

The Dynamics of Mass Killings: Testing Time-Series Models of One-Sided Violence in Bosnia

Web Appendix

This web appendix reports additional findings and robustness checks for the analysis presented in our article. Appendix A discusses our definition of one-sided violence in more detail and also presents some descriptive results for the data. A full description of the dataset can be found in Schneider and Bussmann (2012). Note also that we rely on British spelling in our article. This is the main reason why we employ the term “Bosniacs” instead of “Bosniaks” if we speak about members of the Bosnian Muslim community.¹ Appendix B explains in detail the steps that we used for the construction of the ARIMA models presented in Tables 1 and 2 in the main text. Appendix C offers the full details of the VAR model summarised in Tables 3 and 4.

We used standard handbooks as reference material for the construction of the empirical models. These were in particular Hamilton (1994, chaps. 15-18) for the ARIMA models and Lütkepohl (2005) for the VAR models. All regression tables were created using the “estout”-package by Jann (2005, 2007).

As noted in the text, we could not use a count data algorithm in the spirit of Shepherd (1995) and Brandt and Williams (2001) as such models would have been highly inefficient. The mean of the weekly count of Bosniac victims is 114.75 with a standard deviation of 493.15. As very few counts appear more than once or twice, the corresponding distribution is essentially uniform. To overcome this deficiency, the natural logarithm of the series is used. At the same time, both data series contain zeros. While Serb violence is more frequent and zeros are rather scattered across the conflict, the Bosniac series contains long stretches of no civilian victimization. Hence, the results for Bosniac violence should be interpreted more cautiously.

We constructed the models in line with DeBoef and Keele (2008) insofar as the dynamics of the process of one-sided violence were not considered to be noise but made rather an integral part of our theoretical argument (especially hypothesis 1). Furthermore, our VAR models with different lag length allow us to study the dynamics fully. Granger causality tests, as provided by us towards the end of the statistical analysis, have been widely discussed in the literature (e.g. Holland 1986, Sheehan and Grieves 1982). As we used a double-edged strategy of calculating ARMA and VAR models, we mainly used the latter modelling strategy including the causality tests as a robustness instrument.

¹ See <http://www.oed.com/view/Entry/21759?redirectedFrom=Bosniak#eid> (last consulted July 8, 2011)

Appendix A: Definitions and Descriptive Statistics

The definition of one-sided violence used in this article builds on Eck and Hultman's (2007) pioneering effort. According to Schneider and Bussmann (2012:2), "instances of one-sided violence are lethal or harmful acts that an organized group, which can be either a rebel organization or government actor, directs against unarmed individuals. The aggression results in the immediate physical harming or death of more than one person." The main difference between the KOSVED and the UCDP definition of one-sided violence is that the former project employs a threshold of two or more victims, while the latter data base includes instances of one-sided violence with at least 25 killed civilians per year. Note that the UCDP data set originally only provided yearly count of victims by the rebels or by government troops and did not offer fatality estimates for the individual event. The Uppsala Conflict Data Program's Georeferenced Event Dataset of which a first version was released in December 2011 offers event-level fatality estimates. A further difference between UCDP and KOSVED is that the latter project does not emphasize the intentionality of the acts so much. According to Eck and Hultman (2007:235), "The concept of one-sided violence encompasses only those fatalities that are caused by the intentional and direct use of violence". KOSVED distinguishes between first-order and second-order one-sided violence. While the former category refers to intentional acts in which civilians are the primary goal of the aggression, second-order one-sided violence also refers to cases where the killing and harming of civilians was not a direct goal, but where the planners of military acts deliberately took the possibility of such violence into account in their orders. Civilian victims can thus be related to battle events or to one-sided violence unrelated to actual combat activities. Compared to the PRIO data on battle deaths (Lacina and Gleditsch 2005), the KOSVED data includes civilians that are caught in crossfire (an example of second-order violence) but is not only limited to civilians that fall victim during contested combat.

