

# THE GEOGRAPHY OF INTERSTATE RESOURCE WARS\*

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We establish a theoretical and empirical framework to assess the role of resource endowments and their geographic location in interstate conflict. The main predictions of the theory are that conflict is 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-à-vis the border. We test these predictions on a novel data set featuring oilfield distances from bilateral borders. The empirical analysis shows that the presence and location of oil are significant and quantitatively important predictors of interstate conflicts after World War II. *JEL Codes:* C23, D74, F51, H56, Q34.

## I. INTRODUCTION

Natural riches have often been identified as triggers for interstate war in the public debate and in the historical literature.<sup>1</sup> 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 time of this 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

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1. For example, Bakeless (1921); Wright (1942); Westing (1986); Klare (2002); Kaldor, Karl, and Said (2007); De Soysa, Gartzke, and Lie (2011); and Acemoglu et al. (2012).

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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).<sup>2</sup>

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

The key idea of the article is to relate the likelihood of conflict between two countries to the geographical location of natural-resource deposits vis-à-vis the two countries' bilateral 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, and so on. Therefore, if countries do indeed engage in military confrontations 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 neighbors with minerals far away from the border.

2. References for these conflicts include Price (2005) for Nigeria-Cameroon, Franco (1997) for Ecuador - Peru, Kocs (1995), for Argentina - Uruguay and Algeria - Morocco, BBC (2011) for Algeria - Morocco, Anderson (1999) for China - Vietnam, and 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 (see Mandel 1980; McLaughlin Mitchell and Prins 1999; Carter Center 2010).

As a preliminary check on the plausibility of this, Figure I presents a simple scatterplot that suggests that the geographic location of oil deposits could be related to cross-country conflict. Each point in the graph is a pair of contiguous countries. 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).<sup>3</sup> 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:  $.01$ ]).

The crude correlation in Figure I 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 article 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 find themselves in conflict with neighbors who have natural resources than with those 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 focus most of the analysis on the geographic distribution of resource deposits.

To the best of our knowledge, there is no theoretical model that places conflict (whether over resources or otherwise motivated) inside a geographical setting. Given the prominence of the concept of territorial war, this omission may seem surprising.

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 are described in detail in Section III.A.

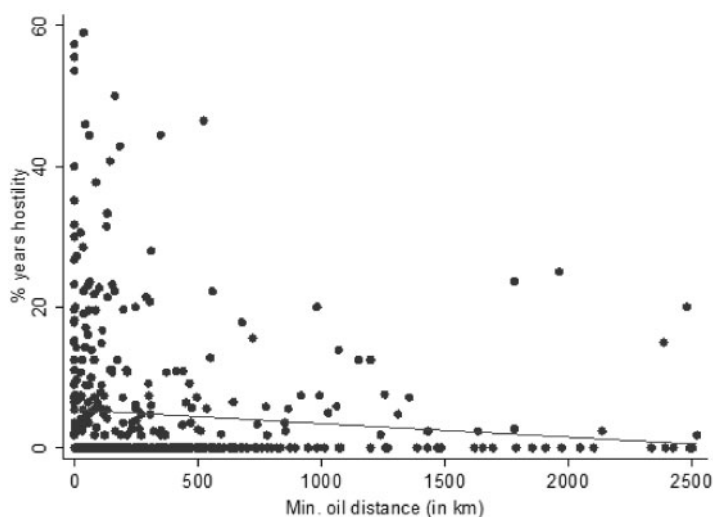


FIGURE I

Oil Distance from the Border and Bilateral Conflict

Hence, we begin 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 meaningful 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 (which could have applications well beyond the present focus on resource wars).

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.

We obtain rich testable implications which go well beyond the simple intuition with which we have opened this section. The model belongs to a much more general class of models of conflict where one player's gain (gross of the cost of engaging in conflict) equals the other player's loss. We remark that in such games, under very general conditions, the likelihood of conflict is

increasing in the asymmetry of payoffs. Increases in payoff asymmetry make the player who is expected to win more aggressive, and the one that is expected to lose less aggressive. Since one party can initiate conflict unilaterally, the former effect tends to dominate.

Hence, the presence and geographic distribution of natural resource deposits increases conflict if it increases payoff asymmetry. Compared to the situation where neither country has oil, the appearance of oil in one country clearly increases payoff asymmetry: 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*, payoff asymmetry increases with the proximity of the oil to the border: as the oil moves toward the border the incentive of the oil-less country to fight increases more than the incentive for the oil-rich one is reduced. 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 important, 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-à-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 translate into asymmetries in payoffs and are thus potentially important determinants of territorial conflict.

Although 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 data set which, for each country pair with a common border (or whose coastlines are relatively 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 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 almost entirely 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 more than three 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).<sup>4</sup> 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.

The article is thus closer to other contributions that have focused on factors that enhance the incentives to engage in (interstate) 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 2014), development (e.g., Gartzke 2007; Gartzke and Rohner 2011), and stocks of weapons (Chassang and Padró i Miquel 2010). Natural resources have

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

received surprisingly little systematic attention in terms of formal modeling or systematic empirical investigations. Acemoglu et al. (2012) build a dynamic theory of 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, Gartzke, and Lie (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.<sup>5</sup>

Unlike in the case of cross-country conflict, there is a lively theoretical and empirical literature, nicely summarized in 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.<sup>6</sup> Our article complements this work by investigating whether the same is true for international conflict.<sup>7</sup>

5. De Soysa, Gartzke, and Lie (2011) 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 II 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 various additional controls).

6. The vast majority of the civil conflict literature focuses on total resource endowments at the country level (see, e.g., Michaels and Lei 2014; Ross 2012; Ploeg and Rohner 2012; 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) and Harari and La Ferrara (2012) find that localities producing oil are more prone to civil violence; Esteban, Morelli, and Rohner (2014) find that groups whose ethnic homelands have larger endowments of oil are more prone to being victimized; Morelli and Rohner (2014) find that intergroup conflict is more likely when total resources are more concentrated in one of the ethnic groups’ homelands. None of these studies make use of information on the distance of natural resource deposits from country/region/ethnic homeland borders. Needless to say, there are also several studies examining the effect of the spatial distribution of resources and geographic features on outcomes other than conflict (e.g., Caselli and Michaels, 2013, for corruption; Alesina, Michalopoulos, and Papaioannou 2012, for development).

7. Much as in the literature linking resources to domestic conflict, our results imply that the net gain from resource discoveries may be well below the gross market value of the discovered reserves. Aside from the risk of losing the oil to its neighbors, countries have to factor in the economic cost of fighting to protect it. Based on their review of the literature Bozzoli, Brueck, and Sottas (2010) conclude



The remainder of the article is organized as follows. Section II presents a simple model of interstate conflict. Section III carries out the empirical analysis, and Section IV concludes.

II. THE MODEL

II.A. Preliminary Remarks: Asymmetric Payoffs and Conflict

Many conflict scenarios can be crudely captured by the following static, two-player game:

		Player B	
		Action 0	Action 1
Player A	Action 0	0,0	$x + c_A, -x + c_B$
	Action 1	$x + c_A, -x + c_B$	$x + c_A, -x + c_B$

where  $x, c_A, c_B$  are real numbers. Action 0 is a “peace” action that, if played by both parties, maintains the “status quo,” here normalized to (0, 0). Action 1 is a “conflict” action, such as initiating a war. The parameter  $x$  ( $-x$ ) is the expected (gross) payoff from the conflict to player A (B). If  $x > 0$  player A is the expected winner. For example,  $x$  could represent the capture of a strategic location or a mineral resource deposit currently located in country B, weighted by the probability that A succeeds at capturing it. Finally,  $c$  is a country-specific cost (or benefit if positive) of undertaking the conflict action.<sup>8</sup>

The condition for observing peace, defined as neither player playing the conflict action, is that

$$c_B \leq x \leq -c_A.$$

Hence, if conflict is usually costly (i.e., most of the time  $c_B < 0, c_A < 0$ ), we will typically see conflict unless  $x$  is relatively small in absolute value. The absolute value  $|x|$  is a measure of *payoff*

that mass conflict causes GDP growth to fall by between 1 and 3 percentage points. Using our preferred specification for the probability of conflict, these values imply that a country that finds oil right at its border (with a country that has no oil) should expect to lose between 1% and 3% of GDP to war every nine years or so.

