Appendix for To Buy a War but Sell the Peace? Mercenaries and Post-Civil War Stability

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Overview

This appendix cover the following aspects in support of the main paper. We first introduce information about our process of Coarsened Exact Matching (CEM), before presenting the full underlying estimates for analyses presented in Figure 2 in the paper (Table A1). In extensions of the analyses presented in the paper, we disaggregate between PMSC hired by government and rebels, respectively (Figure A1), and a more detailed investigation into the temporal dynamics of when PMSC have been used (Table A2). This is followed by reporting the estimates of analyses that focuses on other types of auxiliary forces that may be present in the conflict context (Figures A2-A5).

We then move to report additional information around the section on robustness test in the article in several steps. First, we investigate the risk of systematic bias related to the geographic limits of available PMSC data. We address this by carefully investigating the possibility that conflict contexts differ across regions (Table A3-A4), followed by an analysis of the correlation between different datasets that we employ for robustness testing in the article. We also present the results from a selection model with region-specific fixed effect (Table A5) which shows little differences concerning the context of PMSC use in different world regions.

Second, we explore the possible confounds of conflict context with more complete output than what is presented in the article about the influence of government-rebel strength on the risk of recurrence. We replicate our models using both the specific strength relationship between government and rebels and a measure on battle intensity as a potential indicator of information transfer during the conflict (Table A6).

Third, we explore the linkages between PMSC use during the conflict and into the post-conflict society. Table A7 show that the likelihood of PMSC use in the post-conflict society increases if such forces have been deployed during the conflict, and Table A8 replicates these estimations

using data of all PMSC presence rather than just involvement in combat with substantively similar results.

CEM Matching

Coarsened Exact Matching (CEM) requires the analyst to define categories or cut-off points into which the cases are placed to find suitable treatment and control cases. This is called coarsening a variable. In this study, the variables were coarsened as follows:

Conflict duration: Conflicts that lasted only one year (49% of our cases) vs conflicts that lasted longer than that (51% of our cases).

UN totals (logged)

Only 19 of 113 panels (17%) have peacekeepers at all at any point during the postwar period. The variables is thus coarsened into a binary (peacekeeping yes/no), ignoring the amount of personnel among those cases that have peacekeeping.

GDP per capita (logged)

Coarsened into four equally spaced bins:

5.29-6.26 (18 cases) | 6.26-7.22 (40 cases) | 7.22-8.18 (43 cases) | 8.18-9.14 (12 cases)

Natural resource rents in % of GDP (logged)

Coarsened into four equally spaced bins:

-0.96-0.32 (6 cases) | 0.32-1.60 (20 cases) | 1.60-2.88 (66 cases) | 2.88-4.16 (21 cases)

Full Estimates for Figure 2

These are the estimates corresponding to the coefficient plot presented in Figure 2 of the paper.

Table A1. Full estimates for Figure 2

	(1)	(2)	(3)	(4)
Any PMSC during conflict	1.64*			
	(0.47)			
Any PMSC last year		2.41***		
		(0.70)		
PMSC count of events			1.06	
			(0.04)	
PMSC count, final year				1.13***
				(0.03)
Conflict duration	1.00	1.01	1.01	1.01
	(0.01)	(0.01)	(0.01)	(0.01)
Victory	0.26***	0.24***	0.27***	0.21***
	(0.13)	(0.11)	(0.12)	(0.11)
Settlement	0.59	0.52**	0.57*	0.55*
	(0.20)	(0.17)	(0.19)	(0.19)
UN totals (ln)	0.96	0.96	0.94	0.97
	(0.05)	(0.05)	(0.07)	(0.05)
GDP per capita (ln)	1.02	1.01	1.00	1.01
	(0.16)	(0.16)	(0.16)	(0.16)
Resource rents per capita (ln)	1.01	1.02	1.02	1.03
	(0.13)	(0.13)	(0.13)	(0.14)
Postwar periods	113	113	113	113
N	763	763	763	763

