Oil distance from the border and bilateral conflict

find themselves in conflict with neighbors who have natural resources than with neighbors that are resource-less. There are two shortcomings of this strategy. First, it tells us little about the mechanism by which resource abundance affects conflict. For example, it could just be that resource-abundant countries can buy more weapons. Second, the potential for spurious correlation between being resource-rich and other characteristics that may make a country (or a region) more likely to be involved in conflict is non-trivial. For both reasons, while we do look at the effects of resource abundance per se, we think it is crucial to complement the analysis with the geographical information.

To the best of our knowledge, there is no theoretical model that places conflict inside a geographical setting. Given the prominence of the concept of territorial war, this omission may seem surprising. Hence, we begin the paper by developing a simple but novel two-country model with a well-defined geography, where each country controls some portion of this geography, so there is a well-defined notion of a border, and where the two countries can engage in conflict to alter the location of the border. This provides a simple formalization of territorial war.

We use our model of territorial war to generate testable implications on the mapping from the geographical distribution of natural resources to the likelihood of conflict. We assume that each of the two countries may or may not have a resource deposit (henceforth oil, for short). The one(s) that have oil have the oil at a particular distance from the initial bilateral border. If a war leads one of the two countries to capture a portion of territory that includes an oil field, the control over the oil field shifts as well.

Compared to the situation where neither country has oil, we show that the appearance of oil in one country tends to increase the likelihood of conflict. In particular, the heightened incentive of the resource-less country to seek conflict to capture the other's oil, tends to dominate the reduced conflict incentive of the resource-rich country, which fears losing the oil. Similarly, ceteris paribus, the likelihood of conflict increases with the proximity of the oil to the border: as the oil moves towards the border the incentive of the oil-less country to fight increases more than the incentive for the oil-rich one is reduced. Finally, when both countries have oil, conflict is less likely than when only one does, but more likely than when there is no oil at all. More importantly, conditional on both countries having oil, the key geographic determinant of conflict is the oil fields' asymmetric location: the more asymmetrically distributed the oil fields are vis-a-vis the border the more likely it is that two oil-rich countries will enter into conflict. The overall message is that *asymmetries in endowments and location* of natural resources are potentially important determinants of territorial conflict.

While our theory applies to any type of resource endowment, our empirical work focuses on oil, for which we were able to find detailed location information (and which is the resource most commonly conjectured to trigger conflict). We test the model's predictions using a novel dataset which, for each country pair with a common border (or whose coastlines are relative near each other), records the minimum distance of oil wells in each of the two countries from the international border (from the other country's coastline), as well as episodes of conflict between the countries in the pair over the period since World War II.

We find that indeed having oil in one or both countries of a country pair increases the average dispute risk relative to the baseline scenario of no oil. However, this effect depends massively on the geographical location of the oil. When only one country has oil, and this oil is very near the border, the probability of conflict is between three and four times as large as when neither country has oil. In contrast, when the oil is very far from the border, the probability of conflict is not significantly higher than in pairs with no oil. Similarly, when, both countries have oil, the probability of conflict increases very markedly with the asymmetry in the two countries' oil locations relative to the border.

Our results are robust to concerns with endogeneity of the location of the border, because they hold when focusing on subsamples of country pairs where the oil was discovered only after the border was set; in subsamples where the border looks "snaky," and hence likely to follow physical markers such as mountain ridges and rivers; and in subsamples where the distance of the oil is measured as distance to a coastline rather than to a land border. They are also robust to controlling for a large host of country and country-pair characteristics often thought to affect the likelihood of conflict. Since country fixed effects are included, they are also robust to unobservable factors that may make individual countries more prone to engage in conflict.

Most theoretical work on war onset in political science and economics takes the belligerents' motives as given. The objective is rather either to study the determinants of fighting effort (Hirshleifer, 1991, Skaperdas, 1992), or to identify impediments to bargaining to prevent costly fighting (Bueno de Mesquita and Lalman, 1992, Fearon, 1995, 1996, 1997, Powell, 1996, 2006, Jackson and Morelli, 2007, Beviá and Corchón, 2010).[4] Our approach is complementary: we assume that bargaining solutions are not feasible (for any of the reasons already identified in the literature), and study how the presence and location of natural resources affect the motives for war.[5]

The paper is thus closer to other contributions that have focused on factors that enhance the incentives to engage in conflict. On this, the literature so far has emphasized the role of trade (e.g., Polachek, 1980; Skaperdas and Syropoulos, 2001; Martin, Mayer and Thoenig, 2008; Rohner, Thoenig and Zilibotti, 2013), domestic institutions (e.g., Maoz and Russett, 1993; Conconi, Sahuguet, and Zanardi, 2012), development (e.g., Gartzke, 2007; Gartzke and Rohner, 2011), and stocks of weapons (Chassang and Padró i Miquel, 2010). Natural resources have received surprisingly little systematic attention in terms of formal modelling or systematic empirical investigations. Acemoglu et al. (2012) build a dynamic theory of

[4]These authors highlight, respectively, imperfect information, commitment problems, and agency problems as potential sources of bargaining failure. See also Jackson and Morelli (2010) for an updated survey.

[5]Superimposing our model into one of the existing models of bargaining failure would be feasible, but unlikely to add much further insight. For similar reasons our model does not feature endogenous fighting effort.

trade and war between a resource rich and a resource poor country. But their focus is on the interaction between extraction decisions and conflict, and they do not look at geography. De Soysa et al. (2011) cast doubt on the view that oil-rich countries are targeted by oil-poor ones, by pointing out that oil-rich countries are often protected by (oil-importing) superpowers.[6]

Unlike in the case of cross-country conflict, there is a lively theoretical and empirical literature, nicely summarized in van der Ploeg (2011), on the role of natural resources in civil conflict. The upshot of this literature is that natural-resource deposits are often implicated in civil and ethnic conflict. Our paper complements this work by investigating whether the same is true for international conflict.[7]

The remainder of the paper is organized as follows. Section 2 presents a simple model of inter-state conflict. Section 3 carries out the empirical analysis, and Section 4 concludes. Appendix A describes all data in detail, while Appendix B presents additional empirical results.

[6] De Soysa et al. also find that oil-rich countries are more likely to initiate bilateral conflict against oil-poor ones. Colgan (2010) shows that such results may be driven by spurious correlation between being oil rich and having a "revolutionary" government. in Appendix B we look at a similar "directed dyads" approach and find that, in our sample, oil-rich countries are relatively *less* prone to be (classified as) revisionist, attacker, or initiator of conflict, and that *their propensity to attack is decreasing in their oil proximity to the border*. This difference in results could be due to differences in sample (we only look at contiguous country pairs), or methods (we include a full set of country and time fixed effects and a much more extensive list of controls).

[7] The vast majority of the civil-conflict literature focuses on total resource endowments at the country level (see, e.g. Michaels and Lei, 2011, and Cotet and Tsui, 2013, for recent examples and further references), but recently a few contributions have begun exploiting within-country distributional information. For example, Dube and Vargas (2013) find that localities producing oil are more prone to civil violence; Esteban, Morelli and Rohner (2012) find that groups whose ethnic homelands have larger endowments of oil are more prone to being victimized; Morelli and Rohner (2011) find that inter-group conflict is more likely when total resources are more concentrated in one of the ethnic groups' homelands. Harari and La Ferrara (2012) also find that local mineral-resources are associated with more conflict, though their main focus is on climate shocks. None of these studies make use of information on the distance of natural resource deposits from country/region/ethnic homeland borders.

2 The Model

2.1 Assumptions

The world has a linear geography, with space ordered continuously from $-\infty$ to $+\infty$. In this world there are two countries, A and B. Country A initially controls the $[-\infty, 0]$ region of the world, while country B controls $[0, +\infty]$. In other words the initial border is normalized to be the origin. Each country has a resource point (say an oil field) somewhere in the region that it controls. Hence, the geographic coordinates of the two resource points are two points on the real line, one negative and one positive. We call these points G_A and G_B, respectively. These resource points generate resource flows R_A and R_B, respectively. For simplicity the Rs can take only two values, $R_A, R_B \in \{0, \bar{R}\}$, where $\bar{R} > 0$. Without further loss of generality we normalize $\bar{R}$ to be equal to 1.[8]

The two countries play a game with two possible outcomes: war and peace. If a conflict has occurred, there is a new post-conflict boundary, Z. Intuitively, if $Z > 0$ country A has won the war and occupied a segment Z of country B. If $Z < 0$ country B has won. The implicit assumption here is that in a war the winner will appropriate a contiguous region that begins at the initial border.

We make the following assumptions on the distribution of Z.

Assumption 1 *Z is a continuous random variable with domain $\mathbb{R}$, density f, cumulative distribution function F, and mean $\bar{Z}$.*

In sum, the innovation of the model is to see war as a random draw of a new border between two countries: this makes the model suitable for the study of territorial wars. Note that the mean $\bar{Z}$ can be interpreted as an index of (expected) relative strength of the two countries. If $\bar{Z} > 0$ a potential war is expected to result in territorial gains for country A (the more so the larger $\bar{Z}$), so country A can be said to be stronger. If $\bar{Z} < 0$ country B

[8]As we discuss in Section 2.3.2 it is easy to generate comparative static predictions with respect to changes in R_A and R_B (and hence, implicitly, with respect to changes in oil prices). But data limitations and identification issues prevent us from testing these predictions. Since we do not pursue empirical predictions with respect to R_A and R_B, we normalize their values to unclutter the exposition.

is stronger. Needless to say, since Z is defined on $\mathbb{R}$ it is possible for the (expected) weaker country to win.[9]

We assume that each country's objective function is linearly increasing in the value of the natural resources located in the territory it controls (at the end of the game). This means that, *ceteris paribus*, a country would like to maximize the number of oil fields it controls.

Besides the oil, there is an additional cost or benefit from conflict, b_i, $i = A, B$, which is a catch-all term for all the other considerations that affect a country's decision to go to war. We treat b_i as a random variable, to reflect that conflict is often triggered by political shocks (domestic or international) that change the cost-benefit analysis of going to war. In particular, we think of b_i as "typically" being negative, reflecting the very high costs that war brings in terms of casualties, destruction, and expense. However, there also is a positive "tail" to its distribution, reflecting the fact that sometimes countries have very compelling ideological or political reasons to fight wars. For example, governments facing a collapse in domestic support have been known to take their countries to war to shore up their position by riding nationalist sentiments. In other cases they have felt compelled (or at least justified) to take action to protect the interests of co-ethnic minorities living on the other side of the border.

We make the following assumption on the distribution of the b_is.

Assumption 2 *b_i, $i = A, B$ is a continuous random variable defined on $\mathbb{R}$, with density h and cumulative distribution function H. Further, $h(b)/h(-b) < H(b)/H(-b)$ for $b > 0$.*

The last statement in the assumption is the important one. It implies that $h(\cdot)$ is single-peaked, and that it peaks at a negative value of b, since, as discussed, most of the time the net non-territorial costs of violent conflicts (deaths and destruction) exceed the

[9] For simplicity, we treat $\bar{Z}$ as an exogenous parameter. The important qualitative results remain unchanged if we endogenize $\bar{Z}$ using a standard contest-success-function approach. However, in order to maintain analytical tractability, strong functional form assumptions are required. The results are available from the authors upon request.

benefits.[10] Note that the assumption also implies $h(b)/h(-b) > H(b)/H(-b)$ for $b < 0$.

For simplicity we have implicitly assumed that the distribution H is the same for both countries, and that the two draws of b_i are independent. We discuss relaxing these assumption below.