8. Obviously, the applicability of this framework goes well beyond international (or civil) conflicts. It extends to, for example, price wars over market share, industrial disputes, divorce, and many others.



*asymmetry*: it captures both the extent of the expected gains of one player, and the extent of the expected losses of the other. Hence, in conflict games we expect to observe conflict when pay-offs are asymmetric.

In real-world situations the prize from conflict  $|x|$  is often persistent over time. For example a strategic location often retains its value over years or decades. Yet conflict among two players is only observed some of the time. To capture this pattern, we can assume that the cost of the conflict action,  $c_i$ , is a random variable. The idea is that there are “good times” and “bad times” to fight. For example, the perceived cost of conflict may be particularly low during an economic boom, or if the opponent is going through a period of political upheaval.

Although it is natural to think of  $c_i$  as being negative most of the time, we can also imagine situations in which  $c_i$  is occasionally positive, 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. Hence, it makes sense to assume that  $c$  is a random variable that takes values on the real line.

Suppose then that  $h : \mathbb{R} \rightarrow \mathbb{R}^+$  is the probability density function of  $c_i$ ,  $i = A, B$ , and  $H$  is the corresponding cumulative distribution function. Then the probability of observing peace is  $H(x)H(-x)$ . How does this probability change with changes in payoff asymmetry? By inspection, we have immediately the following

**REMARK 1.** The probability of peace is nonincreasing in  $|x|$  if and only if  $\frac{h(|x|)}{H(|x|)} \leq \frac{h(-|x|)}{H(-|x|)}$ .

In other words, increases in payoff asymmetry always increase conflict if the inverse Mills ratio of the “cost of conflict” distribution evaluated at a positive value of this cost is less than the inverse Mills ratio evaluated at the symmetric negative value. Clearly  $H(|x|) > H(-|x|)$  so we would expect this condition to hold much of the time. Indeed, it holds in all cases where  $h$  is symmetric and single peaked around a negative mode, or whenever  $H$  is log-concave. The vast majority of commonly used distributions defined on  $\mathbb{R}$  are either symmetric or log-concave (or both).

The intuition for this condition is straightforward.  $H(-|x|)$  is the probability that the conflict's prospective winner chooses the peace action, and  $\frac{h(-|x|)}{H(-|x|)}$  is the percentage decrease in this probability when payoff asymmetry  $|x|$  increases. Similarly,  $\frac{h(|x|)}{H(|x|)}$  is the percentage increase in the likelihood that the prospective loser will play the peace action. The inverse Mills ratio condition simply states that the former exceeds the latter. Now, because  $H(-|x|) < H(|x|)$ , it will "typically" be the case that the proportional increase in the bellicosity of the expected winner exceeds the proportional increase in the dovishness of the loser, causing an increase in conflict. A simple way to think about this is that the winner is the player responsible for most conflicts, so what happens to this player's incentive to engage in conflict matters more than what happens to the other player's incentives.

In the next subsection we set up a simple model of conflict over natural resources which fits squarely in this general setup. We will see how the existence and spatial distribution of natural resources affects payoff asymmetry and hence the likelihood of conflict.

## II.B. Territorial Conflict

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, and 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 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  $R$ s 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.<sup>9</sup>

The two countries play a game with two possible outcomes: war and peace. If a conflict has occurred, there is a new postconflict 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.

9. In Section II.D.2 we allow for arbitrary values of  $R_A$  and  $R_B$ .

We make the following assumptions on the distribution of  $Z$ :

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

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 distribution  $f$  need not be symmetric, much less symmetric around 0. The position in space of the distribution will depend on the relative strength of the two countries. If most of the mass point is over the positive real numbers, then a potential war is expected to result in territorial gains for country  $A$  (the more so the more “to the right” the mass of the distribution), so country  $A$  can be said to be stronger. Obviously, since  $Z$  is defined on  $\mathbb{R}$ , it is possible for the (expected) weaker country to win.

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,  $c_i$ ,  $i = A, B$ , which is a catch-all term for all the other considerations that affect a country’s decision to go to war. As in the previous subsection, we assume that  $c_i$ ,  $i = A, B$  is a continuous random variable defined on  $\mathbb{R}$ , with density  $h$ , cumulative distribution function  $H$ , and satisfying the inverse Mills ratio condition  $\frac{h(|c|)}{H(|c|)} < \frac{h(-|c|)}{H(-|c|)}$ . This implies that increases in payoff asymmetry increase the likelihood of conflict.<sup>10</sup>

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). If there has been a war, the payoffs are:

$$U_A^C = R_A I(Z > G_A) + R_B I(Z > G_B) + c_A,$$

$$U_B^C = R_A I(Z < G_A) + R_B I(Z < G_B) + c_B,$$

where  $U_i^C$  is the payoff for country  $i$  after a conflict, and  $I(\bullet)$  is the indicator function. The first two terms in each payoff function are

10. We discuss relaxing the assumption that the two countries draw the  $c$ s from the same distribution in note 17.

the oil fields controlled after the war. For example, country  $A$  has hung on its field 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 nonterritorial costs or benefits from war. Note that implicitly (and for simplicity) we assume that countries are risk neutral.<sup>11</sup>

The timing and actions of the model are as follows. First, each country  $i$  draws a cost of conflict  $c_i$ ,  $i = A, B$ . Then each country decides whether 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.

## II.C. Analysis

This game is readily seen to have the structure discussed in Section II.A. Both countries prefer peace (conditional on their draw of  $c$ ) if  $E(U_A^C) \leq R_A$  and  $E(U_B^C) \leq R_B$  (where the expectation is taken after observing  $c_i$ ). Given Assumption 1 these conditions can be rewritten as

$$(1) \quad c_B \leq -R_A F(G_A) + R_B[1 - F(G_B)] \leq -c_A.$$

Hence, the probability of peace is  $H(x)H(-x)$ , where  $x = -R_A F(G_A) + R_B[1 - F(G_B)]$ . Changes in  $R_A$ ,  $R_B$ ,  $G_A$ , and  $G_B$  increase the likelihood of conflict if they increase  $|x|$ .

The expression for  $x$  clearly conveys 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  $c_i$  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

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 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  $\delta R$  to the conqueror, with  $\delta \in (0, 1]$ . The qualitative predictions would be unchanged. To use our framework to study other aspects of territorial war, it will typically make sense to assume 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 previous version of this article 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.

two events depend on the location of the oil fields. Consider the decision by country  $A$  [second inequality in equation (1)]. 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 its oil, which makes country  $A$  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 2. The case where  $R_A = 0$  ( $R_B = 0$ ) is isomorphic to the case where  $G_A \rightarrow -\infty$  ( $G_B \rightarrow \infty$ ).

For the purposes of evaluating the likelihood of peace, it makes no difference if one country does not have oil, or if its oil is located infinitely far from the border. This observation, which follows directly from inspection of equation (1), simplifies slightly the 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. In particular, we can denote the probability of peace as  $P(G_A, G_B)$ , that is, simply as a function of the location of the oil fields. With some slight abuse of notation, we then denote the probability of peace when only country  $A$  has oil (no country has oil) as  $P(G_A, \infty)$  ( $P(-\infty, \infty)$ ).

PROPOSITION 1.

- (i)  $P(G_A, \infty) \leq P(-\infty, \infty)$ ;
- (ii)  $\frac{\partial P(G_A, \infty)}{\partial G_A} \leq 0$ ;
- (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)  $\frac{\partial P(G_A, G_B)}{\partial G_A} \leq 0$  if and only if  $1 - F(G_A) - F(G_B) \leq 0$ .

The proposition, which follows nearly directly from the inverse Mills ratio condition, 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 that found the oil becomes less likely to wish to get into a conflict because it has more to lose, whereas the other country has an additional potential prize from going to war. The proposition says that (as long as the inverse Mills ratio of the distribution of  $c$  is well behaved) the latter effect systematically dominates, so the likelihood of conflict goes up. The reason is that the oil discovery in country  $A$  creates a payoff asymmetry.