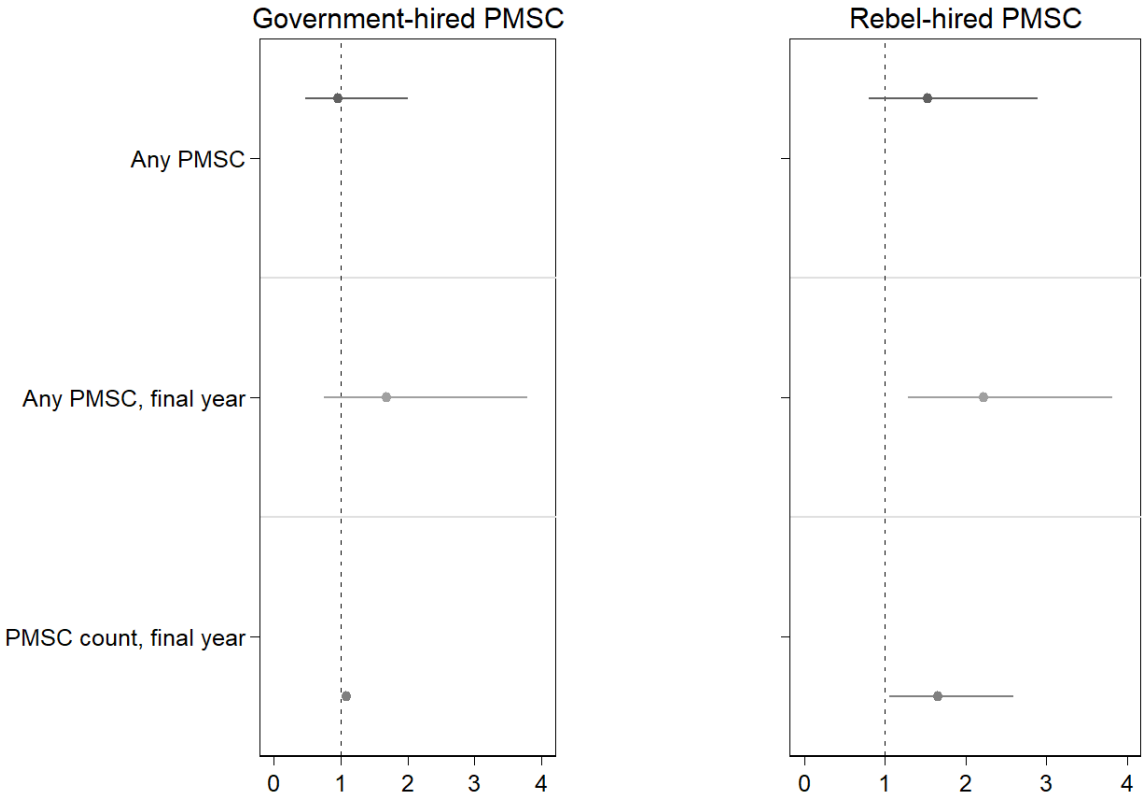
Cox hazard ratios with robust standard errors in parentheses.

* p<0.1 ** p<0.05 *** p<0.01

Government-hired vs rebel-hired PMSC

As Figure A.1 below shows, there are no substantive differences in effect between government- and rebel-hired PMSC. In each of the three models, government and rebel PMSC were estimated together, i.e., as two independent variables in one model, and then presented in side-by-side coefficient plots. In our main model (any PMSC event during the entire war), estimating government- and rebel-hired PMSC as two separate variables renders each of them individually statistically insignificant (whereas we know from Table 3 in the article that they are jointly significant). For the final war year, the effects go in the same direction, but are only significant for rebel-hired PMSC. For event counts in the final year, both estimates are significant and go in the same direction. This is the most important result: that in the one situation in which we expect the strongest effect of PMSC on war recurrence, namely in the final conflict year and with increasing PMSC activity, both government- and rebel-hired PMSC are associated with a statistically significant increase in the risk of war recurrence. The point estimate appears to be stronger for rebel-hired PMSC, but also with more uncertainty around the estimate.

Figure A.1. Government-hired vs rebel-hired PMSC



Temporal Dynamics of PMSC Involvement

In this section we follow up on the finding (from Models 3 and 4 in Table 3 of the article) that it is primarily the involvement of PMSC in the final conflict year that creates problems for trust and credible commitment in the postwar period and thus increases the risk of war recurrence.

Firstly, we analyse whether it is really just the last conflict year, or whether the effect of PMSC involvement on postwar peace just tapers off the further back in the conflict the parties used these private actors. Models 1-3 in Table A2 show that it is indeed only the final conflict year that matters in this regard. For conflicts that least at least two years, PMSC involvement in the second-last year has no statistically significant effect. For conflicts that least at least three years, PMSC involvement in the second-last or third-last year has no statistically significant effect. We should note though that the samples in Model 2 and Model 3 are fairly small.