This discussion results in the following payoff functions. If the outcome is peace, the payoffs are simply R_A for country A and R_B for country B, as by definition there is no border change (and hence also no change in property rights over the oil fields). Similarly, we have (implicitly) defined b as a net benefit of conflict so the bs do not enter the payoffs in case of peace.

If there has been a war, the payoffs are:

$$\begin{aligned} U_A^C &= R_A I(Z > G_A) + R_B I(Z > G_B) + b_A, \\ U_B^C &= R_A I(Z < G_A) + R_B I(Z < G_B) + b_B, \end{aligned}$$

where U_i^C is the payoff for country i after a conflict, and $I(\cdot)$ is the indicator function. The first two terms in each payoff function are the oil wells controlled after the war. For example, country A has hung on its well if the new border is “to the right” of it, and similarly it has conquered B’s oil if the new border is to the right of it. The last term represents the non-territorial costs or benefits from war. Note that implicitly (and for simplicity) we assume that countries are risk neutral.[11,12]

[10] In principle, not all single-peaked functions that peak at a negative value of b need to satisfy the condition in the proposition. However, the condition will be satisfied in all cases where either h is symmetric, or H is log-concave. The vast majority of commonly-used distributions defined on $\mathbb{R}$ are either symmetric or log-concave (or both).

[11] Our payoff functions implicitly assume that the value of the oil fields is the same in case of war or without. It would be fairly trivial to allow for some losses in the value of the oil in case of conflict. For example we could assume that conquered oil only delivers δR to the conqueror, with $\delta \in (0, 1]$. The statements of our propositions would become slightly messier, but the qualitative predictions would be unchanged.

[12] In order to use our framework to study other aspects of territorial war, it will typically make sense that Z enters directly into the payoff functions, reflecting that countries may care about their territorial size *per se* (which in our model is equivalent to the measure of the real line it controls). For example, controlling more territory provides more agricultural land to exploit, or more people to tax. Indeed in a

The timing and actions of the model are as follows. First, each country i draws a benefit of conflict b_i, $i = A, B$. Then each country decides whether or not to declare war, and does so to maximize expected payoffs. If at least one country declares war, war ensues. In case of war, nature draws the new boundary, Z. Then payoffs are collected.

2.2 Analysis

It is convenient to focus the analysis on the probability that peace is the outcome. This requires both countries to prefer peace (conditional on their draw of b), which occurs if $E(U_A^C) \leq R_A$ and $E(U_B^C) \leq R_B$, and where the expectation is taken after observing b_i. Given assumption 1 these conditions can be rewritten as

$$b_A + R_B\left[1 - F(G_B)\right] \leq R_A F(G_A), \tag{1}$$

$$b_B + R_A F(G_A) \leq R_B\left[1 - F(G_B)\right]. \tag{2}$$

These expressions clearly convey the basic trade-off countries face in deciding whether to initiate a conflict (over and above the trade-offs that are already subsumed in the b_i terms): conflict is an opportunity to seize the other country's oil, but also brings the risk of losing one's own. Crucially, the probabilities of these two events depend on the location of the oil fields. Consider the decision by country A. If its own oil is very far from the border (G_A, and hence $F(G_A)$, is small) then country A is relatively unlikely to lose the oil, which makes it in turn less likely to choose peace. Similarly, if country B's oil is nearer the border (G_B small, so $1 - F(G_B)$ large), the prospects of capturing B's oil improve, and A once again is less likely to opt for peace.

Remark: *The case where $R_A = 0$ ($R_B = 0$) is isomorphic to the case where $G_A \to -\infty$ ($G_B \to \infty$).*

For the purposes of evaluating the likelihood of peace, it makes no difference if one country does not have oil, or its oil is located infinitely far from the border. This observation, which follow directly from inspection of equations (1) and (2), simplifies slightly the

previous version of this paper we added the term $+Z$ ($-Z$) to the expression for U_A^C (U_B^C). However this addition complicates the statements of our results, so we have dropped these terms in the current version to focus on the mechanism we are interested in.

presentation of the results, as it implies that the cases where only one or neither country have oil are limiting cases of the case where both countries have oil.

Thanks to the latest remark, we can denote the probability of peace as $P(G_A, G_B)$, i.e. simply as a function of the location of the oil fields. In particular, with some slight abuse of notation, we denote the probability of peace when only country A has oil (no country has oil) as $P(G_A, \infty)$ ($P(-\infty, \infty)$). Then equations (1) and (2), together with Assumption 2, imply

$$P(G_A, G_B) = H(-x)H(x),$$

where

$$x \equiv -R_A F(G_A) + R_B [1 - F(G_B)] .$$

We then obtain the following predictions:

Proposition 1

(i) $P(G_A, \infty) \leq P(-\infty, \infty)$;

(ii) $\partial P(G_A, \infty)/\partial G_A \leq 0$;

(iii) $P(G_A, G_B) \leq P(-\infty, \infty)$;

(iv) $P(G_A, \infty) \leq P(G_A, G_B)$ *if and only if* $1 - F(G_B) \leq 2F(G_A)$*;*

(v) $\partial P(G_A, G_B)/\partial G_A \leq 0$ *if and only if* $1 - F(G_A) - F(G_B) \leq 0$.

Proof: Parts (i), (iii), and (iv) of the proposition use the fact that the function $H(-x)H(x)$ is symmetric around 0, increasing for $x < 0$ and decreasing for $x > 0$. We also have $\partial x/\partial G_A > 0$, so $\partial P/\partial G < 0$ if $\partial P/\partial x < 0$, or $x > 0$. This translates into the statements in parts (ii) and (v).

The proposition enumerates five testable implications about how the presence and location of oil affects the likelihood of conflict among two countries. Parts (i), (iii), and (iv) compare the likelihood of conflict when neither, only one, or both countries have oil. Parts (ii) and (v) look at how the likelihood varies with the location of the oil. In the rest of the section we discuss what these predictions say and how they come about within the logic of the model.

Part (i) of the proposition establishes that conflict is more likely when one country has oil than when neither country does. Recall that a discovery of oil in one country has opposite effects on each country's incentives to go to war. The country which found the oil becomes less likely to wish to get into a conflict because it has more to lose, while the other country has an additional potential prize from going to war. The proposition says that the latter effect systematically dominates, so the likelihood of conflict goes up.

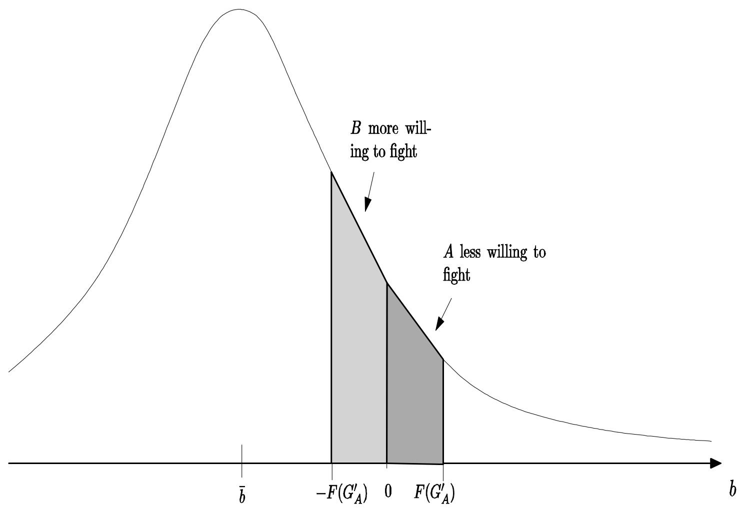

Figure 2: Effect of oil presence and location on incentives to fight

To see why typically the appearance of oil in one country increase the likelihood of conflict, refer then to Figure 2. The bell-shaped curve is the function $h(b)$, assumed to be symmetric in this particular picture. Imagine an initial situation where neither country has oil. In this case country A (B) prefers peace if $b_A \leq 0$ ($b_B \leq 0$), so the area under the h curve and to the left of 0 represents the probability that either country prefers peace. Now suppose that oil appears in country A, at location G'_A. Country A prefers peace if $b_A \leq F(G'_A)$ and country B prefers peace if $b_B \leq -F(G'_A)$. Hence, relative to the no-oil case, country A's desire for peace increases by the shaded area between 0 and $F(G'_A)$, while country B's preference for peace decreases by the shaded area between $-F(G'_A)$ and 0. It is immediately apparent that the latter effect dominates, giving rise to part (i) of the proposition.

Intuitively, the appearance of the oil means that country A is now unwilling to fight even for some positive values of the non-territorial benefit b_A. But positive values of b_A are relatively rare events: most of the time the non-territorial consequences of conflict are losses (deaths, destruction, expenses). Hence, the presence of the oil eliminates cases that are relatively infrequent to start with. On the other hand, the presence of the oil in country A makes B willing to fight even for some negative realizations of b_B. But negative realizations of b are more frequent than positive ones, so overall there are more configurations of (b_A,b_B) that lead to conflict.

Part (ii) says that when oil is only in one country the probability of conflict increases when oil moves closer to the border. To see, this, refer again to Figure 2, and just imagine a further increase in G_A to $G''_A > G'_A$ (not drawn): one can immediately see that the further change has similarly asymmetric effects on the two countries' incentives for conflict. The intuition is along the same lines as the one offered for part (i).

Part (iii) of the proposition tells us that two countries both having oil are more likely to experience a conflict than two countries both not having oil. Oil always makes one country more aggressive, and this is enough to trigger more conflicts. In this sense under our assumptions the mere presence of oil is always a threat to peace.

Part (iv) compares the situation when both countries have oil to the situation when only country A has oil. It says that the discovery of oil in the second country will typically defuse tensions. The intuition is that the second country to find the oil will typically be the country initially responsible for most conflict between the two. When this country finds oil, it becomes less aggressive, as it is concerned with the possibility of losing it. Country A does become more aggressive, but this is typically insufficient to create a more belligerent atmosphere, unless the oil in country A was initially much further away from the border than the new oil discovered in country B – which is the meaning of the conditioning statement in part (iv). Unconditionally, i.e. without knowledge of the locations of the two countries' oil fields, we expect pairs where both countries have oil to engage in less conflict than pairs where only one does.

Finally, part (v) looks at the marginal effect of moving oil towards the border in one country, while leaving the other country's oil location unchanged. To better understand this condition, it is useful to look at the following special case.

Corollary

If $\bar{Z} = 0$ *(the two countries have equal strength), and* f *is symmetric, then* $\partial P(G_A, G_B)/\partial G_A \leq 0$ *if and only if* $|G_A| \leq G_B$.

In other words, when both countries have oil, changes in distance that increase the *asymmetry* of oil locations tend to increase conflict. To see the intuition, we can "recycle" Figure 2. Consider starting from a situation of perfect symmetry, or $-G_A = G_B$. When f

is symmetric, the incentive to fight for the other country's oil exactly cancels out with the deterrent effect from fear of losing one's oil (cf. equations (1) and (2)). Hence, the condition to prefer peace is $b_i \leq 0$, $i = A, B$, much as in the case where neither country has oil. Now consider breaking symmetry by increasing G_A to, say, G'_A. The condition for A changes to $b_A \leq F(G'_A) - F(G_A)$, which is positive, while for B it changes to $b_A \leq -[F(G'_A) - F(G_A)]$. Hence the effects of breaking symmetry can be deduced from Figure 2 by simply replacing $F(G'_A)$ by $[F(G'_A) - F(G_A)]$. The conditioning statement in the proposition generalizes this intuition, as $F(G_A)$ will tend to be larger than $1 - F(G_B)$ when G_A is closer to border than G_B.[13]

The empirical part of the paper tests predictions (i)-(v).