Part (ii) says that when oil is only in one country the probability of conflict increases when oil moves closer to the border. The reason is that the movement of the oil toward the border increases the likelihood that country  $B$  ( $A$ ) will capture (lose) the oil, thus exacerbating payoff asymmetry.

Part (iii) tells us that two countries with both having oil are more likely to experience a conflict than two countries with both not having oil. Oil always makes one country more aggressive, because with oil payoffs will always be more asymmetric than without oil, 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 of course is that when the second country finds oil, payoff asymmetry declines. The country that would typically have been responsible for most conflict becomes less aggressive, as it becomes concerned with the possibility of losing its newly found oil. Country  $A$  does become more aggressive, but this is typically insufficient to create a more belligerent atmosphere. The exception is when 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). In this case, the new discovery in country  $B$  can actually increase payoff asymmetry: from mildly asymmetric in favor of  $B$  to strongly asymmetric in favor of  $A$ . Unconditionally, however, that is, 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 toward the border in one country, while leaving the other

country's oil location unchanged. To better understand this part, it is useful to look at the following special case.

COROLLARY. If  $f$  is symmetric around 0, then  $\frac{\partial P(G_A, G_B)}{\partial G_A} \leq 0$  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 the asymmetry of payoffs. Consider starting from a situation of perfect symmetry, or  $-G_A = G_B$ . When  $f$  is symmetric around 0, the incentive to fight for the other country's oil exactly cancels out with the deterrent effect from fear of losing one's oil (see equation (1)). However, as soon as we break this symmetry, say by moving  $A$ 's oil toward the border, country  $B$  becomes an expected winner. 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  $G_B$ .<sup>12</sup>

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

#### II.D. Discussion and Extensions

*Conflict and Border Changes.* The key modeling 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 Section I 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

12. 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 toward the border is much stronger militarily (i.e., if  $f$  is very skewed in its favor).



involve some level of violence. Weede (1973, p. 87) concludes that "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 also support 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.<sup>13</sup> In Appendix III we show 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, but this need not be the rational expectations distribution. 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).

*Allowing for Variation in  $R$ .* With our assumption that  $R \in \{0,1\}$  we have normalized all nonzero 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 equation (1), an increase in  $R_A$  has identical qualitative effects of a movement of  $A$ 's oil toward the border, while an increase in  $R_B$  is akin to a move of

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

$B$ 's oil toward 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  $R$ s might be tested using variation in oil prices, as an oil price increase is an equi-proportional 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.<sup>14</sup> 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.

*Endogenous F.* 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.<sup>15</sup>

14. Even interacting oil distance from the border with the world oil price would be difficult to interpret, as market participants' assessment of the disruption caused by a war to oil supplies might depend on the distance of the oil from the border. In particular, when the oil is close to the border the fighting is more likely to disrupt oil production and shipment.

15. The strength effect could easily be added to our model by making  $F$  a decreasing function of  $R_A$  and an increasing 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, for example, discovery of oil in one country unambiguously leads to greater likelihood of conflict. This is because in our model the only territorial benefit of conflict is oil—merely being stronger does not make country  $A$  more aggressive. In note 11 we 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.

However, 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.

In any case, although we don't model the strength effect explicitly, in our empirical work we are able to fully control for it by including various measures of each country's aggregate oil endowments.<sup>16</sup>

Other sources of asymmetric strength: Having oil endowments is just one reason a country may be militarily stronger than another. For example, a larger country, a richer country, or a more ethnically homogeneous country could also be expected to be stronger. The same mechanisms that may lead the strength effect to qualify the predictions of the greed effect are thus involved in thinking about these other reasons for military asymmetry, and lead to similar qualifications. For example, if it is the militarily stronger country which finds oil, it is no longer necessarily the case that payoffs become more asymmetric.

Endogenous arming decisions: In the discussion so far, we have assumed that the two countries take their relative strength, represented by the function  $F$ , as given. As we show in the Online Appendix, a similar line of reasoning applies if each country can make military investments to improve its odds of success in case of conflict. Consider, for example, an increase in  $G_A$  when country  $B$  does not have oil. In the baseline model, this has only a direct positive effect on country  $B$ 's chances of capturing the oil and unambiguously leads to more payoff asymmetry and hence more conflict. In the extended model, however, the shift of the oil toward the origin can cause the two countries to change their

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

armaments. If country *A* responds by arming much more than *B*, it is conceivable that this indirect effect will dominate over the direct effect, resulting in a decline of country *B*'s prospects of capturing country *A*'s oil. This may reduce payoff asymmetry, and hence, unlike in the baseline model, an increase in  $G_A$  no longer unambiguously increases conflict. Having said this, the scenario where the likelihood of conflict declines seems very implausible. Specifically, it is not at all clear why *A* should respond to the increase in  $G_A$  with a greater arming effort than *B*, much less that the disparity in response should be so large as to more than negate the direct effect.<sup>17</sup>

### III. EMPIRICAL IMPLEMENTATION

#### III.A. *Data and Empirical Strategy*

*Sample.* We work with a panel data set, where an observation corresponds to a country pair in a given year, for example, Sudan-Chad in 1990. Country pairs are included if they satisfy Stinnett et al. (2002)'s "direct contiguity" criterion: 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.<sup>18</sup> The data set covers the years 1946 to 2008.

All variables are described in detail in Appendix I, which also contains Appendix Table A.1 with summary descriptive statistics. Here we focus on the key dependent variable and the independent variables of interest.

*Dependent Variables.* Our main dependent variable is a measure of interstate disputes, from the Dyadic Militarized Interstate Disputes (MID) data set of Maoz (2005). The MID data are the

17. Much the same style of argument applies if we relax the assumption that  $c_A$  and  $c_B$  are drawn from identical distributions. For example, a natural extension would be to assume that  $c_A$  ( $c_B$ ) is positively (negatively) related to the mean of the distribution of  $Z$ , that is, that the country that expects the largest territorial gains also expects the largest nonterritorial ones (or to pay a less devastating nonterritorial cost for the conflict). For example, if the oil is found (or moves toward the border) in the country with higher mean  $c$ —that is, the country responsible for most conflicts—the deterrence effect on the country with oil may dominate over the greed effect experienced by the country without oil.

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

most widely used data on interstate hostilities.<sup>19</sup> Compared to alternative (and less widely used) data sets—such as the UCDP/PRIO Armed Conflict Dataset (Uppsala Conflict Data Program 2011)—it has the advantage of not only including the very rare full-blown wars between states but also smaller scale conflicts, and provides 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 refer to as War, is 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 radioactive weapons.” Though still very violent, this type of confrontation, which is labeled 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.<sup>20</sup> We also present robustness checks using War only,<sup>21</sup> including disputes receiving a value of 3 in Maoz (2005) – Hostility+,<sup>22</sup> and even specifications relating the intensity of conflict to the presence and geographic location of oil.

An alternative approach is to investigate data which identify the aggressor in a bilateral conflict (as in Colgan 2010 and De Soysa, Gartzke, and Lie 2011). However, in many cases,

19. MID data, as well as Stinnett et al.’s contiguity variable, are accessible through the Correlates of War project. 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 (2014).

20. 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 (2014) code a country pair to experience conflict when hostility levels 3, 4, or 5 are reached.

21. The data set 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).

22. 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”.

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.<sup>23</sup> We submit that our approach based on distance of the oil from the border offers a more robust strategy. Having said this, in Appendix II we use additional 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.

*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 data set of Weidmann, Kuse, and Gleditsch (2010), which contains historically accurate georeferenced borders for every country and year. The data set 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 georeferenced dataset on the location of oil and gas fields from Lujala, Rod, and Thieme (2007; PETRODATA). It includes the geographic 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.<sup>24</sup>

23. See, for example, Gaubatz (1991), Gowa (1999), Potter (2007), and Conconi, Sahuguet, and Zanardi (2014), for more detailed versions of these and other criticisms of the direct dyad approach.

24. 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 (2003).