Secondly, we assess whether the overall number of years that PMSC have been used has an influence on the risk of recurrence. In some of our models in the article we use a count of reported PMSC events as a proxy of the visibility of these actors, assuming that more intense PMSC involvement has a stronger impact on parties' trust, commitment, and their assessment of their opponent's real strength than PMSC involvement that is barely reported. Here we assess whether PMSC involvement over a longer time period also has this effect. As Model 4 in Table A2 shows, this is not the case.

Finally, we would have liked to assess more systematically whether the destabilizing impact of PMSC involvement in the final year is the same whether or not PMSC were there previously. There is an element of surprise if one party uses PMSC as a quick boost to their military capacity, with the result that uncertainty remains about the parties' true balance-of-power into the postwar period. This destabilizing effect of PMSC in the final year should perhaps be weaker if the PMSC have already been there previously. Unfortunately, in the small sample of 60 postwar periods that followed conflicts lasting longer than a year, there are not enough cases in each of these categories (PMSC only in the final year, PMSC in the final and previous years, PMSC only in previous years but not in the final) to make any reliable assessments.

Table A.2. PMSC involvement, temporal dynamics, 1990-2014.

	(1)	(2)	(3)	(4)
PMSC last year	2.41***	2.82***	3.28**	
	(0.70)	(1.02)	(1.57)	
PMSC 2nd last year		0.53	1.60	
		(0.30)	(0.95)	
PMSC 3rd last year			0.68	
			(0.47)	
Total years of PMSC				1.08
				(0.14)
Conflict duration	1.01	0.98	0.98	1.01
	(0.01)	(0.02)	(0.02)	(0.02)
Victory	0.24***	0.16***	0.20	0.27***
	(0.11)	(0.11)	(0.21)	(0.13)
Settlement	0.52**	0.25***	0.23**	0.59
	(0.17)	(0.12)	(0.14)	(0.20)
UN totals (ln)	0.96	0.96	0.94	0.97
	(0.05)	(0.06)	(0.08)	(0.06)
GDP per capita (ln)	1.01	0.88	0.74	1.03
	(0.16)	(0.16)	(0.18)	(0.16)
Resource rents per capita (ln)	1.02	0.95	1.05	1.05
	(0.13)	(0.16)	(0.22)	(0.15)
Postwar periods	113	64	43	113
N	763	388	288	763

Cox hazard ratios with robust standard errors in parentheses.

* p<0.1 ** p<0.05 *** p<0.01

Alternative auxiliary forces

This section presents Kaplan-Meier survival curves for estimations exploring different types of auxiliary forces present during the final year of conflict and subsequent peace duration. Figure A2 shows the survival curve after analysis of last year PMSC forces (Table 3, model 3 in the article). Subsequent figures replicates this analysis but replaces PMSC with external troop support (A3), pro-government militias (A4), and multiple rebel groups (A5).

Figure A2. PMSC combat involvement in final year and probability of peace over time.