Alternative concepts for one-sided violence are "civilian victimization" (Downes 2008), "democides" (Rummel 1994) or mass killings (Valentino 2004). While we frequently use civilian victimization as a synonym for one-sided violence, we avoid employing the other two notions. To start with, the notion of democides is very closely linked to the work of Rummel and his main thesis that autocratic regimes are the main culprits. While we do not want to reject this hypothesis, we prefer to use a concept that is not directly linked to one particular interpretation of the phenomenon. We also did not want to restrict our analyses to the most severe acts of one-sided violence so that we treat the notion of "mass killings" as a subcategory of civilian victimization.

KOSVED relies on journalistic accounts of victims. The reliance on news reports as sources of information on the number of casualties is quite critical and often the numbers are very different, mostly more conservative, from other sources like surveys that do not necessarily provide more accurate numbers. The Srebrenica massacre is a case in point that shows that the figure in KOSVED is smaller but not completely off target. The reliance on news sources might not provide correct numbers of victims but they have another distinct advantage. Press reports are often the only source of information available to the relevant international and national decision-makers. For an extensive discussion of this and related issues see Schneider and Bussmann (2012).

Table A-1 reports summary information on the variables used for the analysis presented in the main article. We also list the source from which we derived the data.

Table A-1: Descriptive statistics

Abbreviation	Source	Obs	Mean	Std.	Min	Max
logsmwt	KOSVED	187	2.581	2.277	0	8.700
logmswt	KOSVED	187	0.524	1.295	0	5.638
logsmwd	KOSVED	187	1.687	1.929	0	8.700
logmswd	KOSVED	187	0.400	1.145	0	5.638
battle	ACLED	187	1.620	2.998	0	22
terrwinism	ACLED	187	0.529	1.830	0	21
terrwinms	ACLED	187	0.262	0.817	0	6
usaser_talks	KEDS	187	0.230	0.422	0	1
eecser_talks	KEDS	187	0.155	0.363	0	1
unoser_talks	KEDS	187	0.503	0.501	0	1
russer_talks	KEDS	187	0.155	0.363	0	1
usaser_agree	KEDS	187	0.064	0.246	0	1
eecser_agree	KEDS	187	0.059	0.236	0	1
unoser_agree	KEDS	187	0.241	0.429	0	1
russer_agree	KEDS	187	0.048	0.215	0	1
usabos_talks	KEDS	187	0.267	0.444	0	1
eecbos_talks	KEDS	187	0.219	0.415	0	1
unobos_talks	KEDS	187	0.497	0.501	0	1
rusbos_talks	KEDS	187	0.107	0.310	0	1
usabos_agree	KEDS	187	0.096	0.296	0	1
eecbos_agree	KEDS	187	0.080	0.272	0	1
unobos_agree	KEDS	187	0.187	0.391	0	1
rusbos_agree	KEDS	187	0.070	0.255	0	1
dumnato	NATO	187	0.064	0.246	0	1
unsanctions	UN	187	0.027	0.192	0	2
uncondem	UN	187	0.118	0.355	0	2
untribunal	UN	187	0.043	0.203	0	1
ununprofor	UN	187	0.176	0.447	0	2

Note: KOSVED (Schneider and Bussmann 2012); KEDS (<http://web.ku.edu/~keds/data.dir/balk.html>); ACLED (Raleigh et al. 2010).

Logsmwt depicts the log of the number Bosniac victims of Serb one-sided violence, logmswt the reverse observation. Terrwinism codes the number of battles in which Serbs gained territory from Bosniacs and, again, terrwinms the reversed event. Dumnato is a dummy variable if NATO flew attacks in the respective week.

Appendix B: ARIMA models

The development of an Autoregressive Integrated Moving Average (ARIMA) model requires the researcher to proceed in a stepwise fashion: i) check whether the time series is stationary; ii) estimate the models without ARIMA-components; iii) test the residuals of these models for autocorrelation; iv) specify the ARIMA components based on the auto-correlations and partial autocorrelation function (ACF and PACF); v) estimate the model with ARIMA components; vi) examine the model for remaining autocorrelation. We will report on these steps in the following in turn and in the end also provide some condensed information for alternative model specifications. We mainly relied, as indicated in the article, on the information criteria (AIC, BIC) to select the models.