Using GIS software, we merge these two data sets so that we can pinpoint each oil field position vis-à-vis a country's borders as well as vis-à-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.<sup>25</sup> 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. The variable *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*  $\times$  *Dist* is the product of the *One* dummy with the distance of the oil from the border. Similarly, *Both*  $\times$  *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*  $\times$  *MaxDist* captures the distance from the border in the country whose oil is further from the border. Note that an increase in *Both*  $\times$  *MinDist* (holding *Both*  $\times$  *MaxDist* constant) is a movement toward symmetry, whereas an increase in *Both*  $\times$  *MaxDist* (holding *Both*  $\times$  *MinDist* constant) is a movement away from symmetry.<sup>26</sup>

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  $1 - e^{-\lambda d}$ , where  $d$  is the crude geographical distance in hundreds

25. Obviously 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).

26. The attentive reader will have noticed that, in constructing our key dependent variables, we have taken the min operator three times: first, for each oil field in a country, between its distance to the other country's border and the other country's coastline (distance of oil field to other country); second, for each country, among all its oil fields' 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.



of kilometers. 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 our benchmark specification we set  $\lambda = 1$ , which is equivalent to assuming that diminishing marginal costs set in fast, consistent with our intuition. We present robustness checks for alternative functional forms (including unscaled distance).

*Control Variables.* In all regressions we control for the average and the absolute difference of land areas in the pair. We also present specifications that further include the average and absolute difference of GDP per capita; the average and absolute difference of population; the average and absolute difference of fighting capabilities; the average and absolute difference of democracy scores; the number of consecutive years the two countries have been at peace before the current period; the volume of bilateral trade (scaled by the sum of GDPs); a measure of genetic distance between the populations of the two countries; a dummy for membership in the same defensive alliance; a dummy for historical inclusion in the same country, kingdom, or empire; a dummy for having been in a colonial relationship; two dummies for civil war incidence in one or both of the countries in the pair; and two dummies for OPEC membership of one or both countries in the pair.<sup>27</sup> Finally, in important robustness checks we discuss later, we include several measures of the amounts of oil production and reserves in the two countries. Again, all variables are discussed in detail in Appendix I.

27. Population and GDP could affect the likelihood of conflict in myriad ways, for example, through relative military strength; 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, or historical roots in the same kingdom or empire, 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), and so has genetic distance (Spolaore and Wacziarg 2013).

*Specification and Methods.* Our benchmark specification is a linear probability model that takes the form

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

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

Crucially, our preferred specification for the error term  $u_{dt}$  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 find a positive estimate of  $\beta$  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. For example, whether a given country is 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.

The inclusion of country fixed effects serves to limit the influence of unobservable determinants of a country's proneness to engage in conflict that may be spuriously correlated with its having oil (or with its having many neighbors having oil). Clearly the theory also predicts that countries with oil (or with oil-rich neighbors) should engage in conflict more frequently, a prediction that is not allowed to influence the results when fixed effects are included. If we could be confident that our control variables fully absorbed all the other determinants of bilateral conflict, specifications that omit fixed effects might be preferable (and we report them). But it is unlikely that the controls fully account for all the determinants of conflict that may be spuriously correlated with having oil (or neighbors with oil). This is particularly true in the present context: the dyadic specification means that all controls must be defined at the country-pair level, not at the country level. Hence, it is likely that the controls are quite ineffective at accounting for country-level covariates of oil endowments and conflict outcomes.

For the same reason, the country fixed effects are insufficient to absorb the influence of factors that affect the likelihood of conflict at the country-pair level, leading us to prefer specifications that include controls. The downside of including the controls is, of course, that some of them may be endogenous to bilateral conflict. This is why we present specifications with and without controls—except for the controls based on surface area, which seem clearly exogenous.

Ideally one would use country-pair fixed effects and base all inference on time-series variation in the variables of interest. 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, and potentially change the distance measures (if the newly discovered field is closer to the border than all the preexisting 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.<sup>28</sup>

In all regressions reported in the main body of the article, the standard errors are clustered at the country-pair level. In the Online Appendix we further report standard errors based on methods that attempt to implement clustering at the country level. The Online Appendix also reports results that control for region-year fixed effects and presents findings for a simple cross-section of country pairs.

### *III.B. Results*

Table I presents the baseline regressions for the main dependent variable, Hostility. In the first four columns we use all oil fields to construct our measures of oil endowments and distance, while in columns (5)–(8) we only use offshore oil, and in columns (9)–(12) only onshore oil. In column (1) we show the coefficients on our variables of interest only after controlling for annual time dummies and average and absolute difference in land areas.

28. For each country pair and each of the five variables of interest we have calculated the number of changes during the sample period. Across the five variables, the fraction of country pairs experiencing no change whatsoever varies between 75% and 85%, and the fraction experiencing no more than one change is between 95% and 100%. Unsurprisingly, this time variation is too small to yield sharp estimations once country-pair fixed effects are included. With the full set of controls, the estimated coefficients (standard errors) are  $\beta = 0.018$  (0.029),  $\gamma = -0.019$  (0.032),  $\delta = 0.049$  (0.044),  $\eta = 0.021$  (0.042), and  $\omega = -0.078$  (0.046).

TABLE I  
BASELINE RESULTS FOR HOSTILITY

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
One	0.034 (0.032)	0.029 (0.027)	0.049* (0.027)	0.077** (0.030)	0.087 (0.054)	0.081** (0.040)	0.143*** (0.048)	0.124*** (0.035)	0.048 (0.042)	0.063* (0.038)	0.058* (0.033)	0.132*** (0.044)
One × Dist	-0.050 (0.035)	-0.044 (0.027)	-0.073*** (0.026)	-0.086*** (0.027)	-0.107* (0.056)	-0.087*** (0.043)	-0.138*** (0.048)	-0.118*** (0.034)	-0.079* (0.044)	-0.072* (0.039)	-0.103*** (0.033)	-0.137*** (0.041)
Both	0.022 (0.021)	0.028 (0.020)	0.034 (0.029)	0.045* (0.027)	0.023 (0.030)	0.048* (0.027)	0.110*** (0.035)	0.073** (0.030)	0.009 (0.024)	0.024 (0.020)	0.020 (0.032)	0.047 (0.031)
Both × MinDist	-0.077** (0.035)	-0.044 (0.035)	-0.105*** (0.030)	-0.089*** (0.029)	-0.088* (0.047)	-0.028 (0.035)	-0.107** (0.051)	-0.066** (0.032)	-0.102*** (0.038)	-0.096** (0.043)	-0.122*** (0.032)	-0.125*** (0.036)
Both × MaxDist	0.026 (0.040)	-0.014 (0.036)	0.016 (0.030)	0.004 (0.029)	0.048 (0.065)	-0.048 (0.050)	0.012 (0.065)	-0.010 (0.044)	0.059 (0.043)	0.042 (0.045)	0.047 (0.034)	0.043 (0.038)
Type oil	All	All	All	All	Offshore	Offshore	Offshore	Offshore	Onshore	Onshore	Onshore	Onshore
Country FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Add. controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	19,962	11,303	19,962	11,303	19,962	11,303	19,962	11,303	19,962	11,303	19,962	11,303
R-squared	0.019	0.090	0.145	0.158	0.020	0.091	0.145	0.156	0.021	0.092	0.146	0.160

Notes. Dependent variable: Hostility. The unit of observation is a country pair in a given year. The sample covers all contiguous country pairs and the years 1946–2001. Method: OLS with robust standard errors clustered at the country-pair level. All explanatory variables are taken as first lag. All specifications control for the average and the absolute difference of land areas in the pair, intercept, and annual time dummies. Additional controls are: The average and absolute difference of GDP per capita, the average and absolute difference of population, the average and absolute difference of fighting capabilities, the average and absolute difference of democracy scores, dummy for one country having civil war, dummy for both countries having civil war, bilateral trade/GDP, dummy for one country being OPEC member, dummy for both countries being OPEC member, genetic distance between the populations of the two countries, dummy for membership in the same defensive alliance, dummy for historical inclusion in the same country, kingdom, or empire, dummy for having been in a colonial relationship, and years since the last hostility in the country pair. Significance levels \*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$ .

In column (2) ((3)) we add all the other controls (country fixed effects), and in column (4) we present our preferred specification with both controls and fixed effects. The estimates are reasonably stable across the four specifications, though statistical significance tends to improve as we add country fixed effects and the further controls.

