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Natural resource wars in the shadow of the future
Web appendix

August 13, 2018

1 Additional robustness checks

To control for the possibility that belligerents engage in talks without real intent to end the conflict, we used two alternative (more costly) measures that indicate a visible commitment to conflict termination. We assume that talks are more likely serious with third party presence or when they result in a signed agreement. Thus, these settings provide more conservative proxies that parties' expect conflict termination to be forthcoming. The first of these is *Mediated talks*, as the presence of an external mediator makes withdrawal more costly. The second is that the parties sign a *Peace agreement* in a given year. While this may not be successfully implemented, we contend that signing of an agreement provides a strong signal that parties expect that the conflict is not continuing indefinitely. While there may be 'spoilers' after a signed agreement, these will primarily seek to threaten a (brief) return to conflict to acquire additional concessions rather than aim for a protracted fight (Werner, 1999).

Table 5 presents the full model estimations using the alternative measurements. Models 1 and 2 focus on mediated talks, while Models 3 and 4 distinguish between years when belligerents sign a peace agreement and those when they do not. Across all models, we find similar results as before. Natural resource locations have fewer battle fatalities when long conflict duration (no mediation or no

peace agreement) is expected, but relatively more when the conflict is expected to end, however, the latter estimates do not reach statistical significance similarly to our main results in Table 3. By reaching similar findings using a more conservative coding for approximating expectations, we are confident that our findings are representative of our proposed logic. Although parties may have incentives to enter into negotiations primarily to reorganize and rearm, this would not systematically comply them to sign a peace agreement which settles the conflict issue. Thus, since we find less violence close to natural resources for situations of expected long conflict duration even when limiting our independent variable to mediated talks, or the years with a peace agreements, there are strong indications that belligerents strategically decide to avoid fighting near natural resources in some phases of the conflict.

In order to make sure that our results are not driven by time dependency or unit specific heterogeneity, we tested the results with yearly dummies and random effects model specifications (reported in Table 5). Both the year dummy and the random effects models depict similar findings of our previous models whereby without talks the grid-cells with natural resources experience significantly less violence and grid-cells with natural resources during talks have a positive but statistically non-significant relationship with battle fatalities.[1]

In addition, we also investigated the disaggregated impact of different natural resources on battle fatalities. The results are organized so that Table 6 reports those natural resources that we assume are more likely to be government controlled, whereas Table 7 shows the results for those natural resources that we believe rebels are more likely to control. *Onshore petroleum* fields have a negative relationship with battle fatalities without peace talks and a positive one during talks, however, neither coefficient reaches statistical significance.

[1]It is not possible to obtain meaningful estimates of our natural resource variable at the grid-cell level using fixed effects models as the presence or absence of natural resources in the grid-cells does not vary over time.