2.3 Discussion

2.3.1 Conflict and border changes

The key modelling choice we have made is to think of international wars as *potentially* border-changing events. The long (and very incomplete) list of examples of territorial wars and militarized border disputes in the Introduction supports this assumption. The International Relations literature provides further systematic evidence. Kocs (1995) has found that between 1945 and 1987 86% of all full-blown international wars were between neighboring states, and that in 72% of wars between contiguous states unresolved disputes over territory in the border area have been crucial drivers. The unstable nature of borders is well recognized. According to Anderson (1999) about a quarter of land borders and some two-thirds of maritime borders are unstable or need to be settled. Tir et al. (1998) identify, following restrictive criteria, 817 territorial changes between 1816 and 1996, many of which are the result of international conflicts. According to Tir et al. (1998) and Tir (2003) 27% of all territorial changes between 1816 and 1996 involve full-blown military conflict, and 47% of territorial transfers involve some level of violence. Weede (1973: 87) concludes that

[13] However in the case where f is not symmetric $|G_A| \leq G_B$ is not sufficient for movements away from symmetry to generate more conflict. The prediction could be overturned if the country whose oil is moving towards the border is much stronger militarily (i.e. if F is very skewed in its favor).

"the history of war and peace is largely identical with the history of territorial changes as results of war."

The data described in the next section supports the existing evidence. In our panel of country pairs 0.4% of all observations feature border changes (corresponding to 90 cases of border change). Yet, conditional on the two countries being in conflict with each other, the incidence of border changes goes up to 7.4%. In other words the probability of a border change increases 19-fold in case of war.[14] In the appendix we reinforce the message from these simple calculations by confirming that conflict remains a significant predictor of border changes after controlling for time and country fixed effects. Indeed we go further and show that the presence and location of oil fields has some predictive power for border changes, despite the very infrequent occurrence of such changes.

Having said that, it is also important to stress that the model emphatically does not predict that *all* conflicts will be associated with border changes. All of our results and calculations allow for the distribution of Z to have a mass point at 0. Indeed, a significant mass point at 0 appears likely in light of the figures above.

It is also important to point out that, strictly speaking, the distribution function f need not be the true distribution of post-conflict border locations Z. f is the distribution used by the decision-makers in the two countries, so the discussion so far essentially assumes that policymakers have correct beliefs about the distribution of outcomes in case of war. Anecdotal observation suggests that overoptimism is often a factor in war and peace decisions, so our guess is that the objective numbers cited above are probably lower bounds on the probabilities assigned by leaders to their chances of moving the border in case of war. For example, it seems likely that Saddam Hussein overstated his chances of permanently shifting the borders of Iraq with Iran (first) and Kuwait (later).

[14] Conversely, while only 6% of observed country pairs are in conflict, 30% of country pairs experiencing a border change are in conflict.

2.3.2 Allowing for Variation in R

With our assumption that $R \in \{0, 1\}$ we have normalized all non-zero oil endowments. It is trivial to relax this assumption to look at the effects of changes in R_A and R_B. In particular, as implied by our Remark above, an increase in R_A has identical qualitative effects of a movement of A's oil towards the border, while an increase in R_B is akin to a move of B's oil towards the border. Our propositions can therefore readily be reinterpreted in terms of changes in quantities. Unfortunately, testing these predictions would require data on oil field-level endowments that we have no access to. Potentially, predictions for changes in the Rs might be tested using variation in oil prices, as an oil price increase is an equiproportional increase in both R_A and R_B. For example, for the case where only one country has oil, our theory would predict that increases in oil prices tend to lead to an increase in the likelihood of conflict. However, ample anecdotal evidence suggests that short-term oil prices are very responsive to conflicts involving oil-producing countries, so it would be very difficult to sort out a credible causal path from oil prices to conflict. Another issue is that what matters for war should be the long-term oil price: it is not clear that current oil prices are good forecasts of long-run ones.

2.3.3 Oil as a Source of Military Strength

In our model the discovery of oil in one country tends to make this country less aggressive, as it fears losing the oil, and the other more aggressive, as it wishes to capture it. We may call this a "greed" effect. However, the discovery of oil may also provide the discoverer with financial resources that allow it to build stronger military capabilities. If oil rich countries are militarily stronger, they might also be more aggressive – as the odds of victory go up. Their neighbors may also be more easily deterred. Hence, there is a potential "strength" effect that goes in the opposite direction to the "greed" effect.[15] To address this potential

[15] The "strength" effect could easily be added to our model by making $\bar{Z}$ an increasing function of R_A and a decreasing function of R_B. However, this would not be enough to fully bring out the ambiguity discussed in the text. For example, it is easy to see that parts (i)-(iii) of our Proposition would still go through exactly unchanged. Hence, it would still be the case that, e.g., discovery of oil in one country unambiguously leads to greater likelihood of conflict. This is because in our model the only territorial

ambiguity, we make three observations, in increasing order of importance.

First, the whole premise that oil should make a country militarily stronger may be somewhat dubious, as a large literature argues that there is a "resource curse" which lowers incomes in oil-rich countries (see Ross, 2012, for a very comprehensive overview).

Second, while the fact of having oil may have some ambiguous implications through the opposing "strength" and "greed" effects, the geographical location of the oil should only matter through greed. Oil will increase resources for fighting irrespective of its location, but the risk of losing it will be more severe if the oil is near the border. Hence, our predictions concerning the effect of oil location on conflict – which are the focus for our most distinctive empirical results – should be unaffected by the strength argument. As mentioned in the Introduction, this is one key reason to focus on the geographic distribution of the oil in the empirical work.

Third, even if we don't model the "strength" effect explicitly, in our empirical work we are able to fully control for it. First, in all our specification we include the GDP of each country in each pair. Since the strength effect operates principally by making a country richer, controlling for GDP should absorb most of this mechanism. Second, lest one may worry that oil revenues are more easily turned into weapons than non-oil revenues, we further control for a measure of "military capabilities." If having oil allows a country to build a more powerful army the index of military capabilities should account for this. Third, just in case oil riches per se make countries more aggressive through channels not picked up by GDP and military capabilities, we also present a battery of robustness checks where we include various measures of each country's aggregate oil endowments.[16]

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benefit of conflict is oil – merely being stronger does not make country A more aggressive. In footnote 12 we have alluded to a previous version of the model where countries have territorial aspirations over and above the control of oil (i.e. Z enters the payoff function). In that model the "strength" effect is present and the empirical predictions are correspondingly a bit more ambiguous.

[16] Note that while we do not have data on oil-field-level oil endowments, we do have data on country-level oil endowments. The former would be required to test the comparative statics of the model with respect to R_A and R_B, i.e. the effect of endowments through the "greed" effect. The latter are sufficient to test for the "strength" effect, which depends only on aggregate endowments matter, and not on their spatial distribution.

To anticipate, not only such robustness checks do not affect our headline results, but also we find very little evidence that overall oil endowments play an independent role in causing conflict. This result casts doubt on the importance of the "strength" effect, consistent with the first of our observations above.

2.3.4 Identical distributions for b_A and b_B

The assumption that the b_A and b_B are drawn from identical distributions could potentially be relaxed. For example, a natural extension would be to assume that b_A (b_B) is positively (negatively) related to $\bar{Z}$, i.e. that the country that expects the largest territorial gains also expects the largest non-territorial ones (or to pay a less devastating non-territorial cost for the conflict). A relatively tractable special case of this is to assume that the country-specific distributions h_A and h_B each satisfy Assumption 2, but differ in their means $\bar{b}_A$ and $\bar{b}_B$, with $0 > \bar{b}_A > \bar{b}_B$ if $\bar{Z} > 0$ and $\bar{b}_A < \bar{b}_B < 0$ otherwise. Under these assumptions numerical simulations using normal distributions suggest that our results are fairly robust. For example, in order to reverse part (ii) of our proposition, it needs to be the case that country A must have a much larger non-territorial benefit from conflict (i.e. $\bar{b}_A >> \bar{b}_B$). The closer is the oil to the border, the larger the required difference in $\bar{b}$s. The intuition is that a much larger $\bar{b}_A$ tends to make country A the relatively more aggressive country (despite being the one having the oil). Hence, as the oil moves towards the border, the deterrent effect on A is the dominant factor, leading to more peaceful relations. Since our result is (numerically) robust to all combinations of $\bar{b}_A$ and $\bar{b}_B$ such that $\bar{b}_B > \bar{b}_A$, as well as many combinations such that $\bar{b}_A > \bar{b}_B$, we conclude that *unconditionally*, i.e. without the possibility to condition on measures of $\bar{b}_B > \bar{b}_A$, we expect the result to hold for the typical country pair.

3 Empirical Implementation

3.1 Data and Empirical Strategy

3.1.1 Sample

We have constructed a panel dataset, where an observation corresponds to a country pair in a given year, e.g. Sudan-Chad in 1990. The country pairs are selected from the country list in the "Correlates of War" (2010, CoW) data set. From the universe of country pairs in CoW, a country pair is included in our data set if it meets a "direct contiguity" criterion, as defined in the "Correlates of War Direct Contiguity Data" (Stinnett et al., 2002). This criterion is that the two countries must either share a land (or river) border, or be separated by no more than 400 miles of water. There are 606 pairs of countries satisfying this criterion.[17] The dataset covers the years 1946-2008.

All variables are described in detail in Appendix A, which also contains Table 7 with summary descriptive statistics. Here we focus on the key dependent variable and the independent variables of interest.

3.1.2 Dependent Variables

Our main dependent variable is a measure of inter-state dispute, from the "Dyadic Militarized Interstate Disputes" data set of Maoz (2005), which is an updated and dyadic (i.e. at the country-pair level) version of the original Militarized Interstate Dispute (MID) dataset (Jones, Bremer, and Singer, 1996). The MID data is the most widely used data on interstate hostilities.[18] Compared to alternative (and less widely used) data sets – such as the UCDP/PRIO Armed Conflict Dataset (Uppsala Conflict Data Program, 2011) – the MID data has the advantage of not only including the very rare full-blown wars between states, but also smaller scale conflicts, and to provide a relatively precise scale of conflict intensity.

In Maoz (2005) interstate disputes are reported on a 0-5 scale. The highest value, 5, is reserved for "sustained combat, involving organized armed forces, resulting in a minimum of 1,000 battle-related combatant fatalities within a twelve month period." This extremely violent form of confrontation, which we will refer to as "War", is very rare: only 0.4% of our observations meet this criterion. The next highest value, 4, is for "Blockade, Occupation of territory, Seizure, Attack, Clash, Declaration of war, or Use of Chemical, Biological, or

[17] Approximately 60% of the country pairs in the sample are separated by a land or river border.

[18] Related papers in economics using this data include for example Martin, Mayer and Thoenig (2008), Besley and Persson (2009), Glick and Taylor (2010), Baliga, Lucca and Sjöström (2011) and Conconi, Sahuguet, and Zanardi (2012).

Radioactive weapons." While still very violent, this type of confrontation, which is labelled "Use of Force," is much more frequent, occurring in as many as 5.2% of our observations. Accordingly, we construct our main dependent variable, which we call "Hostility" by combining all episodes of War and Use of Force.[19] We also present robustness checks using War only,[20] or including disputes receiving a value of 3 in Maoz (2005).[21]

An alternative approach is to investigate data which identifies the aggressor in a bilateral conflict (as in Colgan (2010) and De Soysa et al. (2011)). However, in many cases, identification of the aggressor requires subjective and possibly unreliable judgments. Furthermore, if a country perceives a potential threat, it may choose to attack first, and it is not clear that data focusing on the direction of attack are always able to account for such preemptive strikes.[22] We submit that our approach based on distance of the oil from the border offers a more robust strategy. Having said this, in Appendix B we use data from Maoz (2005) to look at how the presence and the distance of the oil from the border differentially affect the likelihood that the oil rich or the oil poor country is classified as "revisionist", "attacker" or "initiator of conflict". We find robust evidence that oil-rich countries are less likely to be classified any of the above categories, and that this effect becomes stronger as the oil gets closer to the border. There is also fairly strong evidence that countries are more likely to be classified as revisionist towards neighbors that have oil, the more so the closer the oil is to the border.