When we include the full set of country fixed effects and controls (column (4)), 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 interstate disputes than a pair with no oil whatsoever (which is the omitted category). More important, 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 closest to the border—a movement toward 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.<sup>29</sup>

Quantitatively, the effect of geographic location is very sizable. Figure II shows the probability of conflict implied by the regression coefficients in Table I, column (4) 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%. This drops to 3.1% 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 ( $\text{Dist}=0$ ), the probability of conflict is about 3.5 times as large: 10.8%. 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 ( $\text{Dist}=1$ ) the likelihood of conflict is similar to the likelihood when neither

29. Generally speaking, in most specifications we have run the two versions with fixed effects (with and without controls for country-pair characteristics) generate quite similar results. However, the fixed effects are important. For example, in the specifications with controls but without country fixed effects the coefficients on the key distance variables drop by one third to one half and lose significance in about 50% of cases. This suggests that there are unobservable country-level determinants of conflict that are spuriously positively correlated with oil distance.

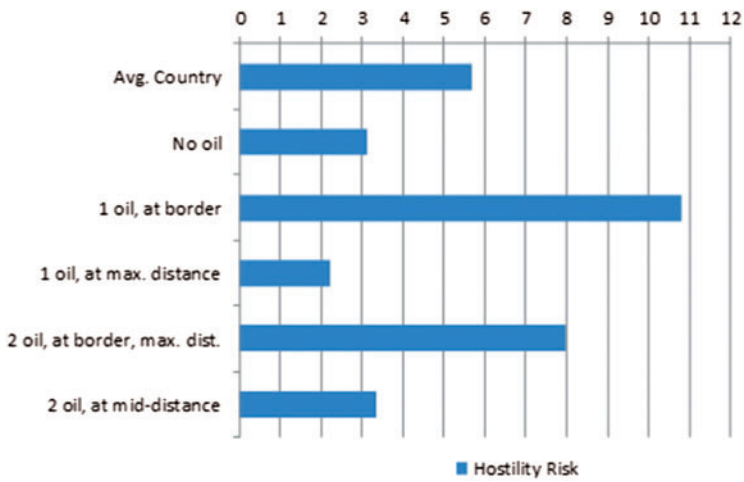


FIGURE II  
Quantitative Effects

Risk of bilateral conflict based on the coefficients in column (4) of Table 1. “No oil” is when One=Both=0. “1 oil, at border” (“1 oil, at max. distance”) is when One=1 and Dist=0 (Dist=1). “2 oil, at border, max. dist.” (“2 oil, at mid-distance”) is when Both=1, MinDist=0, and MaxDist=1 (MinDist=MaxDist=0.5).

country has oil.<sup>30</sup> 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 over 2.5 times as large as in the case where neither country has oil, or 8%. 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 3.4%.<sup>31</sup>

The remaining columns in the table investigate whether the results are driven particularly by offshore or onshore oil. In particular, in columns (5)–(8) we construct our variables of interest using exclusively information on offshore oil fields (so, e.g., if in a

30. Hence, our model’s formal isomorphism between the cases of no oil and infinitely distant oil seems to hold empirically.

31. In constructing Figure II we 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.

country pair all the oil is onshore the pair is treated as a “no oil” pair), and then repeat the four specifications with no controls, only country-pair controls, only country dummies, and all fixed effects and controls. In columns (9)–(12) 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.

*Robustness.* Alternative dependent variables: Table II presents results from our benchmark specifications, but using alternative measures of conflict. Given the similarity between the offshore and onshore results, and to save space, we focus on exercises that treat offshore and onshore oil equally, as in the first four columns of Table I. In columns (1)–(4) we use the most 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. Quantitatively, the coefficients are smaller than when using Hostility, though the impact of distance on War is still economically very sizable.<sup>32</sup>

In a similar spirit, columns (5)–(8) present 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 sizable and highly significant for our preferred specification of column (8).

Finally, in columns (9)–(12) we further exploit Moaz’s finer-grained classification of conflicts on a 0–5 scale, by running Poisson maximum likelihood specifications for conflict intensity. We find that our oil-distance variables exert an economically and

32. For example, while in an average country pair the risk of war is 0.4% per year, this risk goes up to 2.4%—which is six times higher—in the most dangerous configuration where only one country in the pair has oil and this is located right at the border.



TABLE II  
BASELINE RESULTS FOR ALTERNATIVE DEPENDENT VARIABLES

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
		Dep. var.: War				Dep. var.: Hostility+			Dep. var.: Dispute intensity			
One	0.005 (0.008)	0.003 (0.005)	0.008 (0.010)	0.016** (0.007)	0.036 (0.033)	0.026 (0.027)	0.051* (0.030)	0.082*** (0.032)	0.480 (0.382)	0.454 (0.352)	0.530 (0.337)	1.768** (0.789)
One × Dist	-0.007 (0.008)	-0.002 (0.005)	-0.010 (0.009)	-0.010** (0.005)	-0.059* (0.035)	-0.046* (0.027)	-0.083*** (0.027)	-0.094*** (0.028)	-0.804* (0.429)	-0.793*** (0.321)	-1.022*** (0.292)	-2.134*** (0.624)
Both	0.004 (0.006)	0.010** (0.005)	0.009 (0.009)	0.020** (0.009)	0.033 (0.024)	0.035 (0.026)	0.037 (0.033)	0.055* (0.033)	0.384 (0.278)	0.263 (0.272)	0.478 (0.363)	0.503 (0.506)
Both × MinDist	-0.003 (0.005)	-0.008 (0.008)	-0.008* (0.005)	-0.007 (0.006)	-0.092** (0.041)	-0.051 (0.039)	-0.131*** (0.035)	-0.111*** (0.033)	-1.050*** (0.404)	-1.039*** (0.345)	-1.724*** (0.395)	-1.575*** (0.438)
Both × MaxDist	-0.004 (0.007)	-0.003 (0.008)	-0.005 (0.006)	-0.006 (0.008)	0.025 (0.047)	-0.018 (0.041)	0.021 (0.035)	0.005 (0.031)	0.254 (0.408)	0.158 (0.348)	0.143 (0.348)	0.241 (0.441)
Method	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	Poisson	Poisson	Poisson	Poisson
Country FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Add. controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	23,768	11,303	23,768	11,303	19,962	11,303	19,962	11,303	19,962	11,303	19,962	11,303
R-squared	0.005	0.033	0.073	0.103	0.024	0.105	0.155	0.179	n/a	n/a	n/a	n/a
Log pseudo likelihood	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-16,589.39	-6,058.98	-12,419.69	-5,217.07

Notes. The unit of observation is a country pair in a given year. The sample covers all contiguous country pairs and the years 1946–2008. Robust standard errors clustered at the country-pair level. The oil variables are constructed using all oil fields (onshore and offshore). All explanatory variables are taken as first lag. All specifications control for the average and the absolute difference of land areas in the pair, intercept, and annual time dummies. Additional controls are: the average and absolute difference of GDP per capita, the average and absolute difference of population, the average and absolute difference of fighting capabilities, the average and absolute difference of democracy scores, dummy for one country having civil war, dummy for both countries having civil war, bilateral trade/GDP, dummy for one country being OPEC member, dummy for both countries being OPEC member, genetic distance between the populations of the two countries, dummy for membership in the same defensive alliance, dummy for historical inclusion in the same country, kingdom, or empire, dummy for having been in a colonial relationship, and years since the last hostility in the country pair. Significance levels \*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$ .

statistically significant effect on the intensity of conflict, much as they do on conflict occurrence.

In Appendix II we estimate further regressions in the same spirit to predict whether country *A* is classified as more revisionist, attacker, or initiator of conflict than country *B*. We find robust evidence that oil-rich countries are less likely to be classified in any of these categories, and 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 toward neighbors that have oil, the more so the closer the oil is to the border.

Alternative distance scales, functional forms, subsamples: To further assess the robustness of our results, Table III presents variants of our preferred specification of column (4) of Table I. In column (1) we rescale the distance of oil fields from the border using a plain natural log function, and 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.<sup>33</sup> The results are again very similar to our benchmark.<sup>34</sup> 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  $\text{Dist} = \text{MinDist} = 0$ ). This indicates that the findings are not

33. 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 cluster at the country-pair level.