Table 5: Mediation, peace agreement, year dummy and random effects regressions

	(1) Interaction med.	(2) Interaction PA	(3) No talks,yd	(4) Talks, yd	(5) No talks, re	(6) Talks, re
Natural resources	-0.762***	-0.692***	-0.717**	0.605	-0.543***	0.0103
	(-3.89)	(-4.01)	(-3.08)	(1.83)	(-3.82)	(0.09)
Mediation	0.462***					
	(4.04)					
Natural resourcesXMediation	0.701*					
	(2.54)					
Cell area	0.0470	0.0448	0.113	-0.0811	-0.695***	-0.0643
	(0.47)	(0.47)	(0.71)	(-0.54)	(-9.75)	(-0.89)
Govt external	0.631***	0.652***	1.063***	0.0123	0.702***	-0.165
	(3.92)	(4.07)	(3.99)	(0.06)	(7.30)	(-1.84)
Rebel external	0.929***	0.918***	0.669*	-0.388	1.350***	0.342
	(4.31)	(4.50)	(2.05)	(-1.13)	(5.92)	(1.91)
Duration	0.111***	0.120***	0.244***	-0.112***	0.112***	-0.140***
	(4.10)	(4.45)	(3.92)	(-3.44)	(7.19)	(-8.41)
Conflict lag	1.985***	2.076***	2.155***	0.780*	1.571***	0.180
	(10.05)	(10.82)	(10.08)	(2.33)	(13.27)	(1.07)
Contiguity	-1.975***	-1.892***	-3.316***	0.259	-1.248***	-0.317
	(-3.82)	(-3.83)	(-4.81)	(0.43)	(-3.90)	(-1.21)
Capital distance	-0.124	0.000197	-0.332	0.826***	-0.811***	-0.0845
	(-0.67)	(0.00)	(-1.33)	(3.61)	(-6.07)	(-0.81)
Country fatalities	0.149***	0.158***	0.460**	0.274***	0.188***	0.0152
	(3.90)	(4.07)	(3.08)	(8.09)	(7.41)	(1.31)
Population size	0.00344	0.00780	0.0471*	0.114**	0.00187	0.00746
	(0.17)	(0.41)	(2.51)	(3.28)	(0.28)	(0.67)
Previous fatalities	2.448*	2.453**			0.0487	0.00685
	(2.48)	(2.59)			(1.39)	(0.23)
Peace agreement		0.478*				
		(2.23)				
Natural resourcesXPeace Agr.		0.617*				
		(2.02)				
_cons	0.217	0.0930	0.224	1.928**	-0.689**	-0.227
	(0.68)	(0.31)	(0.34)	(3.06)	(-2.87)	(-0.84)
lnalpha						
_cons	1.796***	1.801***	2.187***	1.142***		
	(29.28)	(29.63)	(31.40)	(23.80)		
ln_r						
_cons					-0.852***	0.0976
					(-12.70)	(0.97)
ln_s						
_cons					0.0917	3.786***
					(0.43)	(17.70)
N	4368	4368	3302	1066	3302	1066

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Offshore petroleum fields, however, follow the pattern of the aggregate results by statistically significantly reducing battle fatalities when no talks are underway. The coefficient is positive, but not statistically significant when talks are initiated. *Non-lootable diamond* deposits reduce violence with or without talks, but neither coefficient reaches statistical significance in our models. On the rebel side of things, *Lootable diamond* deposits show a similar relationship as non-lootable diamonds with neither coefficient statistically significant. *Cannabis* equally to offshore petroleum deposits follows the aggregate pattern of reducing battle fatalities without talks and positively, but not statistically significantly increasing them during talks. The results highlight that the variation in the natural resources type is unlikely to stem from who controls it, but rather its relative value to the belligerents. Diamonds seem to deter fighting regardless of peace talks whereas onshore petroleum seems to be consistently contested. This also highlights that external protection is also less likely to be a factor given that onshore petroleum has a positive relationship whereas lootable diamonds a negative relationship with violence. Cannabis and offshore petroleum seem to provide the war time political order suggested by our theoretical frame and these findings warrant further investigation.

We also replicate our primary models with high and low battle fatality estimates from UCDP-GED dataset (Sundberg and Melander, 2013). The results of the robustness checks are reported in Table 8 in the appendix. We ran both of the models with and without talks and altered the country fatalities variables from the best estimate values for a given country to high estimates for the high battle deaths models and low estimates for the low battle estimates models. The results are in accordance with our previous findings.

In order to evaluate the effect of talks on locations of fatalities, we added a nearest neighbour propensity score matching method. This method allows us to

compare the effect of the talks (treatment) between the treated and not treated grid-cells. Since the talks are not randomly assigned to the grid-cells, we match the treated grid-cells to the similar not treated grid-cells to evaluate the impact of talks (Rubin, 1973; Ho et al., 2007). We match the grid-cells on natural resources, capital distance, size of the cell and contiguity. These covariates were selected for the matching since they cannot be affected by the treatment and are relatively fixed over time. The nearest neighbour matching algorithm provides a good match between the treated and not treated observations. The matches are well balanced and below the threshold of 5% bias. Figure 6 in the appendix provides support for the matching meeting the 'common support' condition insofar that there is overlap between the treated and not treated grid-cells. We use *psmatch2* (Leuven and Sianesi, 2014) to evaluate the treatment effect of talks on violence and find that the treated sample has an increase of 41 battle fatalities compared to the non-treated sample. This supports our theoretical argument in so far that during talks battle fatalities are on the rise.