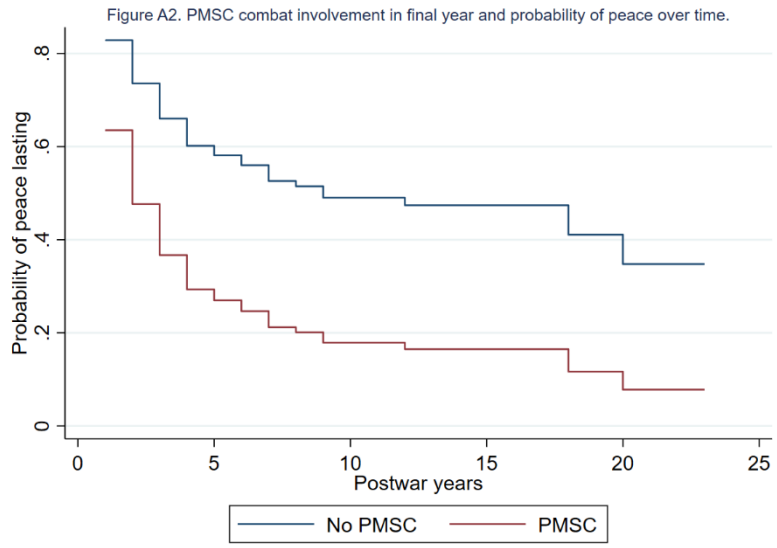
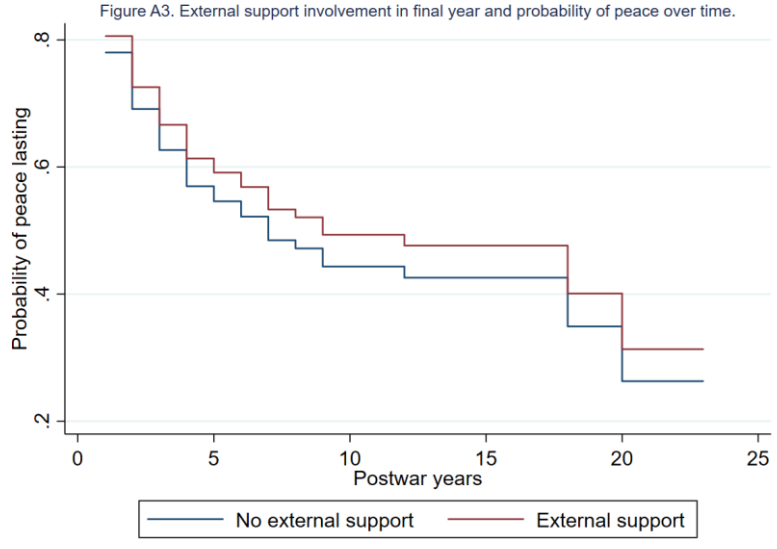
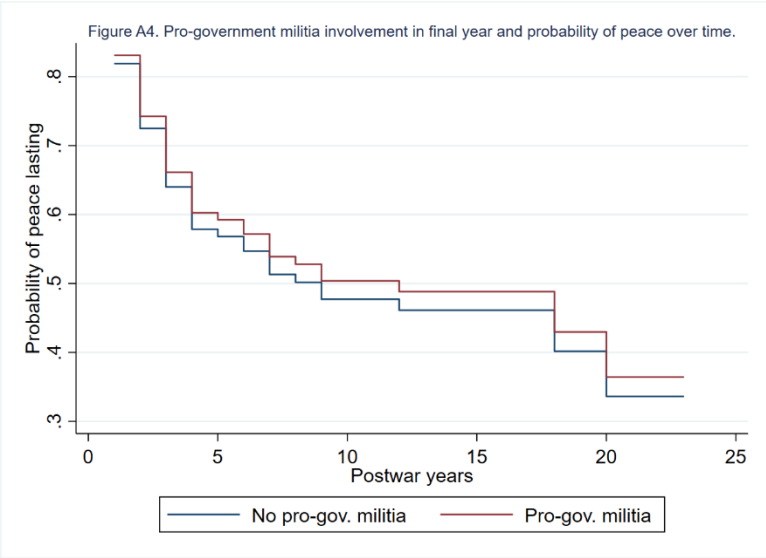
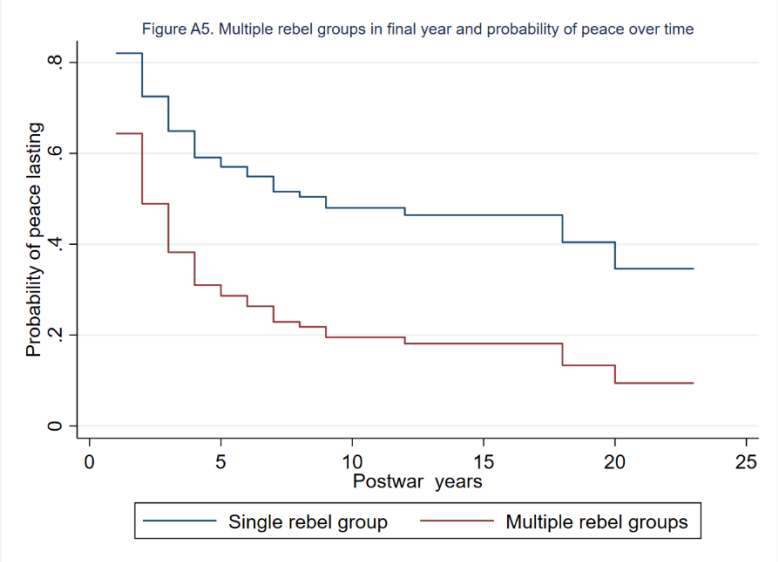


Figure A3. External support involvement in final year and probability of peace over time.