All models were estimated using Stata 9 and 11. Once an adequate specification of the ARMA(p,q)-component was found, the following commands were used in the post-estimation inspection of the models:

```

predict r, resid //predicting residuals
estat ic //calculating information criteria

corrgram r //initial visual inspection
hist r // of residuals

sum r //generating standardized
scalar s_mean = r(mean) // residuals
scalar s_sd = r(sd)
gen r_standardized = (r-s_mean)/s_sd

hist r_standardized, kdens normal //visual inspection

wntestq r_standardized //Portmanteau test for white noise

drop r r_standardized

```

All time series used are stationary, hence no integration is necessary:

	unit root tests	
	Augmented Dickey Fuller	Phillips-Perron
Log Bosniac victims of Serb OSV	-9.921*	-148.330*
Log Serb victims of Bosniac OSV	-9.647*	-135.915*

* $p < 0.01$; Null hypothesis states that series has a unit root.

The ACF/PACF plots and alternative specifications of the ARMA component are documented below:

Table 1, Model 1:

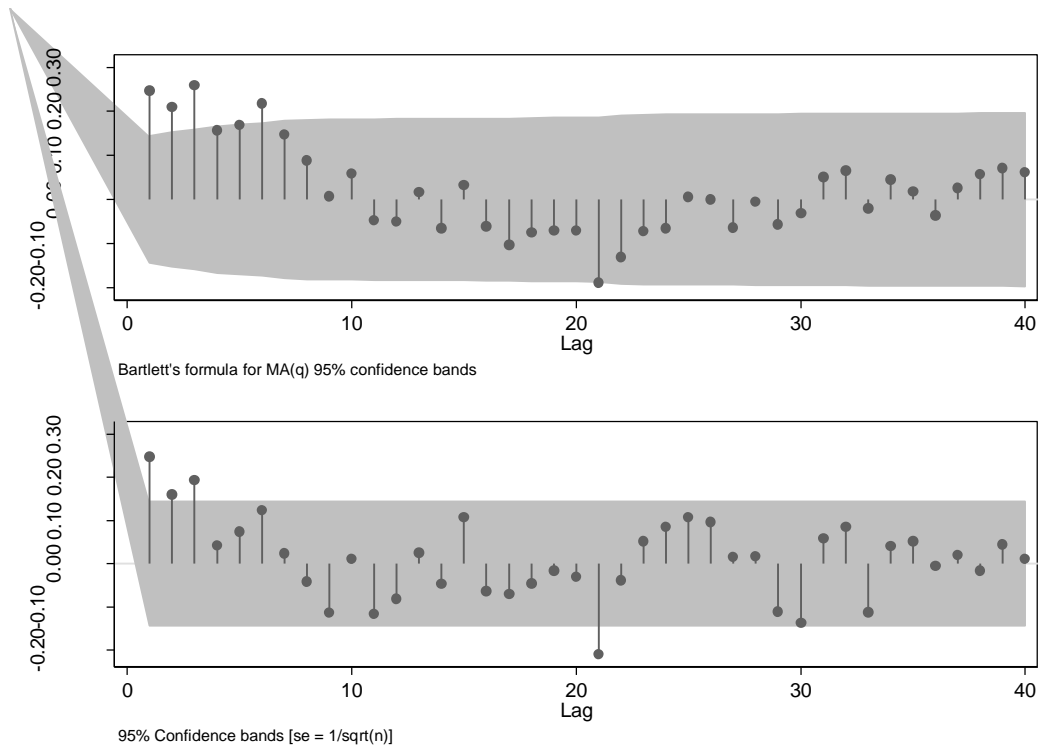


table 1 model 1