Finally, we test our models for spatial dependencies. We generate a spatial weighing matrix with the user-written *spmat* program in Stata (Drukker et al., 2013). The matrix for our spatial tests is a binary row-normalized contiguity matrix with 10260 x 10260 dimensions. Since the spatial dependency tests are very sensitive to missing data, we were not able to include all of our variables into the models. Table 9 summarizes the results of the spatial dependency tests for both spatial autocorrelation in the error term and substantive spatial autocorrelation (only the Lagrange multiplier is statistically significant). Our model does not suffer from either type of spatial dependency. In addition, we tested for global spatial autocorrelation and local spatial autocorrelation by using the *spatgsa* and *spatlsa* commands in Stata (Pisati, 2001). Table 10 shows that some our control variables do seem to have global spatial autocorrelation, how-

ever, only 46 (0.4%) of our grid-cells have statistically significant local spatial autocorrelation.

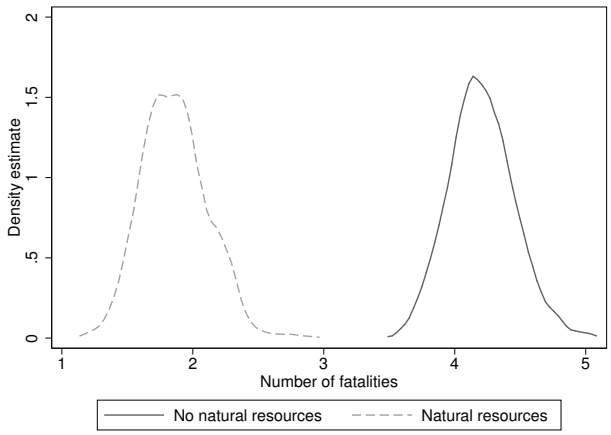

Figure 4: Density estimates without peace talks

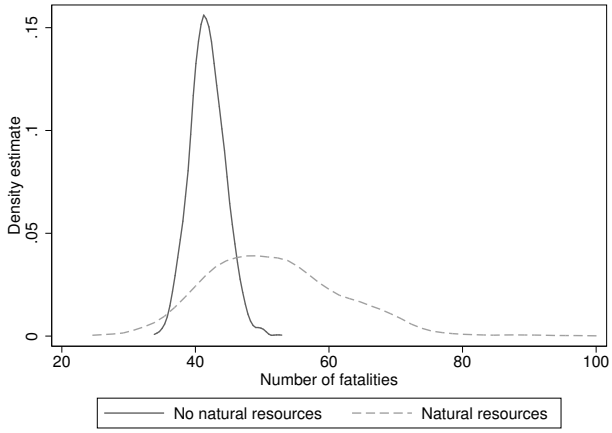

Figure 5: Density estimates with peace talks

Table 6: Negative binomial regressions for different natural resources

	(1) No talks	(2) Talks	(3) No talks	(4) Talks	(5) No talks	(6) Talks
Onshore petroleum	-0.134	0.171				
	(-0.43)	(0.33)				
Cell area	0.0627	0.0189	0.0456	0.0644	0.0642	0.0241
	(0.47)	(0.15)	(0.34)	(0.56)	(0.48)	(0.19)
Govt external	0.967***	-0.204	0.981***	-0.197	1.037***	-0.207
	(4.00)	(-1.43)	(4.05)	(-1.41)	(4.20)	(-1.47)
Rebel external	0.814*	0.403	0.811*	0.354	0.789*	0.408
	(2.46)	(1.67)	(2.46)	(1.46)	(2.34)	(1.69)
Duration	0.164***	-0.0928**	0.168***	-0.0971***	0.161***	-0.0924**
	(3.63)	(-3.22)	(3.70)	(-3.56)	(3.50)	(-3.23)
Conflict lag	1.864***	0.589	1.853***	0.591	1.875***	0.597
	(8.35)	(1.71)	(8.30)	(1.72)	(8.39)	(1.74)
Contiguity	-2.050**	-0.832	-2.079**	-0.773	-2.071**	-0.800
	(-2.98)	(-1.66)	(-3.02)	(-1.45)	(-2.99)	(-1.52)
Capital distance	-0.299	0.342*	-0.296	0.370*	-0.299	0.344*