Geographical Coverage

The PSED dataset covers Africa, Latin America, and Southeast Asia, which means that our sample is based on 113 of 206 instances of conflict recurrence globally between 1990 and 2014 (around 55%). Having a limited sample is in itself not a problem unless it introduces systematic bias into our results. What we are concern about is primarily if (a) there are systematic differences between conflicts depending on region, or (b) the relationship between PMSC and other variables differ depending on region. In the article, we present a few alternative tests of our main model using data that is global in scope but with lower validity towards our theoretical argument, and find substantively similar findings.

To investigate the geographical context, we assess whether the analysed conflicts and the conflicts in the excluded regions differ substantively on those variables that we believe to influence PMSC involvement (and the risk of war recurrence), that is, our control variables. Table A3 offers a comparison of the descriptive statistics on the control variables for the regions included in our analysis (Africa, Latin America and Southeast Asia) and those for which we lack information on PMSC (North America, Europe, MENA, remainder of Asia). We then run a t-test for the difference in means between the included and excluded regions to assess whether this difference in means is statistically significant. We do this only for the cross-section of the first postwar years because t-tests require the assumption that observations are independent of each other.

There are only three control variables for which we see a statistically significant difference in means between our analysis sample and the regions not part of our sample. The first is GDP per capita, perhaps not surprisingly, as our sample excludes wealthier countries in Europe such as the UK, Spain or Russia, as well as Israel. The second is natural resource rents. The resource dependence in our sample is higher than in the excluded countries, driven by conflicts in Libya, Angola, and Congo. Finally, the conflicts included in our sample see on average stronger rebel armies relative to the size of the governments' military expenditures than those excluded from our sample. This difference is driven especially by some of the conflicts in states with weak governments, such as Sierra Leone, Liberia, or the DRC.

Table A3. Comparing control variable means across regions.

Control Variable	**N incl**	**Mean incl**	**N excl**	**Mean excl**	**Mean diff.**	**90% interval**	**p-value**
Conflict duration	113	5.21	93	4.00	-1.21	(-2.87, 0.44)	0.228
Victory	113	0.17	93	0.20	0.04	(-0.05, 0.13)	0.508
Settlement	113	0.21	93	0.25	0.03	(-0.06, 0.13)	0.555
UN personnel (ln)	113	1.18	93	0.91	-0.27	(-0.93, 0.38)	0.487
GDP/cap (ln)	113	7.19	93	8.26	1.07	(0.88, 1.27)	<0.001
Battle deaths (ln)	113	4.93	93	4.76	-0.17	(-0.51, 0.16)	0.39
Resource rents (ln)	113	2.12	93	0.99	-1.13	(-1.48, -0.78)	<0.001
Reb/mil.exp. (ln)	82	1.76	67	0.43	-1.33	(-2.10, -0.56)	0.005

It is hard to say what these differences mean for the expected relationship between private military companies and postwar stability in a global sample because we know very little about the determinants of PMSC involvement. What we can test, however, is the influence these factors have on the risk of conflict recurrence. Table A4 presents the results of a Cox regression using our control variables as predictors of conflict recurrence, both for our actual analysis sample (Model 1, labelled "incl."), and for the sample for which we miss PMSC information (Model 2, labelled "excl."). There are no notable differences in the predictors of war recurrence for the two samples.

Table A4. Comparing Cox estimates across regions, 1990-2014.

	(1) incl.	(2) excl.
Conflict duration	1.01	1.01
	(0.02)	(0.02)
Victory	0.27 ***	0.23***
	(0.12)	(0.12)
Settlement	0.58	0.77
	(0.19)	(0.30)
UN troops (ln)	0.98	0.84
	(0.05)	(0.10)
GDP per capita (ln)	1.04	0.82
	(0.16)	(0.14)
Resource rents (ln)	1.07	1.03
	(0.15)	(0.08)
Postwar periods	113	93
N	763	787

Cox hazard ratios with robust standard errors in parentheses.

* p<0.1 ** p<0.05 *** p<0.01

Importantly, those control variables whose means differed significantly between the two samples based on our t-test (GDP, resource rents and rebel strength) are all not significant predictors of war recurrence in our models. Of course there could be unobserved differences between the included and excluded conflicts/regions that are correlated both with PMSC

involvement and war recurrence. However, on the basis of the observed variables there is little in this comparison that would lead us to believe that a global study would come to fundamentally different conclusions.