34. 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 III  
ROBUSTNESS WITH RESPECT TO ESTIMATOR AND SAMPLE

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
One	0.050 (0.034)	0.048*** (0.018)	2.603*** (0.992)	1.089** (0.448)	0.886** (0.450)		0.066** (0.028)	0.077** (0.030)
One × Dist	-0.004* (0.002)	-0.008*** (0.002)	-3.063*** (0.829)	-1.362*** (0.386)	-1.121** (0.460)	-0.090*** (0.028)	-0.077*** (0.026)	-0.086*** (0.027)
Both	0.049 (0.031)	0.047* (0.024)	0.772 (0.623)	0.285 (0.291)	0.359 (0.311)	-0.032 (0.029)	0.043* (0.026)	0.046* (0.027)
Both × MinDist	-0.005*** (0.002)	-0.011** (0.006)	-2.050*** (0.497)	-1.084*** (0.244)	-1.341*** (0.485)	-0.092*** (0.030)	-0.050*** (0.023)	-0.088*** (0.029)
Both × MaxDist	-0.000 (0.002)	-0.005* (0.003)	0.312 (0.500)	0.175 (0.258)	0.241 (0.474)	0.002 (0.030)	-0.026 (0.026)	0.002 (0.029)
Sample	All	All	All	All	All	Only pairs with oil	w/o Israel	w/o Dist. 0
Method	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	11,303	11,303	8,840	8,840	11,303	9,839	11,158	11,294
R-squared	0.154	0.161	0.319	0.310	0.232	0.171	0.155	0.158

Notes. Dependent variable: Hostility. The unit of observation is a country pair in a given year. The sample covers all contiguous country pairs and the years 1946–2001. In all columns except (5) robust standard errors clustered at the country pair level, in column (5) standard errors clustered at the country pair level (ReLogit does not allow for the robust option). The oil variables are constructed using all oil fields (onshore and offshore). All explanatory variables are taken as first lag. All specifications control for intercept, the average, and the absolute difference of land areas in the pair, the average and absolute difference of GDP per capita, the average and absolute difference of population, the average and absolute difference of fighting capabilities, the average and absolute difference of democracy scores, dummy for one country having civil war, dummy for both countries having civil war, bilateral trade/GDP, dummy for one country being OPEC member, dummy for both countries being OPEC member, genetic distance between the populations of the two countries, dummy for membership in the same defensive alliance, dummy for historical inclusion in the same country, kingdom, or empire, dummy for having been in a colonial relationship, and years since the last hostility in the country pair. All columns, with the exception of (5), also include country fixed effects and annual time dummies (ReLogit does not allow for FE and TE). Significance levels \*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$ .

driven by hostilities arising from difficulties in managing common-pool resources.

**Oil endowments:** In Section II.D.3 we noted that countries with oil might experience more frequent conflict simply because oil revenues confer resources that can be spent on 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. Having said this, to make sure that our distance variables do not spuriously correlate with oil endowments, in Table IV we perform further robustness checks with respect to the overall quantitative endowments of oil in the two countries in each pair.<sup>35</sup> Specifically, we control (in turn) for the mean and difference of: oil output (column (1)), estimated oil reserves (2), and oil output as a share of GDP (3). Furthermore, 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)). In column (5) we perform the same analysis as in column (4), but this time with oil reserves.

We can make three broad observations from the results of Table IV. 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. However, we have verified that this effect is due to a drop in the sample size. Third, the oil output/endowment variables are only rarely statistically significant predictors of conflict, possibly because their influence is already captured by the controls for GDP and for military capabilities.

*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

35. Recall that we do not have oil-field-level information on endowments, so we cannot test the model's predictions with respect to oil field size.

TABLE IV  
ROBUSTNESS WITH RESPECT TO OIL QUANTITIES

	(1)	(2)	(3)	(4)	(5)
One	0.082** (0.036)	0.061 (0.039)	0.078** (0.036)	0.084** (0.037)	0.061 (0.039)
One × Dist	−0.101*** (0.034)	−0.082** (0.034)	−0.099*** (0.034)	−0.104*** (0.035)	−0.083** (0.034)
Both	0.042 (0.032)	0.013 (0.042)	0.039 (0.032)	0.036 (0.032)	0.016 (0.042)
Both × MinDist	−0.070*** (0.025)	−0.072*** (0.025)	−0.072*** (0.024)	−0.070*** (0.024)	−0.072*** (0.026)
Both × MaxDist	−0.013 (0.028)	−0.009 (0.028)	−0.010 (0.027)	−0.014 (0.027)	−0.012 (0.029)
Oil production (mean)	−0.008** (0.004)				
Oil production (difference)	0.002 (0.001)				
Oil reserves (mean)		0.062 (0.123)			
Oil reserves (difference)		−0.041 (0.031)			
Oil production/GDP (mean)			−0.188*** (0.063)		
Oil production/GDP (difference)			0.063 (0.043)		
Oil production (further)				0.000 (0.001)	
Oil production (closer)				−0.001 (0.001)	
Oil reserves (further)					0.020 (0.035)
Oil reserves (closer)					0.018 (0.034)
Observations	9,580	7,089	9,240	9,580	7,089
R-squared	0.167	0.181	0.161	0.166	0.181

Notes. Dependent variable: Hostility. The unit of observation is a country pair in a given year. The sample covers all contiguous country pairs and the years 1946–2001. Method: OLS with robust standard errors clustered at the country-pair level. The oil variables are constructed using all oil fields (onshore and offshore). All explanatory variables are taken as first lag. All specifications control for intercept, annual time dummies, country fixed effects for each country of the dyad, the average and the absolute difference of land areas in the pair, the average and absolute difference of GDP per capita, the average and absolute difference of population, the average and absolute difference of fighting capabilities, the average and absolute difference of democracy scores, dummy for one country having civil war, dummy for both countries having civil war, bilateral trade/GDP, dummy for one country being OPEC member, dummy for both countries being OPEC member, genetic distance between the populations of the two countries, dummy for membership in the same defensive alliance, dummy for historical inclusion in the same country, kingdom, or empire, dummy for having been in a colonial relationship, and years since the last hostility in the country pair. Significance levels \*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$ .

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location, since countries enter into (potentially) border-changing conflict with a view of capturing each other's oil. But even *ex ante* borders, that is, 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 to ensure oil fields remained on its side. Or colonial powers might have chosen to draw postcolonial 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 to diversify the risk of disruption arising from turbulence in any one country.

To address these concerns, we follow three distinct strategies. The first is to focus on observations where we know that the border predates the discovery of oil. The second 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. 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 idea in columns (1)–(2) and (3)–(4) of Table V. In columns (1)–(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.<sup>36</sup> The results of columns (1)–(2) show that our key

36. Hence, if  $t_{oil}$  is the date at which oil was first discovered in either country, and  $t_1, t_2, t_3, \dots$  are the *ordered* dates of border changes (i.e.,  $t_i > t_{i-1}$ ), we (i) define  $\bar{t}$  such that  $t_{\bar{t}-1} < t_{oil}$  and  $t_{\bar{t}} \geq t_{oil}$ , and (ii) drop all observations dated  $t > t_{\bar{t}}$ . 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.