	(-1.34)	(2.05)	(-1.32)	(2.15)	(-1.34)	(2.08)
Country fatalities	0.322**	0.0940**	0.323**	0.0928*	0.320*	0.0924*
	(2.59)	(2.67)	(2.59)	(2.45)	(2.56)	(2.53)
Population size	-0.0301	0.0226	-0.0301	0.0232	-0.0311	0.0224
	(-1.45)	(1.29)	(-1.44)	(1.32)	(-1.50)	(1.29)
Previous fatalities	3.352**	1.492	3.391**	1.466	3.361**	1.496
	(2.65)	(1.83)	(2.64)	(1.77)	(2.64)	(1.82)
Offshore petroleum			-6.930***	0.777		
			(-5.50)	(1.12)		
Non-lootable diamonds					-1.020	-0.327
					(-1.69)	(-1.04)
_cons	-0.201	2.802***	-0.159	2.668***	-0.204	2.782***
	(-0.46)	(5.67)	(-0.37)	(5.52)	(-0.47)	(5.52)
lnalpha						
_cons	2.141***	1.031***	2.137***	1.030***	2.140***	1.031***
	(27.61)	(14.14)	(27.42)	(14.47)	(27.58)	(14.24)
N	3302	1066	3302	1066	3302	1066

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: Negative binomial regressions for different natural resources

	(1) No talks	(2) Talks	(3) No talks	(4) Talks
Cannabis	-1.242**	0.496		
	(-2.89)	(0.95)		
Cell area	0.0939	0.0258	0.0681	0.0276
	(0.70)	(0.21)	(0.51)	(0.22)
Govt external	0.823***	-0.264	1.026***	-0.215
	(3.58)	(-1.92)	(4.17)	(-1.53)
Rebel external	0.787*	0.466	0.794*	0.410
	(2.45)	(1.89)	(2.36)	(1.70)
Duration	0.189***	-0.0939***	0.161***	-0.0936**
	(4.19)	(-3.32)	(3.53)	(-3.26)
Conflict lag	1.751***	0.584	1.880***	0.607
	(7.58)	(1.71)	(8.39)	(1.77)
Contiguity	-2.434***	-0.781	-2.065**	-0.816
	(-3.50)	(-1.49)	(-2.98)	(-1.55)
Capital distance	-0.410	0.298	-0.297	0.336*
	(-1.84)	(1.80)	(-1.32)	(2.03)
Country fatalities	0.336*	0.0928*	0.319*	0.0919*
	(2.52)	(2.53)	(2.56)	(2.52)
Population size	-0.0209	0.0212	-0.0310	0.0219
	(-0.88)	(1.22)	(-1.50)	(1.26)
Previous fatalities	3.103*	1.487	3.356**	1.492
	(2.51)	(1.81)	(2.64)	(1.81)
Lootable diamonds			-0.906	-0.350
			(-1.70)	(-1.35)
_cons	-0.0598	2.818***	-0.218	2.783***
	(-0.14)	(5.54)	(-0.50)	(5.52)
lnalpha				
_cons	2.123***	1.030***	2.140***	1.031***
	(27.66)	(14.31)	(27.57)	(14.25)
N	3302	1066	3302	1066

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8: Negative binomial regressions for high and low battle deaths estimates