Alternative datasets

In the paper, we include analyses of PMSC using data from Radziszewski & Akcinaroglu (2020) and Malet (2017), respectively (Table 5, Models 17 and 18. The data of Radziszewski and Akcinaroglu (2020) cover 1990-2008 but have a more limited definition of PMSC, only cover those with a contract with the government side, and is mainly is concerned with PMSC training of the local troops.. We also use global data from Malet (2017) that focuses on foreigners fighting only on the rebel side but this data may be too inclusive, as it does not differentiate between commercial and ideologically motivated forces. The PSED (not counting missing data due to different temporal scope) and Radziszewski & Akcinaroglu (2020) overlap in 75% of cases; while PSED and Malet (2017) overlap in 74%. This is comparable to the overlap between the two global datasets as Radziszewski & Akcinaroglu (2020) and Malet (2017) cover 78% of the same cases despite different focuses on auxiliary forces used by the government and rebel side. This justifies our approach of using a combination of the information from Radziszewski & Akcinaroglu (2020) and Malet (2017) as an approximate extension of the PSED data in other regions as a robustness test in the article (Table 5, Model 19).

Different datasets, cross-tabulations of correlations

		PSED		
		Yes	No	missing
Radziszewski & Akcinaroglu (2020)	Yes	**6**	4	8
	No	19	**63**	71
	Missing	4	17	**14**

		PSED		
		Yes	No	missing
Malet (2017)	Yes	**11**	11	13
	No	18	**73**	80
	Missing	0	0	0

		Radziszewski and Akcinaroglu (2020)		
		Yes	No	missing
Malet (2017)	Yes	3	23	9
	No	15	**130**	26
	Missing	0	0	0

Our final investigation into the possibility of systematic geographical bias looks at where PMSC are deployed at some point of the conflict with region-specific fixed effects (Table A5). It is worth remembering here that our sample only include conflicts that have ended (so may recur) which leaves out many high-profile cases of PMSC use in ongoing conflicts such as in Afghanistan, Iraq, or Libya. Again, we focus on the control variables as the most relevant predictors of deployment and we find that there is little difference in results between the cases covered by PSED (Africa, Latin America, and Southeast Asia) and when we add information from other geographical regions. Taken together, we see this indicative that there is a low risk of systematic bias because of the geographical coverage concerning our overall results.

Table A5. Possible geographical selection bias for PMSC use

Geographical sample	(1) *PSED*	(2) *Global (combined data)*
Conflict duration	0.11***	0.09***
	(0.03)	(0.02)
Victory	0.10	0.41
	(0.67)	(0.52)
Settlement	0.26	0.87*
	(0.63)	(0.48)
UN troops (ln)	0.14*	0.13**
	(0.08)	(0.06)
GDP per capita (ln)	0.88**	0.28
	(0.39)	(0.27)
Resource rents (ln)	0.45	0.38**
	(0.27)	(0.15)
N	113	206

Logistic regression with region-specific fixed effects and robust standard errors in parentheses.

* p<0.1 ** p<0.05 *** p<0.01

Additional controls for Civil Wars Context

Models 13 and 14 in Table 5 in the article include information about the rebel-government strength as a possible confound for both PMSC use and post-conflict stability. Table A6 provide additional estimations focusing on this issue. Our government-rebel strength ratio consist of the number of rebels per million USD spent in military expenditures by the government (Models 1, and 3), but where we lose many observations due to lack of data on rebel troop strength. In addition, we here present estimations using an alternative measure of battle intensity (calculated as total battledeaths in conflict/duration) as an indicator of combatant information-transfer during fighting (Models 2 and 4). In the article, we report the results from the matched sample which is a more reliable test given the large amount of missing data. That analysis finds that the involvement of PMSC in combat during any year of the conflict is still associated with an

increased risk of recurrence. For the full sample, there is little change in the coefficients but the relationship is not statistical significant at commonly accepted significance levels (Models 1, 3). However, our main empirical argument about how PMSC involvement in combat at the end of conflict is the most important destabilizing factor remains clearly associated with a strongly increased risk of recurrence (Models 2, 4) even within this subsample of cases.