TABLE V  
CONTROLLING FOR POTENTIALLY ENDOGENOUS OR ARTIFICIAL BORDERS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
One	0.052* (0.029)	0.087** (0.034)	0.019 (0.027)	0.042 (0.026)	0.130*** (0.037)	0.081** (0.032)	0.072** (0.031)	0.191 (0.117)
One × Dist	-0.079*** (0.027)	-0.103*** (0.032)	-0.042* (0.024)	-0.061** (0.024)	-0.127*** (0.035)	-0.084*** (0.029)	-0.061** (0.025)	-0.195 (0.122)
Both	0.045* (0.026)	0.036 (0.026)	0.007 (0.023)	0.012 (0.027)	0.164*** (0.052)	0.045 (0.034)	0.154*** (0.056)	0.055 (0.038)
Both × MinDist	-0.100*** (0.030)	-0.055** (0.025)	-0.083*** (0.028)	-0.061*** (0.023)	-0.135** (0.062)	-0.038 (0.042)	-0.157** (0.073)	-0.023 (0.039)
Both × MaxDist	-0.011 (0.038)	-0.025 (0.030)	0.026 (0.030)	0.009 (0.026)	-0.018 (0.071)	-0.028 (0.051)	0.016 (0.081)	-0.044 (0.046)
Sample	No border changes after oil discovery	No border changes after oil discovery	No border changes after oil discovery, historical borders older than oil discovery or 1816	No border changes after oil discovery, historical borders older than oil discovery or 1816	Removed 50% with least “snaky” border	Removed 50% with least “snaky” border	Only country pairs without land border	
Additional controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	16,504	9,482	11,771	7,266	9,907	5,399	8,168	4,341
R-squared	0.151	0.149	0.231	0.148	0.187	0.203	0.172	0.148

Notes. Dependent variable: Hostility. The unit of observation is a country pair in a given year. The sample covers all contiguous country pairs and the years 1946–2001. Method: OLS with robust standard errors clustered at the country-pair level. The oil variables are constructed using all oil fields (onshore and offshore). All explanatory variables are taken as first lag. All specifications control for intercept, annual time dummies, country fixed effects for each country of the dyad, and the average and the absolute difference of land areas in the pair. Additional controls are: the average and absolute difference of GDP per capita, the average and absolute difference of population, the average and absolute difference of fighting capabilities, the average and absolute difference of democracy scores, dummy for one country having civil war, dummy for both countries having civil war, bilateral trade/GDP, dummy for one country being OPEC member, dummy for both countries being OPEC member, genetic distance between the populations of the two countries, dummy for membership in the same defensive alliance, dummy for historical inclusion in the same country, kingdom, or empire, dummy for having been in a colonial relationship, and years since the last hostility in the country pair. Significance levels \*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$ .



findings are statistically and economically robust to dropping borders that changed after oil discoveries.<sup>37</sup>

The exercise in columns (1)–(2) is suitable to remove concerns with ex post endogeneity, that is, with border changes in response to oil discoveries. However, it is still potentially vulnerable to ex ante endogeneity, that is, with the position of the oil affecting the drawing of the original borders. To address ex ante endogeneity, in columns (3)–(4) we further drop all country pairs that 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.<sup>38</sup> Again, despite the substantial drop in sample size, our headline results on 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 of building, for each bilateral land border, a measure of the deviation of the actual border from a relatively smooth arc (see Appendix I 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, whereas 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)–(6) we reestimate our baseline specifications 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

37. The removal of borders which changed after oil discoveries, as well as the other strategies examined in Table V, involves a significant drop in sample size. Our full set of controls induces further losses due to missing values. For these reasons, we include in the table specifications with no controls alongside our benchmark specifications with controls.

38. Following 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 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, for example, when borders were already drawn in colonial times.

Both  $\times$  MinDist, which loses significance in the specification with the full set of controls).

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)–(8) we reestimate our main specifications on the subsample of pairs that do not share a land border.<sup>39</sup> Even with this most restrictive criterion for inclusion in the sample, we find that our headline results largely hold (except for the last column where the reduction in sample size is most extreme and where our key variables now narrowly miss the 10% significance threshold).

#### IV. CONCLUSIONS

In this article we have studied the effect of natural resource endowments, as well as their geographic distribution, on the risk of interstate conflict. We have built a simple model that predicts the risk of interstate 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.

39. 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 preexisting 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.

We have tested these predictions empirically with a novel georeferenced data set designed 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 three to four times more likely to engage in conflict than country pairs with no oil, or where the oil is very far from the border, or when both countries have oil near the border. These results are robust to several strategies to deal with the potential endogeneity of bilateral borders.

Although 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, particularly regarding the endogenous evolution of borders and, hence, country size and location (e.g., Alesina and Spolaore 2003). This is a priority for future work.<sup>40</sup> Empirically, the priority is to complement our data on oil field location with data on oil field size and reserves. In addition, our theory applies equally and our empirical methods could be usefully applied to mineral natural resources other than oil. Finally, one could enrich the geographic dimension of both theory and empirics. For example, our analysis is silent on the location of oil fields vis-à-vis the country capital, but recent work suggests a weakening of political and institutional links away from the capital (Campante, Guimaraes, and Do 2013; Campante and Do 2014; Michalopoulos and Papaioannou 2014), which might have implications for the propensity of peripheral areas to be targets of foreign military action.

## APPENDIX I: DATA

This appendix describes the variables used in Section III and provides summary descriptive statistics in Appendix Table A.1.

40. In the Online Appendix we take a first step toward a dynamic model, via a dynamic extension with discrete geography. The qualitative predictions of the static model are robust, but even this simple extension promises to generate additional interesting predictions that we plan to pursue in future work.

### A. *Dependent Variables*

The dependent variables, Hostility, War, Hostility+, and Dispute intensity, have been explained in detail in Section III.A. We now explain the dependent variables used in Appendixes II and III, respectively.

*State A Revisionist (Attacker) [Initiator]*: We use the variables *revstata* and *revstatb* (*sidea* and *sideb*) [*rolea* and *roleb*] from Maoz (2005) which take values 1 if state *A* and, respectively, state *B* are deemed to seek to change the borders (be on the side of the initiator) [be the conflict's initiator], and 0 otherwise. Note that it is possible that in a country pair either both, one, or neither of the countries are revisionist (attacker) [initiator]. We construct our dependent variable for Appendix II 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.

*Border Change*: Our dependent variable for Appendix III is a dummy 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/>.

### B. *Explanatory Variables*

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 1,000 square kilometers. From World Bank (2009).

*GDP per capita*: Real gross domestic product per capita (in 1,000), current price national accounts at PPPs. From Heston, Summers, and Aten (2009).

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

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

TABLE A.1  
SUMMARY STATISTICS

Variable	Obs.	Mean	Std. dev.	Min.	Max.
Hostility	20,564	0.057	0.233	0	1
War	24,387	0.004	0.066	0	1
Hostility +	20,564	0.072	0.259	0	1
Dispute Intensity	20,564	0.284	1.014	0	5
State A revisionist	19,965	0.011	0.216	-1	1
State A attacker	19,965	0.006	0.263	-1	1
State A initiator	19,965	0.008	0.256	-1	1
Border change	24,387	0.004	0.061	0	1
One	24,387	0.349	0.477	0	1
One $\times$ Dist	24,387	0.285	0.424	0	1
Both	24,387	0.512	0.500	0	1
Both $\times$ MinDist	24,387	0.253	0.382	0	1
Both $\times$ MaxDist	24,387	0.332	0.431	0	1
Land area (mean)	24,366	1,330.520	2,277.200	0.300	13,365.100
Land area (diff)	24,366	1,928.770	3,909.240	0.010	17,055.200
GDP p.c. (mean)	18,075	6.099	7.219	0.108	80.983
GDP p.c. (diff)	18,075	3.941	5.982	0	99.604
Population (mean)	20,418	31.991	63.520	0.053	682.280
Population (diff)	20,418	45.064	109.178	0.003	1,129.500
Capabilities (mean)	20,489	0.013	0.024	0	0.200
Capabilities (diff)	20,489	0.019	0.040	0	0.362
Democracy (mean)	20,055	0.086	6.508	-10	10
Democracy (diff)	20,055	5.499	6.063	0	20
Bilat. trade/GDP	17,201	0.003	0.007	0	0.121
Genetic distance	23,566	374.012	563.105	0	2,908
Defensive pact	19,948	0.389	0.488	0	1
Ever same country	22,738	0.156	0.363	0	1
Colonial relation	22,738	0.062	0.242	0	1
Civil war 1	24,387	0.263	0.440	0	1
Civil war 2	24,387	0.041	0.197	0	1
OPEC 1	24,387	0.134	0.340	0	1
OPEC 2	24,387	0.025	0.157	0	1
Years since last Hostility	20,564	15.992	13.726	0	56
Years since last War	24,387	23.823	16.253	0	63
Years since last Hostility+	20,564	15.228	13.598	0	56
Years since last Bor. change	24,387	23.685	16.213	0	63
Oil prod. (mean)	19,547	2.850	5.975	0	52.175
Oil prod. (diff)	19,547	4.674	9.930	0	56.950
Oil res. (mean)	15,606	0.088	0.252	0	2.014
Oil res. (diff)	15,606	0.139	0.396	0	2.643
Oil/GDP (mean)	18,600	0.061	0.125	0	1.125
Oil/GDP (diff)	18,600	0.077	0.149	0	1.213
Border snakiness	24,387	1.929	0.744	1	2.757

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

*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.