Another alternative dependent variable potentially consistent with our theory is border

[19] It is standard practice in the empirical literature on international conflict to aggregate over more than one of the Maoz (2005) categories. For example, Martin, Mayer and Thoenig (2008) and Conconi, Sahuguet, and Zanardi (2012) code a country pair to experience conflict when hostility levels 3, 4 or 5 are reached.

[20] The dataset from Maoz (2005) only runs until 2001. As alternative data on full-blown wars is readily available, when we check the results using "War" we update this variable using the UCDP/PRIO Armed Conflict Dataset (Uppsala Conflict Data Program, 2011).

[21] Disputes receive a mark of 3 when they meet the criterion of "Display use of force", which is reserved for "Show of force, Alert, Nuclear alert, Mobilization, Fortify border, Border violation".

[22] See, e.g., Gaubatz (1991), Gowa (1999), Potter (2007), and Conconi, Sahuguet, and Zanardi (2012), for more detailed versions of these and other criticisms of the "direct dyad" approach.

changes. However, recall from our discussion in Section 2.3 that our theory is consistent with a mass point at 0 for the distribution of border changes following a conflict. Furthermore, the theory is consistent with subjective assessments by key decision makers that overstate the likelihood of border changes following a conflict. For both these reasons we think that the occurrence of conflict, rather than the actual occurrence of a border change, better captures the forces at work in our model. In addition, because of these considerations border change is an extremely rare event: only 0.4% of our observations feature a border change. Hence, we expect regressions focussing on border change to have very little power. Having said all this, in Appendix C we do report results using as dependent variable a dummy variable for border change (constructed from Tir et al., 1998), and still find some support for a role for oil and oil location - though the coefficients are, not surprisingly, less consistently significant than using Hostility.

3.1.3 Explanatory Variables of Interest

Our main independent variables are one-period lagged measures of the presence and distance of oil fields in each country in the pair from the bilateral border or from the other country's coastline. To construct these we have combined two sources. The first source is the CShapes dataset of Weidmann, Kuse and Gleditsch (2010), which contains historically accurate geo-referenced borders for every country and year. The dataset accounts for border changes over time, both the ones originating from state creation and split-ups, and those arising from border adjustments. Their border adjustment information is based on Tir et al. (1998).

The second source is a time varying and geo-referenced dataset on the location of oil and gas fields from Lujala, Rod and Thieme (2007, PETRODATA). It includes the geo-coordinates of hydrocarbon reserves and is specifically designed for being used with geographic information systems (GIS). In total, PETRODATA consists of 884 records for onshore and 378 records for offshore fields in 114 countries. Note that PETRODATA includes all oil and gas fields known to exist, including those not yet under production, which is clearly appropriate given that incentives to appropriate will likely be similar for operating and not-yet-operating fields.[23]

Using Geographical Information System (GIS) software, we merge these two data sets so that we can pinpoint each oil field position vis-a-vis a country's borders as well as vis-a-vis the coastline of neighboring countries. Then, for each country pair and for each oil field belonging to one of the two countries, we measure the oil field's minimum distance to the other country's land border, as well as the minimum distance to the coastline of the other country. The oil field's distance to the other country is then the minimum of these two.[24] The minimum oil distance from the other country is the minimum across all oil fields' minimum distances.

On the basis of these data, we have constructed the following five explanatory variables. "One" is a dummy variable taking the value of 1 when only one country in the pair has oil. Similarly, "Both" takes a value of 1 if both countries of the pair have oil. The omitted baseline category hence is the case where none of the countries in the pair has oil. "One x Dist" is the product of the "One" dummy with the distance of the oil from the border. Similarly, "Both x MinDist" is the product of the "Both" dummy and the minimum of the distances of the oil from the border in the two countries. Analogously, "Both x MaxDist" captures the distance from the border in the country whose oil is further from the border. Note that an increase in "Both x MinDist" (holding "Both x MaxDist" constant) is a movement towards symmetry, while an increase in "Both x MaxDist" (holding "Both x

[23]The main data sources of PETRODATA include World Petroleum Assessment by U.S. Geological Survey (USGS, 2000), Digital database on Giant Fields of the World by Earth Sciences and Resources Institute at the University of South Carolina (ESRI-USC, 1996), and World Energy Atlas by Petroleum Economist (Petroleum Economist, 2003).

[24]Needless to say in many cases there is no land border and in many others there is no coastline, so in these cases the distance variable is just the distance from the coastline (border).

MinDist" constant) is a movement away from symmetry.[25]

In our main specifications, all the distance variables are normalized to lie between 0 and 1, to reduce their range, and constructed so that there are "diminishing marginal costs" from geographical distance. In particular, the functional form is $1 - e^{-d}$, where d is the crude geographical distance (in Kms). The idea for the diminishing costs is that conquering the first Km in the enemy's territory may be a more momentous decision than conquering the 601st Km when one has already captured the first 600. In any case we present robustness checks for alternative re-scaling or crude unscaled distances.

3.1.4 Control Variables

We include several control variables. Because our distance measures could potentially be mechanically correlated with country size, and country size could potentially affect conflict independently, in all regressions we control for the maximum and minimum land area in the pair (i.e. if in a country pair the larger country has a land area of x, and the smaller one a land area of y, the maximum land area variable for this pair-year takes the value x, while the minimum area variable takes the value of y). Such minimum-maximum variables are standard in the literature studying country pairs.

Besides land area, which is always included, most specifications also include a set of "baseline controls" suggested by the conflict literature. These are: minimum and maximum population, minimum and maximum GDP per capita, minimum and maximum fighting capabilities, minimum and maximum democracy scores, the number of consecutive years the two countries have been at peace before the current period, bilateral trade / GDP, a dummy for membership in the same defensive alliance, two dummies for civil war incidence in one or both of the countries in the pair, and two dummies for OPEC membership of one

[25] The attentive reader will have noticed that, in constructing our key dependent variables, we have taken the min operator three times: first, for each oilfield in a country, between its distance to the other country's border and the other country's coastline (distance of oilfield to other country); second, for each country, among all its oilfields' distances to the other country (minimum oil distance to other country); and, third, between the two countries' minimum oil distances (MinDist). MaxDist is the max between the two countries' minimum oil distances.

or both countries in the pair.[26] Finally, in important robustness checks we discuss later, we further include several variables on the amounts of oil production and reserves in the two countries. Again, all variables are explained in detail in Appendix A.

3.1.5 Specification and Methods

Our benchmark specification is a linear-probability model that takes the form

$$\begin{aligned} \text{HOSTILITY}_{d,t+1} &= \alpha + \beta \ \text{One}_{dt} + \gamma \left(\text{One x Dist}\right)_{dt} \\ &\quad + \delta \ \text{Both}_{dt} + \eta \left(\text{Both x MinDist}\right)_{dt} + \omega \left(\text{Both x MaxDist}\right)_{dt} \\ &\quad + \mathbf{X}'_{dt}\boldsymbol{\xi} + u_{d,t}, \end{aligned}$$

where d indexes country pairs, t indexes time, and $\mathbf{X}$ is the vector of afore-mentioned controls. We consider alternative functional forms (including probit and logit) in robustness checks.

Crucially, our preferred specification for the error term $u_{d,t}$ includes a full set of country dummies as well as a full set of time dummies. This implies that the key source of identification for, say, the effect of "One" is the relative propensity of a given country to experience conflict with its oil-rich neighbors and with its oil-poor neighbors. We will find a positive estimate of β when the same country has more conflicted relations with its oil-rich neighbors. The identification of the other coefficients is driven by similar within-country comparisons, e.g. is a given country more likely to find itself in conflict with a neighbor whose oil is near the border than with one whose oil is far away from the border.

In all regressions the standard errors are clustered at the country-pair level. In principle,

[26] Population and GDP could affect the likelihood of conflict in myriad ways, e.g. through the tax base; fighting capabilities directly affect the chances of success, so clearly enter the calculation of whether to engage in conflict; democracy scores are included to account for the "democratic peace" phenomenon (Maoz and Russett, 1993); joint membership in alliances or in OPEC may offer countries venues to facilitate the peaceful resolution of conflicts; previous history of conflict is meant to absorb unobserved persistent factors leading to conflict between the two countries; recent history of domestic civil wars captures one factor that may weaken one country and tempt the other to take advantage; bilateral trade has been found to matter for bilateral conflict by Martin, Mayer and Thoenig (2008).

we could go further and include a full set of country-pair dummies. Identification of the oil-related coefficients would then be driven by (i) oil discoveries, which switch the dummies "One" and "Both" from 0 to 1, as well as potentially changing the distance measures (if the newly-discovered field is closer to the border than all the pre-existing fields); and (ii) changes in borders. Unfortunately there are too few (relevant) oil discoveries and border changes in our dataset to provide sufficient power for identification. Accordingly, when we do include a full set of country-pair dummies (and two-way cluster the standard errors at the country level), most coefficients retain the sign of the benchmark results, but lose statistical significance.[27]

3.2 Results

Table 1 displays the baseline regressions for the main dependent variable, Hostility. In the first three columns we use all oil fields to construct our main variables, while in columns 4-6 we only use offshore oil, and in columns 7-9 only onshore oil. In column 1 we show the coefficients on our variables of interest only after controlling for annual time dummies and minimum and maximum land area. In column 2 we add country fixed effects, and in column 3 we further add the full set of baseline controls discussed above. The estimates are reasonably stable across the three specifications, though statistical significance tends to improve as we add country fixed effects and the further controls.

The specification with the full set of country fixed effects and controls (column 3) is our preferred specification. In this specification, both the presence and geographic location of the oil are statistically significant predictors of bilateral conflict. As predicted by the model a country pair with one or both countries having oil is significantly more prone to inter-state disputes than a pair with no oil whatsoever (which is the omitted category). More importantly, when only one country has oil, the likelihood of conflict significantly drops when the oil is further away from the border. Similarly, when both countries have oil, the likelihood of conflict is decreasing in the distance from the border of the oil that is

[27] In particular in our preferred model in Column 3 of Table 1 only the coefficient on "Both" remains significant at conventional confidence levels (results available on request).

closest to the border - a movement towards symmetry. The only prediction of the model for which the support is weak concerns the distance of the furthest oil field: while the sign of the coefficient is positive, as predicted, it is not statistically significant.

Quantitatively, the effect of geographic location is very sizeable. Figure 3 shows the probability of conflict implied by the regression coefficients in Column 3 as a function of the oil's distance from the border (when all the controls are set at their average values). As already noted, the average risk of conflict in our sample is 5.7 percent. This drops to 3.1 percent for country pairs in which neither country has oil. In contrast, when one country in the pair has oil, and this oil is right at the border (Distance = 0), the probability of conflict is almost 4 times as large: 11.6 percent. But this greater likelihood of conflict is very sensitive to distance. Indeed when the oil is located at the maximum theoretical value for our distance measure (Distance = 1) the likelihood of conflict is similar to the likelihood when neither country has oil.[28] The last two bars in the figure look at the case where both countries have oil. In the first instance, asymmetry is maximal: one country has oil right at the border (MinDist=0), the other at the maximum distance (MaxDist=1). The likelihood of conflict is almost three times as large as in the case where neither country has oil, or 8.6 percent. In the second instance, we look at a case of perfect symmetry: both countries have oil at a distance that is one half of the maximum distance (MinDist=MaxDist=0.5). The likelihood of conflict is a much more modest 4.1 percent.[29]

[28] Hence, our model's formal isomorphism between the cases of no oil and "infinitely distant" oil seems to also hold empirically.