	(1) No talks	(2) Talks	(3) No talks	(4) Talks
Natural resources	-0.735***	0.239	-0.716***	0.0594
	(-3.31)	(0.85)	(-3.40)	(0.28)
Cell area	0.206	-0.0166	0.0498	0.0145
	(1.30)	(-0.12)	(0.35)	(0.12)
Govt external	0.938**	-0.163	1.036***	-0.254
	(3.08)	(-1.15)	(4.22)	(-1.80)
Rebel external	0.0462	0.423	0.702*	0.442
	(0.14)	(1.48)	(2.30)	(1.72)
Duration	0.218***	-0.0746**	0.144**	-0.0891**
	(6.96)	(-2.68)	(3.24)	(-3.20)
Conflict lag	1.893***	0.916**	1.990***	0.562
	(8.48)	(2.73)	(8.72)	(1.64)
Contiguity	-3.084***	-1.806***	-2.552***	-0.775
	(-4.30)	(-3.98)	(-3.77)	(-1.48)
Capital distance	-0.347	0.332	-0.467*	0.322*
	(-1.22)	(1.62)	(-2.13)	(2.01)
Country high est.	0.383***	0.102***		
	(3.76)	(6.62)		
Population size	-0.0515*	0.0304*	-0.0261	0.0221
	(-2.33)	(2.05)	(-1.18)	(1.29)
Previous fatalities	2.362**	0.898	3.258**	1.461
	(2.75)	(1.96)	(2.92)	(1.79)
Country low est.			0.202**	0.0948*
			(2.85)	(2.56)
_cons	0.258	3.246***	0.0246	2.823***
	(0.52)	(6.12)	(0.05)	(5.56)
lnalpha				
_cons	1.859***	0.666***	2.108***	1.050***
	(30.18)	(13.80)	(26.98)	(14.92)
N	3302	1066	3302	1066

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9: Spatial dependency tests of a fitted regression model

Weights matrix			
Name: Ws Type: Imported (binary) Row-standardized: Yes			
Diagnostics			
Test	Statistic	df	p-value
Spatial error:			
Moran's I	1.817	1	0.069
Lagrange multiplier	4.249	1	0.039
Robust Lagrange multiplier	3.359	1	0.067
Spatial lag:			
Lagrange multiplier	2.574	1	0.109
Robust Lagrange multiplier	1.684	1	0.194

Table 10: Spatial dependency tests of specific variables

Weights matrix					
Name: Ws Type: Imported (binary) Row-standardized: Yes					
Moran's I					
Variables	I	E(I)	sd(I)	z	p-value*
Battle deaths	0.019	-0.000	0.006	3.045	0.001
Natural resources	0.042	-0.000	0.007	6.321	0.000
Cell area	0.566	-0.000	0.007	84.473	0.000
Capital distance	0.509	-0.000	0.007	75.891	0.000
Population	0.303	-0.000	0.007	45.553	0.000
Country fatalities	0.406	-0.000	0.007	60.576	0.000

*1-tail test

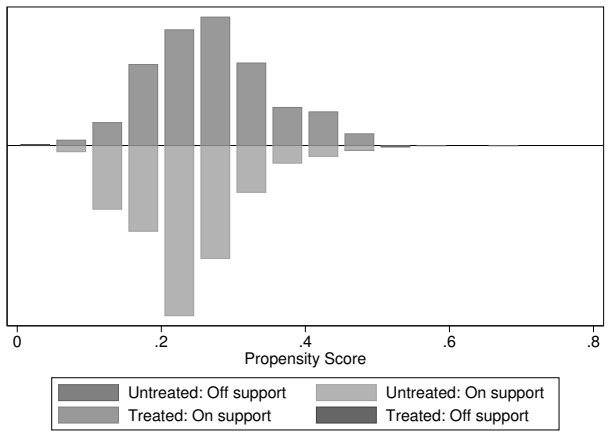

Figure 6: Overlap graph of treated and not treated grid-cells

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