*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).

*Genetic distance between the populations of the two countries*: Genetic distance between current plurality groups (variable *fst\_distance\_dominant*), from Spolaore and Wacziarg (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).

*Ever same country*: Dummy variable taking value 1 if countries were or are the same country (variable *smctry*), from Mayer and Zignago (2011).

*Colonial relationship*: Dummy variable taking value 1 for pairs that were ever in colonial relationship (variable *colony*), from Mayer and Zignago (2011).

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

*Civil War 2*: Dummy with value of 1 if there is a civil war in both countries of the pair, 0 otherwise. Constructed using data from Uppsala Conflict Data Program (2011).

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

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

*Oil production*: In 10 million tons (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*: Authors' calculations. Using the georeferenced shapes of bilateral country borders from Weidmann, Kuse,

TABLE A.2  
REGRESSIONS WITH DIRECTED DYADS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	State A revisionist			State A attacker			State A initiator					
Oil A	-0.022 (0.014)	-0.012 (0.010)	-0.044** (0.019)	-0.034** (0.017)	-0.006 (0.015)	-0.018 (0.014)	-0.022 (0.017)	-0.041*** (0.015)	-0.006 (0.015)	-0.016 (0.015)	-0.024 (0.016)	-0.041*** (0.015)
Oil A ×	0.033** (0.016)	0.022 (0.015)	0.032** (0.016)	0.045*** (0.015)	0.027* (0.015)	0.018 (0.015)	0.033* (0.017)	0.040*** (0.013)	0.029* (0.016)	0.019 (0.015)	0.037** (0.016)	0.041*** (0.013)
MinDist A	0.031* (0.017)	0.003 (0.022)	-0.004 (0.014)	0.000 (0.016)	0.008 (0.018)	-0.010 (0.017)	-0.007 (0.020)	-0.010 (0.018)	0.004 (0.018)	-0.012 (0.017)	-0.014 (0.019)	-0.017 (0.018)
Oil B ×	-0.035** (0.017)	-0.018 (0.021)	-0.025* (0.014)	-0.022* (0.013)	-0.014 (0.017)	-0.005 (0.016)	-0.021 (0.017)	-0.023 (0.016)	-0.011 (0.018)	-0.001 (0.016)	-0.017 (0.017)	-0.016 (0.017)
MinDist B	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Country FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Add. controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	19,962	11,303	19,962	11,303	19,962	11,303	19,962	11,303	19,962	11,303	19,962	11,303
R-squared	0.006	0.022	0.058	0.089	0.005	0.014	0.046	0.048	0.006	0.017	0.048	0.054

Notes. The unit of observation is a country pair in a given year. The sample covers all contiguous country pairs and the years 1946–2001. Method: OLS with robust standard errors clustered at the country-pair level. The oil variables are constructed using all oil fields (onshore and offshore). All explanatory variables are taken as first lag. The dependent variable in the columns (1)–(4) is the dummy for country A being revisionist, minus the dummy for 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 (5)–(8) and (9)–(12) with being attacker, resp. initiator instead of revisionist as underlying variable. All specifications control for intercept, land areas of both countries and annual time dummies. Additional controls for each country in the pair are: population, GDP per capita, democracy score, capabilities, dummy for having a civil war, dummy for being OPEC member, and all the controls at the country pair level, which are, years since the last hostility in the country pair, bilateral trade/GDP, genetic distance between the populations of the two countries, dummy for membership in the same defensive alliance, dummy for historical inclusion in the same country, kingdom, or empire, and dummy for having been in a colonial relationship. Significance levels \*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$ .



TABLE A.3  
CONFLICT AND BORDER CHANGES

	(1)	(2)	(3)	(4)
Hostility	0.018*** (0.006)		0.015*** (0.004)	
War		0.070*** (0.022)		0.064*** (0.020)
Country FE	No	No	Yes	Yes
Observations	20,564	24,387	20,564	24,387
R-squared	0.013	0.014	0.033	0.031

Notes. Dependent variable: Border change. The unit of observation is a country pair in a given year. The sample covers all contiguous country pairs and the years 1946–2008. Method: OLS with robust standard errors clustered at the country-pair level. All specifications control for intercept and annual time dummies. Significance levels \*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$ .

and Gleditsch (2010), we compute an index of bilateral border snakiness, using the following formula:

“Border snakiness”

$$= \frac{\text{“Actual bilateral border length”}}{\left\{ \begin{array}{l} 0.5 * \text{“Convex hull below the bilateral border”} \\ + 0.5 * \text{“Convex hull above the bilateral border”} \end{array} \right\}}.$$

This measure takes a value of 1 when the border is a straight line, while its value increases when the border becomes more winding, or. snaky.

APPENDIX II: DIRECTED DYADS

The results of the regressions with directed dyads are displayed in Appendix Table A.2.

APPENDIX III: BORDER CHANGES

The results of the regressions with border changes are displayed in Appendix Tables A.3 and A.4.

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TABLE A.4  
OIL LOCATION AND BORDER CHANGES

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
One	0.002 (0.002)	0.001 (0.002)	0.004 (0.003)	0.005* (0.003)	0.014* (0.007)	0.014* (0.009)	0.017** (0.007)	0.020* (0.011)	0.002 (0.002)	0.001 (0.002)	0.004 (0.003)	0.005 (0.004)
One × Dist	-0.002 (0.002)	-0.001 (0.001)	-0.003 (0.002)	-0.004 (0.003)	-0.016** (0.008)	-0.016* (0.009)	-0.019** (0.007)	-0.021** (0.009)	-0.003 (0.002)	-0.001 (0.002)	-0.003 (0.003)	-0.004 (0.004)
Both	0.006*** (0.002)	0.006*** (0.003)	0.013*** (0.004)	0.008* (0.004)	0.006 (0.004)	0.001 (0.002)	0.011** (0.005)	0.004 (0.005)	0.005** (0.002)	0.006** (0.003)	0.011** (0.005)	0.008 (0.006)
Both ×	0.000 (0.003)	-0.002 (0.005)	-0.001 (0.002)	-0.002 (0.003)	0.002 (0.002)	0.000 (0.002)	0.000 (0.003)	-0.002 (0.002)	-0.003 (0.004)	-0.004 (0.006)	-0.004 (0.003)	-0.002 (0.004)
MinDist	-0.006* (0.003)	-0.005 (0.004)	-0.009*** (0.003)	-0.005 (0.005)	-0.008 (0.006)	-0.002 (0.004)	-0.010* (0.006)	0.000 (0.003)	-0.002 (0.004)	-0.003 (0.004)	-0.006* (0.003)	-0.006 (0.005)
MaxDist	All	All	All	All	Offshore	Offshore	Offshore	Offshore	Onshore	Onshore	Onshore	Onshore
Type oil	All	All	All	All	Offshore	Offshore	Offshore	Offshore	Onshore	Onshore	Onshore	Onshore
Country FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Add. controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	23,768	11,303	23,768	11,303	23,768	11,303	23,768	11,303	23,768	11,303	23,768	11,303
R-squared	0.011	0.011	0.027	0.035	0.012	0.012	0.027	0.037	0.011	0.011	0.026	0.035

Notes. Dependent variable: Border change. The unit of observation is a country pair in a given year. The sample covers all contiguous country pairs and the years 1946–2008. Method: OLS with robust standard errors clustered at the country-pair level. All explanatory variables are taken as first lag. All specifications control for the average and the absolute difference of land areas in the pair, intercept, and annual time dummies. Additional controls are: the average and absolute difference of GDP per capita, the average and absolute difference of population, the average and absolute difference of fighting capabilities, the average and absolute difference of democracy scores, dummy for one country having civil war, dummy for both countries having civil war, bilateral trade/GDP, dummy for one country being OPEC member, dummy for both countries being OPEC member, genetic distance between the populations of the two countries, dummy for membership in the same defensive alliance, dummy for historical inclusion in the same country, kingdom, or empire, dummy for having been in a colonial relationship, and years since the last border change in the country pair. Significance levels \*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$ .

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### SUPPLEMENTARY MATERIAL

An Online Appendix for this article can be found at QJE  
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