[29] In constructing Figure 3 we have used the coefficient on the interaction term between the "oil in two countries" dummy and the maximum distance variable even though it is statistically insignificant. Because it is a very small number, however, using 0 instead has only a minor effect on the quantities in the table.

Table 1: Baseline results for Hostility

	Dependent variable: Hostility								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
One	0.034	0.049*	0.085***	0.087	0.143***	0.136***	0.048	0.058*	0.141***
	(0.032)	(0.027)	(0.030)	(0.054)	(0.048)	(0.037)	(0.042)	(0.033)	(0.044)
One x Dist	-0.050	-0.073***	-0.091***	-0.107*	-0.138***	-0.128***	-0.079*	-0.103***	-0.144***
	(0.035)	(0.026)	(0.027)	(0.056)	(0.048)	(0.036)	(0.044)	(0.033)	(0.041)
Both	0.022	0.034	0.055*	0.023	0.110***	0.079**	0.009	0.020	0.058*
	(0.021)	(0.029)	(0.028)	(0.030)	(0.035)	(0.031)	(0.024)	(0.032)	(0.033)
Both x MinDist	-0.077**	-0.105***	-0.092***	-0.088*	-0.107**	-0.064*	-0.102***	-0.122***	-0.128***
	(0.035)	(0.030)	(0.029)	(0.047)	(0.051)	(0.033)	(0.038)	(0.032)	(0.036)
Both x MaxDist	0.026	0.016	0.002	0.048	0.012	-0.012	0.059	0.047	0.041
	(0.040)	(0.030)	(0.029)	(0.065)	(0.065)	(0.044)	(0.043)	(0.034)	(0.038)
Type Oil	All	All	All	Offshore	Offshore	Offshore	Onshore	Onshore	Onshore
Country FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Add. Controls	No	No	Yes	No	No	Yes	No	No	Yes
Observations	19962	19962	11401	19962	19962	11401	19962	19962	11401
R-squared	0.019	0.145	0.158	0.020	0.145	0.155	0.021	0.146	0.160

Note: The unit of observation is a country pair in a given year. The sample covers all direct contiguous country pairs of the Correlates of War list and the years 1946-2001. OLS regressions with intercept in all columns. Significance levels *** p<0.01, ** p<0.05, * p<0.1. In all columns robust standard errors clustered at the country pair level in parenthesis. All independent variables are taken as first lag. All specifications control for minimum and maximum land areas and annual time dummies (not displayed). In addition, columns 2, 3, 5, 6, 8, and 9 include country fixed effects for each country of the dyad. In addition, columns 3, 6, and 9 include the following set of unreported control variables: Minimum population, maximum population, minimum GDP per capita, maximum GDP per capita, minimum democracy score, maximum democracy score, minimum capabilities, maximum capabilities, dummy for one country having civil war, dummy for both countries having civil war, bilateral trade / GDP, defensive pact, dummy for one country being OPEC member, dummy for both countries being OPEC member, and years since the last hostility in the country pair.

Figure 3: Quantitative effects

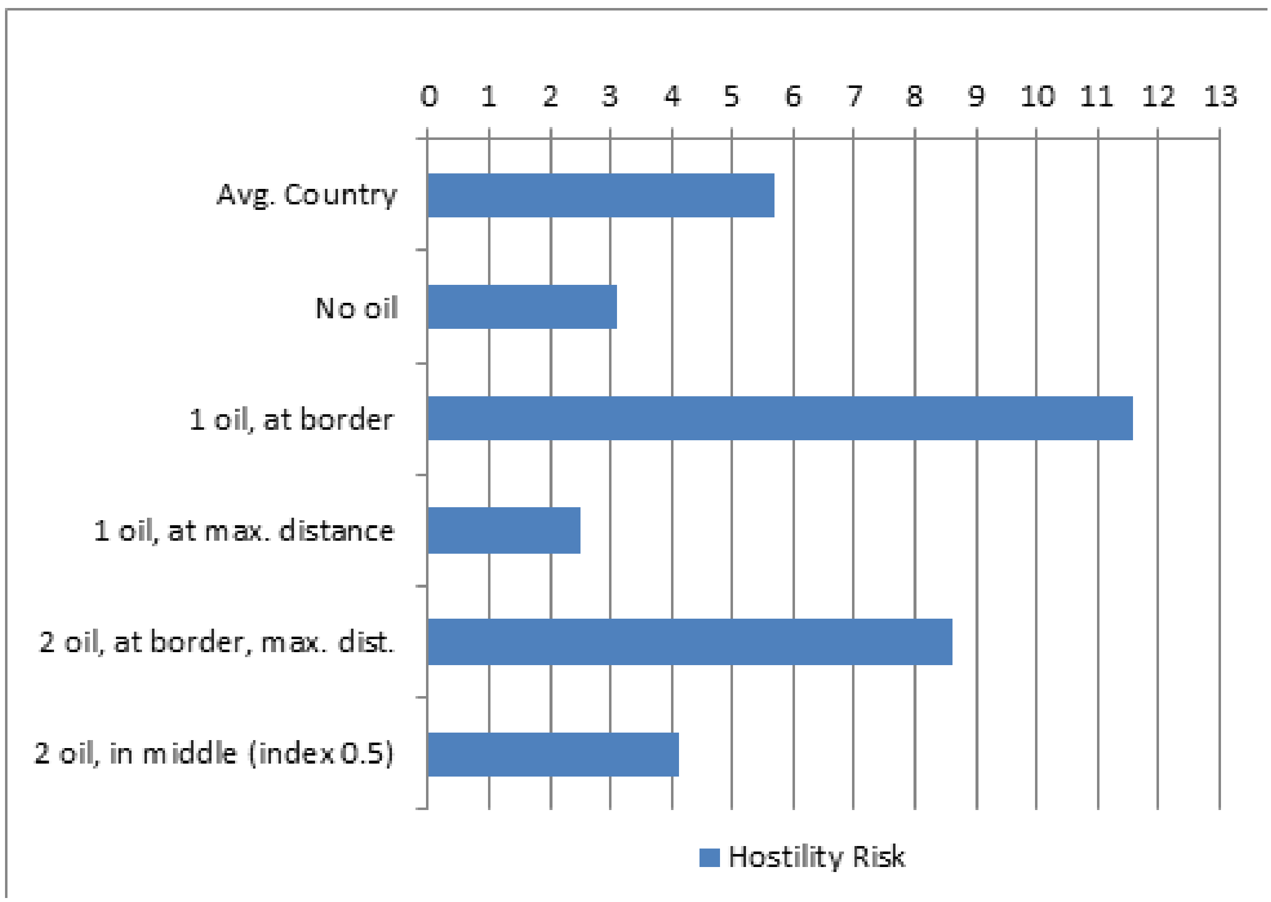

Table 2: Baseline results for War

	Dependent variable: War								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
One	0.005	0.008	0.018***	0.026*	0.029*	0.041***	0.007	0.013	0.021**
	(0.008)	(0.010)	(0.007)	(0.016)	(0.016)	(0.015)	(0.010)	(0.011)	(0.008)
One x Dist	-0.007	-0.010	-0.012**	-0.030*	-0.032**	-0.040***	-0.011	-0.016	-0.018**
	(0.008)	(0.008)	(0.005)	(0.017)	(0.016)	(0.015)	(0.010)	(0.010)	(0.007)
Both	0.004	0.009	0.021**	-0.005**	0.003	0.009	0.005	0.012	0.018**
	(0.006)	(0.009)	(0.009)	(0.002)	(0.007)	(0.007)	(0.006)	(0.009)	(0.009)
Both x MinDist	-0.003	-0.008*	-0.008	0.001	0.006	0.001	-0.004	-0.008**	-0.009
	(0.005)	(0.005)	(0.006)	(0.003)	(0.006)	(0.005)	(0.005)	(0.004)	(0.006)
Both x MaxDist	-0.004	-0.005	-0.007	0.001	-0.015**	-0.008	-0.005	-0.005	-0.007
	(0.007)	(0.006)	(0.008)	(0.002)	(0.008)	(0.007)	(0.007)	(0.006)	(0.009)
Type Oil	All	All	All	Offshore	Offshore	Offshore	Onshore	Onshore	Onshore
Country FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Add. Controls	No	No	Yes	No	No	Yes	No	No	Yes
Observations	23768	23768	11401	23768	23768	11401	23768	23768	11401
R-squared	0.005	0.073	0.101	0.009	0.075	0.107	0.006	0.073	0.102

Note: The unit of observation is a country pair in a given year. The sample covers all direct contiguous country pairs of the Correlates of War list and the years 1946-2008. OLS regressions with intercept in all columns. Significance levels *** p<0.01, ** p<0.05, * p<0.1. In all columns robust standard errors clustered at the country pair level in parenthesis. All independent variables are taken as first lag. All specifications control for minimum and maximum land areas and annual time dummies (not displayed). In addition, columns 2, 3, 5, 6, 8, and 9 include country fixed effects for each country of the dyad. In addition, columns 3, 6, and 9 include the following set of unreported control variables: Minimum population, maximum population, minimum GDP per capita, maximum GDP per capita, minimum democracy score, maximum democracy score, minimum capabilities, maximum capabilities, dummy for one country having civil war, dummy for both countries having civil war, bilateral trade / GDP, defensive pact, dummy for one country being OPEC member, dummy for both countries being OPEC member, and years since the last war in the country pair.

Table 3: Baseline results for the "broad" definition of Hostility (taking a value of 1 for intensity levels 3, 4 and 5)

	Dependent variable: Hostility (coded as 1 for conflict intensity levels 3,4 and 5)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
One	0.036	0.051*	0.089***	0.101*	0.167***	0.180***	0.049	0.054	0.145***
	(0.033)	(0.030)	(0.032)	(0.060)	(0.051)	(0.042)	(0.044)	(0.037)	(0.043)
One x Dist	-0.059*	-0.083***	-0.099***	-0.131**	-0.173***	-0.169***	-0.086*	-0.111***	-0.151***
	(0.035)	(0.027)	(0.028)	(0.063)	(0.051)	(0.040)	(0.045)	(0.035)	(0.041)
Both	0.033	0.037	0.064*	0.020	0.106***	0.097***	0.020	0.019	0.062
	(0.024)	(0.033)	(0.033)	(0.035)	(0.040)	(0.034)	(0.027)	(0.036)	(0.038)
Both x MinDist	-0.092**	-0.131***	-0.113***	-0.112*	-0.139**	-0.087**	-0.127***	-0.152***	-0.161***
	(0.041)	(0.035)	(0.033)	(0.058)	(0.060)	(0.035)	(0.048)	(0.042)	(0.049)
Both x MaxDist	0.025	0.021	0.002	0.071	0.034	0.004	0.069	0.059	0.057
	(0.047)	(0.035)	(0.031)	(0.076)	(0.073)	(0.043)	(0.054)	(0.042)	(0.050)
Type Oil	All	All	All	Offshore	Offshore	Offshore	Onshore	Onshore	Onshore
Country FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Add. Controls	No	No	Yes	No	No	Yes	No	No	Yes
Observations	19962	19962	11401	19962	19962	11401	19962	19962	11401
R-squared	0.024	0.155	0.177	0.025	0.155	0.175	0.027	0.156	0.179

Note: The unit of observation is a country pair in a given year. The sample covers all direct contiguous country pairs of the Correlates of War list and the years 1946-2001. OLS regressions with intercept in all columns. Significance levels *** p<0.01, ** p<0.05, * p<0.1. In all columns robust standard errors clustered at the country year level in parenthesis. All independent variables are taken as first lag. All specifications control for minimum and maximum land areas and annual time dummies (not displayed). In addition, columns 2, 3, 5, 6, 8, and 9 include country fixed effects for each country of the dyad. In addition, columns 3, 6, and 9 include the following set of unreported control variables: Minimum population, maximum population, minimum GDP per capita, maximum GDP per capita, minimum democracy score, maximum democracy score, minimum capabilities, maximum capabilities, dummy for one country having civil war, dummy for both countries having civil war, bilateral trade / GDP, defensive pact, dummy for one country being OPEC member, dummy for both countries being OPEC member, and years since the last hostility in the country year.