Table A6. Rebel strength, battle intensity, and war recurrence, 1990-2014

	(1)	(2)	(3)	(4)
PMSC during conflict	1.48	1.53		
	(0.49)	(0.44)		
PMSC last year			2.23**	2.33***
			(0.73)	(0.68)
Conflict duration	0.99	1.00	1.00	1.00
	(0.02)	(0.02)	(0.02)	(0.01)
Victory	0.34**	0.24***	0.32**	0.21***
	(0.17)	(0.12)	(0.15)	(0.11)
Settlement	0.49	0.56*	0.42*	0.49**
	(0.22)	(0.19)	(0.19)	(0.16)
UN totals (ln)	1.01	0.96	1.01	0.95
	(0.06)	(0.05)	(0.06)	(0.05)
GDP per capita (ln)	0.98	1.05	0.98	1.04
	(0.22)	(0.17)	(0.21)	(0.17)
Resource rents per capita (ln)	0.88	0.99	0.87	0.98
	(0.14)	(0.14)	(0.14)	(0.14)
Rebels/Mio. mil. expend. (ln)	0.98		0.98	
	(0.07)		(0.07)	
Mean annual battledeaths (ln)		1.09		1.11
		(0.10)		(0.10)
Postwar periods	82	113	82	113
N	516	763	516	763

Cox hazard ratios with robust standard errors in parentheses.

* p<0.1 ** p<0.05 *** p<0.01

Linking PMSC use during conflict with the post-conflict context

Models 15 and 16 in Table 5 in the article present estimations about how continued use of PMSC into the post-conflict society influences peace duration. In Table A7 we present the results of an investigation about the links between PMSC use during and after conflict. We find that the likelihood that PMSC continues to be used in a country is greater if they have been used during the conflict. Although that may create additional problems in society, our main investigation in the paper shows that the use of PMSC in the post-conflict society by itself does not correlate with a statistically significant increased risk of conflict recurrence.

Table A7. Negative binomial regression for PMSC use after end of conflict

	(1)	(2)
PMSC during conflict	1.50***	
	(0.43)	
PMSC last year		1.79***
		(0.57)
Conflict duration	0.02	0.04*
	(0.02)	(0.02)
Victory	0.27	0.10
	(0.38)	(0.42)
Settlement	0.70	0.38
	(0.61)	(0.65)
UN totals (ln)	-0.03	-0.03
	(0.07)	(0.07)
GDP per capita (ln)	0.28	0.34*
	(0.18)	(0.17)
Resource rents per capita (ln)	0.74***	0.76***
	(0.19)	(0.23)
time	-0.70***	-0.67***
	(0.25)	(0.23)
time2	0.09***	0.09***
	(0.03)	(0.03)
time3	-0.00***	-0.00***
	(0.00)	(0.00)
Postwar periods	113	113
N	763	763

Alternative specification of PMSC role in postwar society

In this table, the postwar PMSC events can refer to any type/service, and not just combat as in Table 5 in the article and Table A7 above, as long as the PMSC are hired by government or rebels.

Table A8. Total postwar PMSC (not only combat) in the postwar period and peace stability, 1990-2014

	DV: Postwar PMSC count		DV: Recurrence	
	Negative binomial regression		Cox regression	
	(1)	(2)	(3)	(4)
PMSC during conflict	1.53***		1.53	
	(0.51)		(0.48)	
PMSC last year		1.77***		2.29***
		(0.59)		(0.72)
PMSC count postwar			1.08	1.04
			(0.14)	(0.13)
Conflict duration	-0.00	0.02	1.00	1.01
	(0.02)	(0.02)	(0.01)	(0.01)
Victory	0.34	0.24	0.27***	0.24***
	(0.49)	(0.52)	(0.12)	(0.12)
Settlement	1.52***	1.23**	0.56*	0.50**
	(0.57)	(0.56)	(0.20)	(0.17)
UN totals (ln)	-0.03	-0.03	0.98	0.97
	(0.07)	(0.07)	(0.06)	(0.05)
GDP per capita (ln)	0.89***	0.89***	1.02	1.02
	(0.22)	(0.21)	(0.16)	(0.16)
Resource rents (ln)	0.62***	0.63***	1.01	1.02
	(0.23)	(0.23)	(0.13)	(0.14)
time	-0.47**	-0.41*		
	(0.24)	(0.23)		
time2	0.06*	0.05*		
	(0.03)	(0.03)		
time3	-0.00*	-0.00*		
	(0.00)	(0.00)		
Postwar periods	112	112	112	112
N	746	746	746	746

Models 1 and 2: Coefficients with robust standard errors in parentheses.
Models 3 and 4: Cox hazard ratios with robust standard errors in parentheses.
* p<0.1 ** p<0.05 *** p<0.01.