The remaining columns in the table investigate whether the results are driven particularly by offshore or onshore oil. In particular, in columns 4-6 we construct our variables of interest using exclusively information on offshore oil fields (so, e.g., if in a country pair all the oil is onshore the pair is treated as a "no oil" pair), and then repeat the three specifications with no controls, only country dummies, and all baseline controls. In columns 7-9 we do the same for onshore oil. It turns out that the coefficients on the variables of interest and patterns of significance are quite similar for offshore and onshore oil (and thus to the baseline case). Hence, if the mechanism driving the results is the one implied by our theory, it seems that having another country's oil near one's coastline is as "tempting" as having it near one's border.

3.2.1 Robustness

Alternative dependent variables Table 2 presents results from the same set of specifications as in Table 1, but using the more stringent definition of conflict, namely "War". Because of the very infrequent occurrence of "War" (sample mean 0.004), these regressions have much less statistical power than those using Hostility, and some of our variables of interest accordingly lose statistical significance. Nevertheless, perhaps surprisingly, the coefficients on the One and Two dummies, as well as the coefficient on Distance, remain significant (when including the full set of controls, and with the exception of Two in the case of offshore oil). Quantitatively, the coefficients are smaller than when using Hostility, though the impact of distance on War is still economically very sizable.[30].

In a similar spirit, Table 3 presents results using a definition of conflict broader than Hostility, namely including conflicts classified as having intensity 3 in the Maoz data set. The results are very similar to the ones using our baseline Hostility measure, with the coefficients of most of our key variables being sizeable and highly significant for our preferred specification of column 3.

[30] For example, while in an average country pair the risk of war is 0.4% per year, this risk goes up to 2.6% –which is more than 6 times higher– in the most dangerous configuration where only one country in the pair has oil and when it is located right at the border.

Alternative distance scales, functional forms, subsamples To further assess the robustness of our results, Table 4 presents variants of our preferred specification of column 3 of Table 1. In column 1 we re-scale the distance of oil fields from the border using a plain natural log function (recall that so far we have measured distance as $1 - e^{-d}$, where d is raw distance in hundreds of Kms), while in column 2 we use raw oil distance. The results are very similar to the ones of the benchmark regression. In columns 3, 4 and 5 we replace our linear probability model with, respectively, logit, probit and rare events logit (ReLogit) estimators.[31] The results are again very similar to our benchmark.[32] To further reduce unobserved heterogeneity, in column 6 we restrict the sample to country pairs where one or both of the countries have oil (hence dropping all country pairs without any oil). The results of the benchmark continue to hold in this restricted sample. In column 7 we show that our results are robust to dropping country pairs including Israel, a country that has been involved in frequent conflict in an oil-rich region of the world (but not necessarily because of oil). Finally, column 8 shows that our results are also robust to dropping country pairs with oil fields that straddle the border (i.e. for which MinDist=0). This indicates that the findings are not driven by hostilities arising from difficulties in managing common-pool resources.

[31] The rare events logit (ReLogit) estimator is from Tomz, King, and Zeng (2003), and adjusts the estimation for the fact that the dependent variable takes much more often a value of 0 than of 1. The ReLogit estimator is not designed for the inclusion of fixed effects and for robust standard errors. Hence, we remove all fixed effects and use standard errors without the robust option, but still clustered at the country-pair level.

[32] Note that the sample size drops in columns 3 and 4 with the logit, resp. probit estimators as countries with no variation in the dependent variable (i.e. countries being in all periods in peace with all their neighbors) drop from the sample when country fixed effects are included.

Table 4: Robustness with respect to Estimator and Sample

	Dependent variable: Hostility							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
One	0.060*	0.052***	2.800***	1.162**	0.783*		0.074**	0.085***
	(0.034)	(0.018)	(1.006)	(0.452)	(0.451)		(0.029)	(0.030)
One x Dist	-0.005**	-0.009***	-3.297***	-1.458***	-0.955**	-0.093***	-0.082***	-0.092***
	(0.002)	(0.002)	(0.851)	(0.389)	(0.473)	(0.028)	(0.026)	(0.027)
Both	0.061*	0.056**	1.018	0.377	0.370	-0.029	0.052*	0.056**
	(0.032)	(0.025)	(0.631)	(0.297)	(0.306)	(0.029)	(0.027)	(0.028)
Both x MinDist	-0.006***	-0.012**	-2.185***	-1.169***	-1.264***	-0.096***	-0.055**	-0.091***
	(0.002)	(0.005)	(0.503)	(0.250)	(0.482)	(0.030)	(0.024)	(0.029)
Both x MaxDist	-0.001	-0.006**	0.206	0.167	0.168	0.003	-0.027	-0.000
	(0.002)	(0.003)	(0.500)	(0.257)	(0.448)	(0.029)	(0.026)	(0.029)
Sample	All	All	All	All	All	Only I1, I2	w/o Israel	w/o Dist. 0
Estimator	OLS	OLS	Logit	Probit	ReLogit	OLS	OLS	OLS
Country FE and TE	Yes	Yes	Yes	Yes	NO	Yes	Yes	Yes
Scale distances	Nat.log.	in 100 km	Standard	Standard	Standard	Standard	Standard	Standard
Observations	11401	11401	8939	8939	11401	9937	11256	11392
R-squared	0.154	0.161	0.318	0.308	0.228	0.170	0.155	0.158

Note: The unit of observation is a country pair in a given year. The sample covers all direct contiguous country pairs of the Correlates of War list and the years 1946-2001. Significance levels *** p<0.01, ** p<0.05, * p<0.1. In all columns robust standard errors clustered at the country pair level in parenthesis. The oil variables are constructed using all oil fields (onshore and offshore). All independent variables are taken as first lag. All specifications control for intercept, minimum and maximum land area, minimum population, maximum population, minimum GDP per capita, maximum GDP per capita, minimum democracy score, maximum democracy score, minimum capabilities, maximum capabilities, dummy for one country having civil war, dummy for both countries having civil war, bilateral trade / GDP, defensive pact, dummy for one country being OPEC member, dummy for both countries being OPEC member, and years since the last hostility in the dyad. All columns, with the exception of the ReLogit regression in column 5, also include country fixed effects and annual time dummies.

Oil endowments In Section 2.3.3 we noted that countries with oil might experience more frequent conflict simply because oil revenues confer resources that can be spent in weaponry and other military capabilities. Our regressions already control for GDP and a measure of military capability, so in principle this effect should indirectly already have been absorbed by these variables. Perhaps more importantly, even if the presence of oil influences military capability, it is hard to see how distance from the border should matter for this particular mechanism. It is precisely this observation that underscores one of the benefits of focusing on the geographic distribution of the oil fields. Having said all that, in order to make sure that our distance variables do not spuriously correlate with oil endowments, in Table 5 we perform further robustness checks with respect to the overall quantitative endowments of oil in the two countries in each pair.[33] Specifically, we control (in turn) for the minimum and maximum of: oil output (column 1), estimated oil reserves (2), and oil output as a share of GDP (3). Further, we control for oil output in the country with oil closest to the border, and in the country with oil further from the border (column 4).

We can make three broad observations from the results of Table 5. First, and most important, the results relating to distance of the oil from the border are very robust, both in magnitude and in statistical significance, to controlling for the overall oil endowments. Second, the One and Two dummies are less systematically significant, especially the latter. While a small part of the reduced significance of the two dummies is due to the inclusion of the quantity variables (which is not surprising as by construction these dummies are correlated with the oil output/endowment measures), most of the effect is due to a drop in the sample size.[34] Third, the oil output/endowment variables are only rarely statistically significant predictors of conflict, possibly because their influence is already captured by the

[33] Recall that we do not have oilfield-level information on endowments, so we cannot test the model's predictions with respect to oilfield size.

[34] In particular, when running the regressions of columns 1 to 3 on the same reduced sample but without including the quantity measures, "One" becomes also insignificant in column 2, and "Both" is also insignificant in all three of the columns. In column 4 "Both" becomes significant at the 10% level when running the regression on the reduced sample but without including the quantity variables.

controls for GDP and for military capabilities. Interestingly, though, when these variables are significant they imply that more asymmetric endowments are associated with greater likelihood of conflict.[35]

3.2.2 Endogenous Borders

In interpreting our regressions so far we have implicitly assumed that borders are located randomly in space - or at least without consideration for the presence and location of the oil. There may be reasons to query this identifying assumption, as the process by which borders come about may be affected by the spatial distribution of oil fields. Indeed in our own model the *ex-post* border is certainly endogenous to the oil's location, since countries enter into (potentially) border-changing conflict with a view of capturing each other's oil. But even *ex-ante* borders, i.e. borders drawn before countries have made conflict-peace decisions, could have been influenced by the location of oil. For example, a country with more bargaining power might have insisted on deviating somewhat from "natural" borders in order to insure oil fields remained on its side. Or, colonial powers might have chosen to draw post-colonial borders so as to make sure that oil fields are located in the country more likely to be friendly to its interests - or perhaps so as to divide the oil fields between the two countries in order to diversify the risk of disruption arising from turbulence in any one country.

In order to address these concerns, we follow three distinct strategies. The first strategy is to focus on observations were we know that the border predates the discovery of oil. The second strategy is to focus on observations in which the border has the physical appearance of a natural border. The third strategy is to focus on observations in which the distance variables are distances of the oil from a coastline, which are necessarily exogenous.

We begin with borders that were drawn/set *before* the oil was discovered. By construction, if the parties do not know the oil is there, they cannot be influenced by its presence when drawing the border or fighting over territory. We implement two versions of this

[35] This is because it is the "min" variable that tends to show up as significant, and with a negative coefficient, so an increase in this variable reduces asymmetry and is associated with less conflict.

Table 5: Robustness with respect to oil quantities

	Dependent variable: Hostility			
	(1)	(2)	(3)	(4)
One	0.103***	0.027	0.098***	0.090**
	(0.038)	(0.080)	(0.038)	(0.036)
One x Dist	-0.122***	-0.107***	-0.117***	-0.102***
	(0.033)	(0.033)	(0.033)	(0.034)
Both	0.048	-0.107	0.043	0.053
	(0.038)	(0.140)	(0.038)	(0.033)
Both x MinDist	-0.077***	-0.088***	-0.079***	-0.072***
	(0.025)	(0.026)	(0.025)	(0.025)
Both x MaxDist	-0.011	0.000	-0.006	-0.014
	(0.028)	(0.028)	(0.027)	(0.028)
Oil Prod.(max)	-0.002			
	(0.001)			
Oil Prod.(min)	-0.006*			
	(0.003)			
Oil Res.(max)		-0.011		
		(0.062)		
Oil Res.(min)		0.066		
		(0.077)		
Oil/GDP(max)			-0.042	
			(0.038)	
Oil/GDP(min)			-0.133**	
			(0.067)	
Oil Prod. (further)				0.001
				(0.001)
Oil Prod. (closer)				-0.001
				(0.001)
Country FE, TE, all controls	Yes	Yes	Yes	Yes
Observations	9331	6206	8991	9814
R-squared	0.167	0.197	0.161	0.161

Note: The unit of observation is a country pair in a given year. The sample covers all direct contiguous country pairs of the Correlates of War list and the years 1946-2001. Significance levels *** p<0.01, ** p<0.05, * p<0.1. In all columns robust standard errors clustered at the country pair level in parenthesis. The oil variables are constructed using all oil fields (onshore and offshore). All independent variables are taken as first lag. OLS with intercept in all columns. All specifications control for minimum land area, maximum land area, minimum population, maximum population, minimum GDP per capita, maximum GDP per capita, minimum democracy score, maximum democracy score, minimum capabilities, maximum capabilities, dummy for one country having civil war, dummy for both countries having civil war, bilateral trade / GDP, defensive pact, dummy for one country being OPEC member, dummy for both countries being OPEC member, and years since the last hostility in the country pair, country fixed effects and annual time dummies.

idea in columns (1)-(2) and, respectively, (3)-(4) of Table 6. In columns 1 and 2 we drop from our sample all observations featuring a border that has changed subsequently to the first oil discovery in either country in the pair. More specifically, we use information from Lujala, Rod and Thieme (2007) to identify the date at which oil was first discovered in either country in the pair, and we use information from Tir et al. (1998) to identify all dates at which borders changed between the two countries. We then drop from the analysis all observations dated after the first border change following the first oil discovery.[36] Because this procedure –as well as all other procedures examined in this table– involves a significant drop in sample size, and because our full set of controls induces further losses due to missing values, we report specifications without (column 1) and with (column 2) controls (and similarly for all other experiments). Whether we include the full set of controls or not, the results of columns 1 and 2 show that our key findings are statistically and economically robust to dropping borders that changed after oil discoveries.

The exercise in columns (1) and (2) is suitable to remove concerns with *ex-post* endogeneity, i.e. with border changes in response to oil discoveries. However, it is still potentially vulnerable to *ex-ante* endogeneity, i.e. with the position of the oil affecting the drawing of the original borders. To address ex-ante endogeneity, in columns (3) and (4) we further drop all country pairs which first came to share a border (for example when one or both countries first came into existence) after oil was first discovered in either of them.[37] Again, despite the substantial drop in sample size, our headline results on

[36] Hence, if t_{oil} is the date at which oil was first discovered in either country, and t_1, t_2, t_3, ... are the *ordered* dates of border changes (i.e. $t_i > t_{i-1}$), we (i) define $\tilde{\imath}$ such that $t_{\tilde{\imath}-1} < t_{oil}$ and $t_{\tilde{\imath}} \geq t_{oil}$, and (ii) drop all observations dated $t > t_{\tilde{\imath}}$. Note that if oil was discovered in a country pair before 1946, and the border experienced one or more changes between the date of discovery and 1946, the country pair is dropped entirely from the analysis. Also note that we do not observe border changes before 1816, so t_1 is the first border change after 1816. However oil was a nearly valueless commodity before 1816 so any border change before that date cannot conceivably have been motivated by oil.

[37] Following on the same notation, denote now t_0 the date at which the border between two countries first came in existence. We now drop all the same observations as in columns (1) and (2) and, in addition, all those satisfying $t_{oil} \leq t_0$. As before, however, all pairs where the border was drawn before 1816 (which is the start date of the Correlates of War data on state creation) are kept in the analysis, on the ground

minimum distance turn out to be robust.

Our second strategy to assess the threat to identification posed by endogenous borders is to drop country pairs whose borders "look artificial." This strategy, inspired by recent work by Alesina, Easterly and Matuszeski (2011), consists on building, for each bilateral land border, a measure of the deviation of the actual border from a relatively smooth arc (see the appendix for a detailed description). We name this variable "border snakiness." The idea is that the smoother the border (the less "snaky" it is), the more likely it is to have been designed artificially, while the more "snaky" it is, the more likely it is to follow natural geographical features like mountain ridges or rivers. Based on this reasoning, in columns (5) and (6) we re-estimate our baseline specifications (with and without the full set of controls) only on the subset of country pairs with above median snakiness. Once again despite the massive loss of sample size the key results appear robust (except for the coefficient on "Both x MinDist," which loses significance in the specification with the full set of controls).

that oil could not have influenced these borders even if its presence was known at the time. To find out the earliest establishment of current borders for all pairs, we have used data from Strang (1991), Correlates of War (2010), CIA (2012) and Encyclopedia Britannica (2012). Note that we use the date of the first drawing of the currently active borders, even if this date is earlier than independence, e.g. when borders were already drawn in colonial times.

Table 6: Controlling for potentially endogenous or artificial borders

	Dependent variable: Hostility							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
One	0.052*	0.097***	0.019	0.055**	0.130***	0.113***	0.072**	0.219*
	(0.029)	(0.035)	(0.027)	(0.025)	(0.037)	(0.036)	(0.031)	(0.122)
One x Dist	-0.079***	-0.112***	-0.042*	-0.073***	-0.127***	-0.101***	-0.061**	-0.210*
	(0.027)	(0.033)	(0.024)	(0.023)	(0.035)	(0.028)	(0.025)	(0.123)
Both	0.045*	0.050*	0.007	0.017	0.164***	0.124**	0.154***	0.108**
	(0.026)	(0.028)	(0.023)	(0.027)	(0.052)	(0.051)	(0.056)	(0.047)
Both x MinDist	-0.100***	-0.050*	-0.083***	-0.069***	-0.135**	-0.071	-0.157**	-0.038
	(0.030)	(0.025)	(0.028)	(0.025)	(0.062)	(0.043)	(0.073)	(0.041)
Both x MaxDist	-0.011	-0.037	0.026	0.007	-0.018	-0.057	0.016	-0.056
	(0.038)	(0.030)	(0.030)	(0.027)	(0.071)	(0.057)	(0.081)	(0.045)
Sample	No border changes (bc) after oil discovery		No bc after oil disc., historical borders older than oil disc. or 1816		Removed 50% with least "snaky" border		Only country pairs without land border	
Additional controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	16504	9572	11771	7290	9907	5481	8168	4423
R-squared	0.151	0.151	0.231	0.147	0.187	0.200	0.172	0.166

Note: The unit of observation is a country pair in a given year. The sample covers all direct contiguous country pairs of the Correlates of War list (unless noted otherwise) and the years 1946-2001. OLS regressions with intercept in all columns. Significance levels *** p<0.01, ** p<0.05, * p<0.1. In all columns robust standard errors clustered at the country pair level in parenthesis. All independent variables are taken as first lag. All specifications use the same unreported controls as the benchmark specification of column (2) of Table 1: Country fixed effects for each country of the country pair, annual time dummies, and minimum and maximum land areas. In addition, the specifications (2), (4), (6) and (8) also include all unreported controls from column (3) of Table 1: Minimum and maximum population, minimum and maximum GDP per capita, minimum and maximum democracy scores, minimum and maximum capabilities, dummy for one country having civil war, dummy for both countries having civil war, bilateral trade / GDP, defensive pact, dummy for one country being OPEC member, dummy for both countries being OPEC member, and years since the last hostility in the country pair.

Our third and final strategy to assuage concerns with endogeneity builds on the fact that coastlines, as opposed to land borders, are (mostly) exogenous to human activity. Recall that our sample contains both country pairs that share a land border and country pairs that do not share a land border but are separated by less than 400 miles of water. In the latter case, by construction, all our oil distance variables are distances of oil fields to the other country's coastline. Because both the oil location, and the position of the coastline are natural phenomena, it is difficult to think of plausible mechanisms that would lead these distances to respond to incentives by the two countries in the pair. Accordingly, in columns (7) and (8) of Table 6 we re-estimate our main specifications (with and without the full set of controls) on the subsample of pairs that do not share a land border.[38] Even with this most restrictive criterion for inclusion in the sample we find that our headlines results largely hold, the only exception being once again the loss of significance on "Both x MinDist" when the full set of controls is included.

4 Conclusions

In this paper we have studied the effect of natural resource endowments, as well as their geographic distribution, on the risk of inter-state conflict. We have built a simple model that predicts the risk of inter-state disputes to be largest in the presence of natural resource *asymmetry*. The most dangerous situations are the ones where only one country of the pair has oil, and this oil is close to the border. When both countries have oil, conflict risk is maximal when the location of oil fields is maximally asymmetric.

We have tested these predictions empirically with a novel geo-referenced dataset de-

[38] Note that by construction the subset for the results in columns (7) and (8) is a strict subsample of the corresponding samples in the other columns of this table. This is because we have treated coastlines as pre-existing any oil discovery (so all country pairs without a land border are retained in columns (1)-(4)) and because we have treated all bodies of water separating countries (other than rivers) as "natural," and hence assigned maximum snakiness to country pairs that do not share a land border (so all country pairs without a land border are included in columns (5)-(6)). Recall that only about 40% of country pairs do not share a land border. It may also be appropriate to note that in this subsample about 50% of the pairs have the closest oil onshore.

signed to capture these geographical asymmetries. Controlling for a battery of determinants of bilateral conflict, as well as country fixed effects and annual time dummies, we find large quantitative effects from asymmetric oil location. For example, country pairs where only one country has oil near the border are as much as four times more likely to engage in conflict than country pairs with no oil, or where the oil is very far from the border, and still much higher than when both countries have oil near the border. These results are robust to several strategies to deal with the potential endogeneity of bilateral borders.

While our theoretical model is novel and has the advantage of simplicity, it also has several limitations. The theoretical framework is static, and is thus unable to capture a host of interesting dynamic effects. This is a priority for future work. Empirically, the priority is to complement our data on oil field location with data on oil field size and reserves. Finally, our theory applies equally, and our empirical methods could be usefully applied to, mineral natural resources other than oil.

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Appendix A: Data

This appendix describes the variables used in section 3, and provides summary descriptive statistics in Table 7. The dependent variables, "Hostility", "War" and "Hostility (broad definition, coded as 1 when intensity is 3 or above)" have been explained in detail in subsection 3.1. We now explain the dependent variables used in Appendices B and C, respectively.

"Revisionist": We use the variable "revstata" ("revstatb") of Maoz (2005) which takes a value of 1 if "State A is revisionist" ("State B is revisionist"), and 0 otherwise. Note that it is possible that in a country pair either both, one or neither of the countries are revisionist. Having constructed dummy variables for "revisionist", we construct our dependent variable for Appendix B as the difference between the dummy for the first-listed

country in the pair (country A) and the dummy for the second-listed country (country B). This variable can be interpreted as a measure of relative aggressiveness of country A. This allows us to run a specification quite similar in spirit to the benchmark model we used for the other dependent variables. In particular, we estimate the impact on the relative aggressiveness of A of: oil in country A, distance of country A's oil to the border, oil in country B, and distance of country B's oil to the border.

"Attacker": We use the variable "sideaa" ("sideab") of Maoz (2005) which takes a value of 1 if "State A is on Side A of MID" ("State B is on Side A of MID"), and 0 otherwise, where "Side A" refers to the initiator side. Having constructed dummy variables for "attacker", we construct our dependent variable for Appendix B as the difference between the dummy for the first-listed country in the pair (country A) and the dummy for the second-listed country (country B). This variable can be interpreted as a measure of relative aggressiveness of country A. This allows us to run a specification quite similar in spirit to the benchmark model we used for the other dependent variables. In particular, we estimate the impact on the relative aggressiveness of A of: oil in country A, distance of country A's oil to the border, oil in country B, and distance of country B's oil to the border.

"Initiator": We use the variable "rolea" ("roleb") of Maoz (2005) and re-code it as 1 when the variable takes a value of 1, i.e. when country A (country B) is coded as "Principal initiator", and 0 otherwise. Having constructed dummy variables for "initiator", we construct our dependent variable for Appendix B as the difference between the dummy for the first-listed country in the pair (country A) and the dummy for the second-listed country (country B). This variable can be interpreted as a measure of relative aggressiveness of country A. This allows us to run a specification quite similar in spirit to the benchmark model we used for the other dependent variables. In particular, we estimate the impact on the relative aggressiveness of A of: oil in country A, distance of country A's oil to the border, oil in country B, and distance of country B's oil to the border.

"Territorial Change": Dummy variable taking a value of 1 if there has been a territorial change in a given pair year. From Tir et al. (1998), version 4.01 obtained from http://www.correlatesofwar.org/.

The explanatory variables One, Both, Dist, MinDist, and MaxDist have also been described in the detail in the main text. The others are as follows.

"Land area": In 1000 Square kilometers. From World Bank (2009).

"*Population":* In Millions. From Heston, Summers, and Aten (2009).

"GDP per Capita": Real Gross Domestic Product per Capita (in 1000), Current Price National Accounts at PPPs. From Heston, Summers, and Aten (2009).

"*Polity Score":* Democracy scores ranging from -10 (strongly autocratic) to +10 (strongly democratic). From Polity IV (2009).

"Capabilities": Capability scores from Correlates of War (2010).

"CW1": Dummy with value of 1 if there is a civil war in one country of the pair, and 0 otherwise. Constructed using data from Uppsala Conflict Data Program (2011).

"CW2": Dummy with value of 1 if there is a civil war in both countries of the pair, and 0 otherwise. Constructed using data from Uppsala Conflict Data Program (2011).

"Bilateral trade /GDP": Sum of total bilateral trade between the two countries of the pair divided by the sum of their total GDPs. Bilateral trade data from Barbieri and Keshk (2012), GDP data from Heston, Summers, and Aten (2009).

"Defensive pact": Dummy taking a value of 1 if the countries of the pair are together in a defense pact, and 0 otherwise. From Correlates of War (2010).

"OPEC1": Dummy with value of 1 if one country in the pair is an OPEC member, and 0 otherwise. From OPEC (2012).

"OPEC2": Dummy with value of 1 if both countries in the pair are OPEC members, and 0 otherwise. From OPEC (2012).

"Number of years since the last hostility, resp. war between the countries in the pair": Authors' calculations, based on the "hostility", "war", resp. "hostility (broad definition)" variables.

"Oil production": In 10 million tones (mean = 3). From British Petroleum (2009).

"Oil reserves": In 100 billion barrels. From British Petroleum (2009).

"*Oil production/GDP":* Total value of current oil production / GDP. Production quantities and prices from British Petroleum (2009), corresponding GDP in current prices from World Bank (2009).

"Border snakiness": Author's calculations. Using the geo-referenced shapes of bilateral country borders from Weidmann, Kuse, and Gleditsch (2010), we compute an index of bilateral border snakiness, using the following formula: "Border snakiness" = "Actual

bilateral border length" / (0.5 * "Convex hull below the bilateral border" + 0.5 * "Convex hull above the bilateral border"). This measure takes a value of 1 when the border is a straight line, while its value increases when the border becomes more winding, resp. snaky.

Appendix B: Directed Dyads

The results of the regressions with directed dyads are displayed in Table 8.

Appendix C: Border Changes

The results of the regressions with border changes are displayed in Tables 9 and 10.

Table 7: Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Hostility	20564	0.057	0.233	0	1
War	24387	0.004	0.066	0	1
Hostil. (Int. 3, 4 and 5)	20564	0.072	0.259	0	1
State A revisionist	19965	0.011	0.216	-1	1
State A attacker	19965	0.006	0.263	-1	1
State A initiator	19965	0.008	0.256	-1	1
Border change	24387	0.004	0.061	0	1
One	24387	0.349	0.477	0	1
One x Dist	24387	0.285	0.424	0	1
Both	24387	0.512	0.500	0	1
Both x MinDist	24387	0.253	0.382	0	1
Both x MaxDist	24387	0.332	0.431	0	1
Land area (min)	24366	366.135	906.894	0.002	9632.030
Land area (max)	24366	2294.900	4146.070	0.340	17098.200
Pop. (min)	20418	9.459	17.791	0.017	234.694
Pop. (max)	20418	54.522	117.102	0.064	1129.870
GDP p.c. (min)	18075	4.129	5.710	0.088	57.259
GDP p.c. (max)	18075	8.070	9.461	0.118	104.707
Democracy (min)	20055	-2.664	7.115	-10	10
Democracy (max)	20055	2.835	7.242	-10	10
Capabilities (min)	20489	0.003	0.010	0	0.177
Capabilities (max)	20489	0.022	0.043	3.00E-06	0.364
CW1	24387	0.263	0.440	0	1
CW2	24387	0.041	0.197	0	1
Bilat. Trade / GDP	17201	0.003	0.007	0	0.121
Defensive pact	19948	0.389	0.488	0	1
OPEC1	24387	0.134	0.340	0	1
OPEC2	24387	0.025	0.157	0	1
Oil prod. (min)	18854	0.532	2.390	0	49.870
Oil prod. (max)	18854	5.377	10.881	0	56.950
Oil res. (min)	13965	0.020	0.121	0	1.384
Oil res. (max)	13965	0.176	0.461	0	2.643
Oil/GDP (min)	17907	0.023	0.093	0	1.037
Oil/GDP (max)	17907	0.104	0.187	0	1.213
Border snakiness	24387	1.929	0.744	1	2.757
Border snak. (alt. def.)	24387	1.171	0.235	1	2.757

Table 8: Regressions with Directed Dyads

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	State A revisionist			State A attacker			State A initiator		
Oil A	-0.022	-0.044**	-0.029*	-0.006	-0.022	-0.041***	-0.006	-0.024	-0.041***
	(0.014)	(0.019)	(0.017)	(0.015)	(0.017)	(0.015)	(0.015)	(0.016)	(0.015)
Oil A x MinDist A	0.033**	0.032**	0.039**	0.027*	0.033*	0.038***	0.029*	0.037**	0.039***
	(0.016)	(0.016)	(0.015)	(0.015)	(0.017)	(0.013)	(0.016)	(0.016)	(0.014)
Oil B	0.031*	-0.004	0.003	0.008	-0.007	-0.008	0.004	-0.014	-0.016
	(0.017)	(0.014)	(0.017)	(0.018)	(0.020)	(0.018)	(0.018)	(0.019)	(0.019)
Oil B x MinDist B	-0.035**	-0.025*	-0.019	-0.014	-0.021	-0.022	-0.011	-0.017	-0.014
	(0.017)	(0.014)	(0.014)	(0.017)	(0.017)	(0.017)	(0.018)	(0.017)	(0.017)
Country FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Add. Controls	No	No	Yes	No	No	Yes	No	No	Yes
Observations	19962	19962	11401	19962	19962	11401	19962	19962	11401
R-squared	0.006	0.058	0.095	0.005	0.046	0.054	0.006	0.048	0.059

Note: The unit of observation is a country pair in a given year. The sample covers all direct contiguous country pairs of the Correlates of War list and the years 1946-2001. Significance levels *** p<0.01, ** p<0.05, * p<0.1. In all columns OLS regressions are run, with robust standard errors clustered at the country pair level in parenthesis. All independent variables are taken as first lag. The dependent variable in the columns 1-3 is the dummy of country A being revisionist minus the dummy of country B being revisionist (hence the dependent variable takes values of -1, 0, and 1). The construction of the dependent variable is analogous for columns 4-6 and 7-9 with being attacker, resp. initiator instead of revisionist as underlying variable. All specifications control for land areas of both countries and annual time dummies (not displayed). In addition, columns 2, 3, 5, 6, 8 and 9 include country fixed effects for each country of the country pair. In addition, columns 3, 6, and 9 include the following set of unreported control variables for both countries in the pair: Population, GDP per capita, democracy score, capabilities, dummy for having a civil war, bilateral trade / GDP, defensive pact, dummy for being OPEC member, and years since the last hostility in the country pair.

Table 9: Conflict and Border Changes

	(1)	(2)	(3)	(4)
	Dependent variable: Border Change			
Hostility	0.018***		0.015***	
	(0.006)		(0.004)	
War		0.070***		0.064***
		(0.022)		(0.020)
Country FE	No	No	Yes	Yes
Observations	20564	24387	20564	24387
R-squared	0.013	0.014	0.033	0.031

Note: The unit of observation is a country pair in a given year. The sample covers all direct contiguous country pairs of the Correlates of War list and the years 1946-2008. OLS regressions with intercept in all columns. Significance levels *** p<0.01, ** p<0.05, * p<0.1. In all columns robust standard errors clustered at the dyad level in parenthesis. All specifications control for annual time dummies (not displayed).

Table 10: Oil Location and Border Changes

	Dependent variable: Border change								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
One	0.002	0.004	0.005*	0.014*	0.017**	0.020*	0.002	0.004	0.005
	(0.002)	(0.003)	(0.003)	(0.007)	(0.007)	(0.010)	(0.002)	(0.003)	(0.004)
One x Dist	-0.002	-0.003	-0.004	-0.016**	-0.019**	-0.021**	-0.003	-0.003	-0.004
	(0.002)	(0.002)	(0.003)	(0.008)	(0.007)	(0.009)	(0.002)	(0.003)	(0.004)
Both	0.006***	0.013***	0.008*	0.006	0.011**	0.003	0.005**	0.011**	0.009
	(0.002)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.002)	(0.005)	(0.006)
Both x MinDist	0.000	-0.001	-0.002	0.002	0.000	-0.003	-0.003	-0.004	-0.002
	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.004)	(0.003)	(0.004)
Both x MaxDist	-0.006*	-0.009***	-0.006	-0.008	-0.010*	0.001	-0.002	-0.006*	-0.007
	(0.003)	(0.003)	(0.004)	(0.006)	(0.006)	(0.003)	(0.004)	(0.003)	(0.005)
Type Oil	All	All	All	Offshore	Offshore	Offshore	Onshore	Onshore	Onshore
Country FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Add. Controls	No	No	Yes	No	No	Yes	No	No	Yes
Observations	23768	23768	11401	23768	23768	11401	23768	23768	11401
R-squared	0.011	0.027	0.035	0.012	0.027	0.037	0.011	0.026	0.035

Note: The unit of observation is a country pair in a given year. The sample covers all direct contiguous country pairs of the Correlates of War list and the years 1946-2008. OLS regressions with intercept in all columns. Significance levels *** p<0.01, ** p<0.05, * p<0.1. In all columns robust standard errors clustered at the country pair level in parenthesis. All independent variables are taken as first lag. All specifications control for minimum and maximum land areas and annual time dummies (not displayed). In addition, columns 2, 3, 5, 6, 8, and 9 include country fixed effects for each country of the dyad. In addition, columns 3, 6, and 9 include the following set of unreported control variables: Minimum population, maximum population, minimum GDP per capita, maximum GDP per capita, minimum democracy score, maximum democracy score, minimum capabilities, maximum capabilities, dummy for one country having civil war, dummy for both countries having civil war, bilateral trade / GDP, defensive pact, dummy for one country being OPEC member, dummy for both countries being OPEC member, and years since the last border change in the country pair.

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