	(1)	(2)	(3)	(4)	(5)	(6)
	Log Bosnia~V	Log Bosnia~V	Log Bosnia~V	Log Bosnia~V	Log Bosnia~V	Log Bosnia~V
Log Bosnia victim~V						
Log Serb victims o~V	0.321** (2.07)	0.258* (1.76)	0.348** (2.47)	0.309** (2.22)	0.255* (1.86)	0.286** (2.09)
L.Log Serb victims~V	0.118 (1.11)	0.099 (0.95)	0.004 (0.03)	0.005 (0.05)	0.047 (0.45)	0.030 (0.28)
Constant	2.363*** (10.17)	2.396*** (8.81)	2.403*** (8.34)	2.415*** (7.40)	2.410*** (6.19)	2.401*** (6.22)
ARMA						
L.ar	0.253*** (3.26)	0.213*** (2.67)	0.201*** (2.69)	0.178** (2.31)	0.879*** (12.31)	0.716*** (3.58)
L2.ar		0.176** (2.27)		0.124* (1.66)		
L3.ar			0.242*** (3.39)	0.212*** (2.90)		0.106 (1.06)
L.ma					-0.693*** (-6.67)	-0.553*** (-2.59)
sigma						
Constant	2.126*** (12.17)	2.094*** (12.28)	2.067*** (12.54)	2.051*** (12.59)	2.051*** (12.63)	2.044*** (12.63)
observations	186	186	186	186	186	186
ll	-404.208	-401.482	-399.061	-397.696	-397.634	-397.013
aic	818.416	814.964	810.121	809.392	807.268	808.025
bic	834.544	834.319	829.476	831.972	826.622	830.605

t statistics in parentheses
 * p<0.1, ** p<0.05, *** p<0.01

Table 1, Model 2:

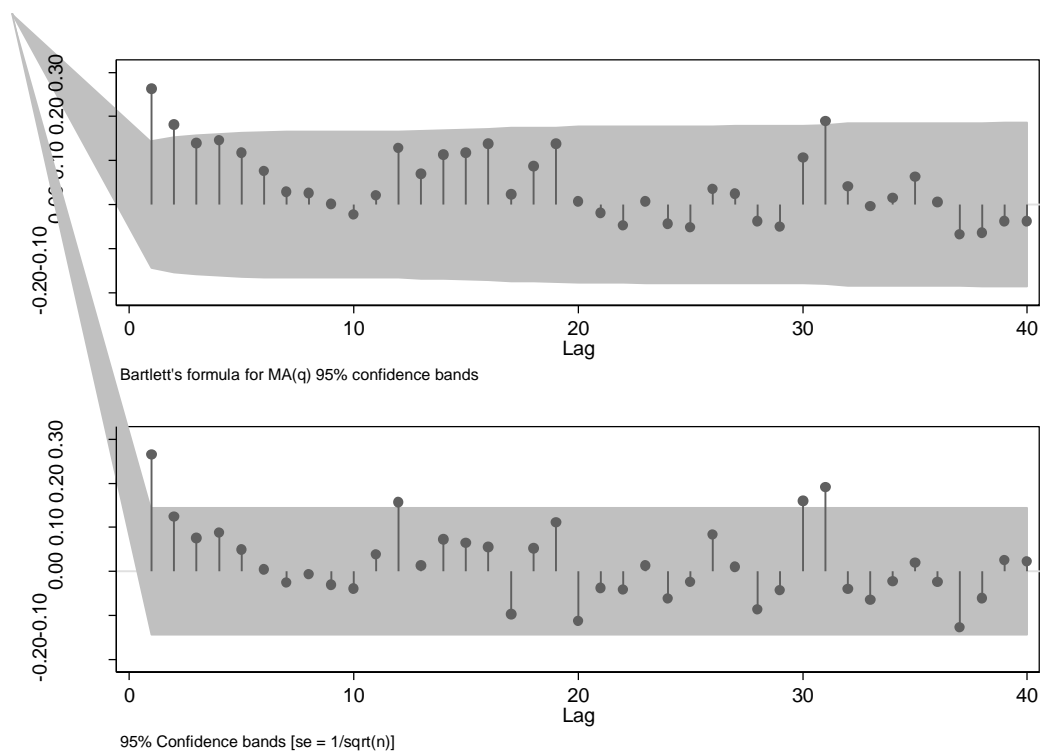


table 1 model 2

	(1)	(2)	(3)	(4)	(5)	(6)
	Log Serb v~v	Log Serb v~v	Log Serb v~v	Log Serb v~v	Log Serb v~v	Log Serb v~v
Log Serb victims o~v	0.117***	0.108***	0.122***	0.113***	0.113***	0.105**
Log Bosniac victim~v	(2.75)	(2.59)	(2.84)	(2.68)	(2.62)	(2.44)
L.Log Bosniac vict~v	0.070*	0.065	0.071*	0.067	0.065	0.059
	(1.73)	(1.63)	(1.74)	(1.63)	(1.51)	(1.38)
ARMA						
L.ar	0.266***	0.265***			0.252***	0.255***
	(4.77)	(4.61)			(4.49)	(4.38)
L4.ar					0.119*	0.107
					(1.86)	(1.59)
L.ma			0.215***	0.215***		
			(4.05)	(3.88)		
sigma						
Constant	1.201***	1.188***	1.210***	1.197***	1.192***	1.181***
	(22.54)	(24.79)	(22.00)	(23.97)	(23.07)	(25.14)
ARMA12						
L.ar		0.159***		0.160***		0.148**
		(2.63)		(2.73)		(2.37)
Observations	186	186	186	186	186	186
ll	-297.958	-296.124	-299.370	-297.518	-296.622	-295.065
aic	603.915	602.249	606.741	605.037	603.245	602.130
bic	616.818	618.378	619.644	621.166	619.374	621.484

t statistics in parentheses
 * p<0.1, ** p<0.05, *** p<0.01

Table 1, Model 3:

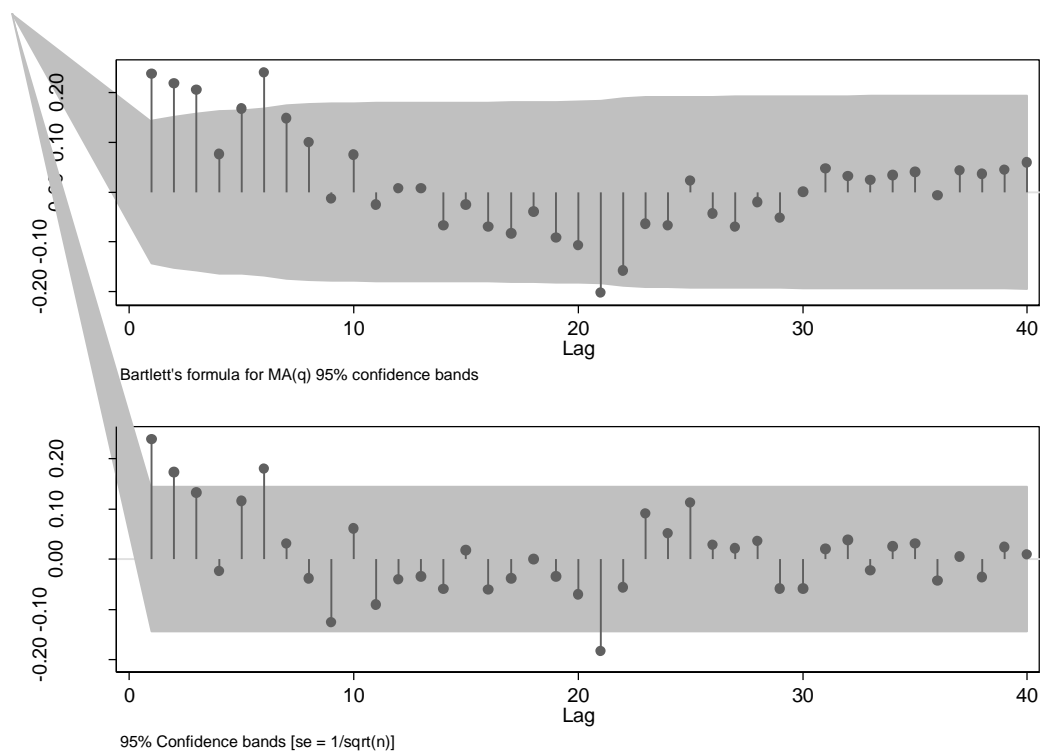


table 1 model 3

	(1)	(2)	(3)	(4)	(5)	(6)
	Log Bosnia~V	Log Bosnia~V	Log Bosnia~V	Log Bosnia~V	Log Bosnia~V	Log Bosnia~V
Log Bosniac victim-v number of battles	0.136 (1.22)	0.121 (1.06)	0.086 (0.75)	0.086 (0.75)	0.086 (0.75)	0.091 (0.83)
Bosniac territoria~e	0.345 (0.91)	0.334 (0.90)	0.421 (1.22)	0.340 (0.96)	0.343 (0.98)	0.405 (1.16)
L.Bosniac territor~e	0.230 (0.94)	0.151 (0.59)	0.155 (0.63)	0.060 (0.26)	0.046 (0.20)	0.133 (0.55)
Serb territorial w~i	0.009 (0.04)	0.023 (0.11)	0.099 (0.52)	0.062 (0.30)	0.062 (0.30)	0.087 (0.45)
L.Serb territorial~i	-0.183* (-1.83)	-0.189** (-2.27)	-0.173** (-2.51)	-0.182** (-2.38)	-0.181** (-2.40)	-0.172** (-2.53)
Constant	2.316*** (9.39)	2.349*** (8.29)	2.317*** (6.45)	2.390*** (6.20)	2.389*** (6.16)	2.319*** (5.85)
ARMA						
L.ar	0.262*** (3.22)	0.217*** (2.60)	0.182** (2.31)	0.874*** (11.70)	0.830*** (4.17)	0.365 (1.34)
L2.ar		0.180** (2.35)	0.165** (2.18)		0.033 (0.28)	0.133 (1.18)
L6.ar			0.218*** (2.84)			0.189** (2.26)
L.ma				-0.683*** (-6.27)	-0.656*** (-3.83)	-0.201 (-0.74)
sigma						
Constant	2.061*** (12.62)	2.028*** (12.65)	1.978*** (13.37)	1.997*** (12.96)	1.997*** (12.87)	1.973*** (13.22)
observations	186	186	186	186	186	186
ll	-398.440	-395.535	-390.995	-392.728	-392.671	-390.574
aic	812.881	809.070	801.989	803.456	805.343	803.147
bic	838.687	838.101	834.247	832.488	837.600	838.631

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table1, Model 4:

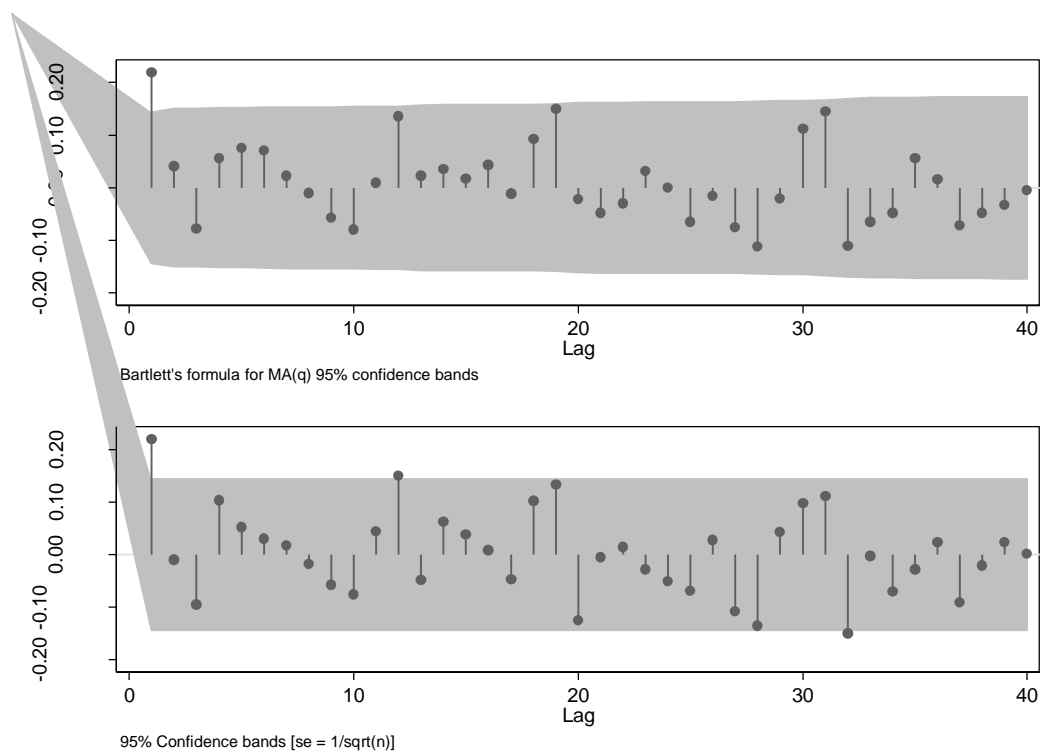


table 1 model 4

	(1) Log Serb v~v	(2) Log Serb v~v	(3) Log Serb v~v	(4) Log Serb v~v	(5) Log Serb v~v	(6) Log Serb v~v
Log Serb victims o~v number of battles	0.265*** (9.21)	0.265*** (9.10)	0.256*** (9.15)	0.272*** (9.91)	0.265*** (9.10)	0.267*** (8.56)
Bosniac territoria~e	-0.226*** (-2.60)	-0.226*** (-2.58)	-0.214** (-2.54)	-0.216** (-2.43)	-0.226*** (-2.58)	-0.224** (-2.55)
L.Bosniac territor~e	0.196** (2.41)	0.196** (2.29)	0.126 (1.43)	0.240*** (3.08)	0.196** (2.29)	0.205** (2.33)
Serb territorial w~i	-0.271*** (-3.55)	-0.271*** (-3.54)	-0.276*** (-3.74)	-0.279*** (-3.75)	-0.271*** (-3.54)	-0.273*** (-3.32)
L.Serb territorial~i	0.043 (0.86)	0.043 (0.85)	0.036 (0.68)	0.041 (0.80)	0.043 (0.85)	0.043 (0.83)
ARMA						
L.ar	0.259*** (4.95)	0.259*** (4.70)	0.271*** (5.25)		0.258 (1.16)	0.481 (0.09)
L2.ar		-0.000 (-0.01)				-0.068 (-0.05)
L4.ar			0.109* (1.80)			
L.ma				0.235*** (4.28)	0.001 (0.00)	-0.221 (-0.04)
sigma						
Constant	1.162*** (32.22)	1.162*** (32.04)	1.156*** (30.67)	1.164*** (31.74)	1.162*** (32.04)	1.162*** (31.25)
Observations	186	186	186	186	186	186
ll	-291.839	-291.839	-291.027	-292.271	-291.839	-291.832
aic	597.678	599.678	598.053	598.542	599.678	601.664
bic	620.258	625.484	623.859	621.122	625.484	630.695

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 2, Model 1:

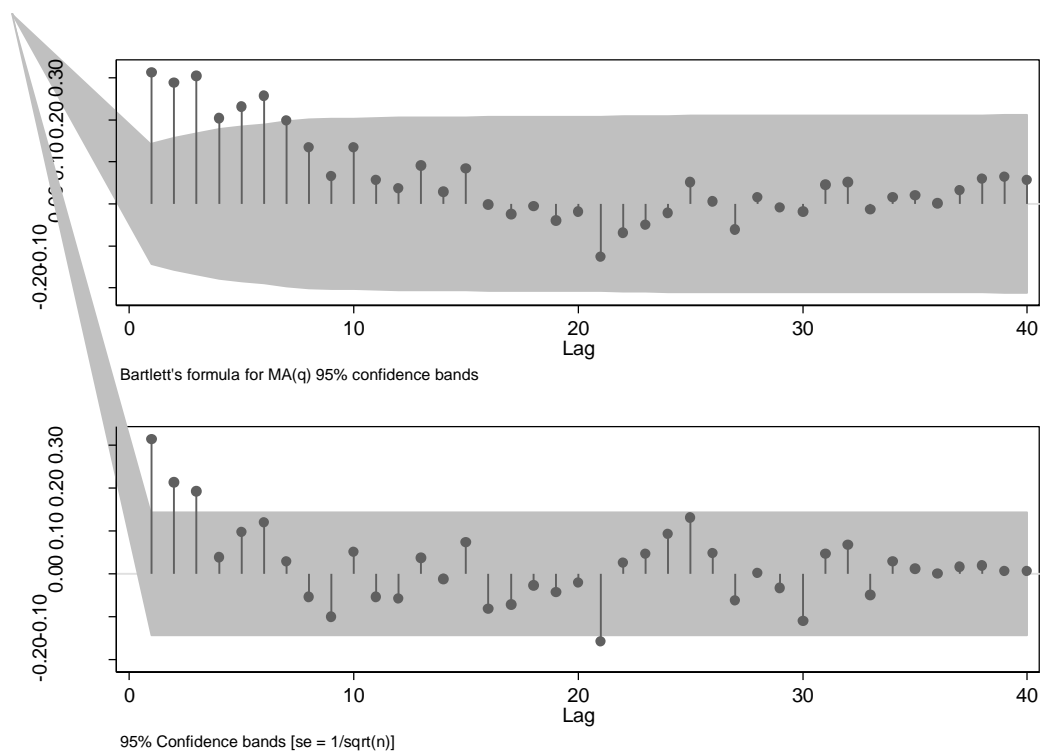


table 2 model 1

	(1)	(2)	(3)	(4)	(5)	(6)
	Log Bosnia~V	Log Bosnia~V	Log Bosnia~V	Log Bosnia~V	Log Bosnia~V	Log Bosnia~V
Log Bosniac victim~v						
L.(max) dumnato	0.715 (0.83)	0.891 (1.08)	0.566 (0.62)	0.568 (0.61)	0.762 (0.91)	0.761 (0.91)
L.UN sanctions	-0.968 (-0.76)	-1.031 (-0.95)	-1.259 (-1.10)	-0.882 (-0.67)	-1.020 (-1.02)	-1.024 (-1.03)
L.UN condemnation	-0.052 (-0.10)	0.113 (0.22)	0.268 (0.56)	0.056 (0.10)	0.187 (0.39)	0.204 (0.42)
L.UN tribunal	1.452* (1.76)	1.166 (1.35)	1.691** (2.04)	1.284 (1.50)	1.398 (1.61)	1.384 (1.58)
L.UNPROFOR	-0.647* (-1.73)	-0.693* (-1.75)	-0.691* (-1.72)	-0.534 (-1.41)	-0.699* (-1.74)	-0.699* (-1.73)
Constant	2.633*** (9.88)	2.610*** (8.20)	2.591*** (6.79)	2.619*** (11.75)	2.580*** (5.71)	2.578*** (5.69)
ARMA						
L.ar	0.373*** (4.48)	0.289*** (3.40)	0.248*** (3.03)		0.887*** (14.48)	0.858*** (4.70)
L2.ar		0.213*** (2.75)	0.139* (1.77)			0.022 (0.18)
L3.ar			0.216*** (2.96)			
L.ma				0.277*** (3.22)	-0.652*** (-6.91)	-0.635*** (-4.13)
sigma						
Constant	2.119*** (12.72)	2.072*** (12.91)	2.029*** (13.03)	2.164*** (12.12)	2.026*** (13.27)	2.026*** (13.23)
observations	186	186	186	186	186	186
ll	-403.684	-399.567	-395.729	-407.518	-395.445	-395.422
aic	823.367	817.134	811.458	831.036	808.889	810.843
bic	849.173	846.166	843.715	856.842	837.921	843.100

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 2, Model 2:

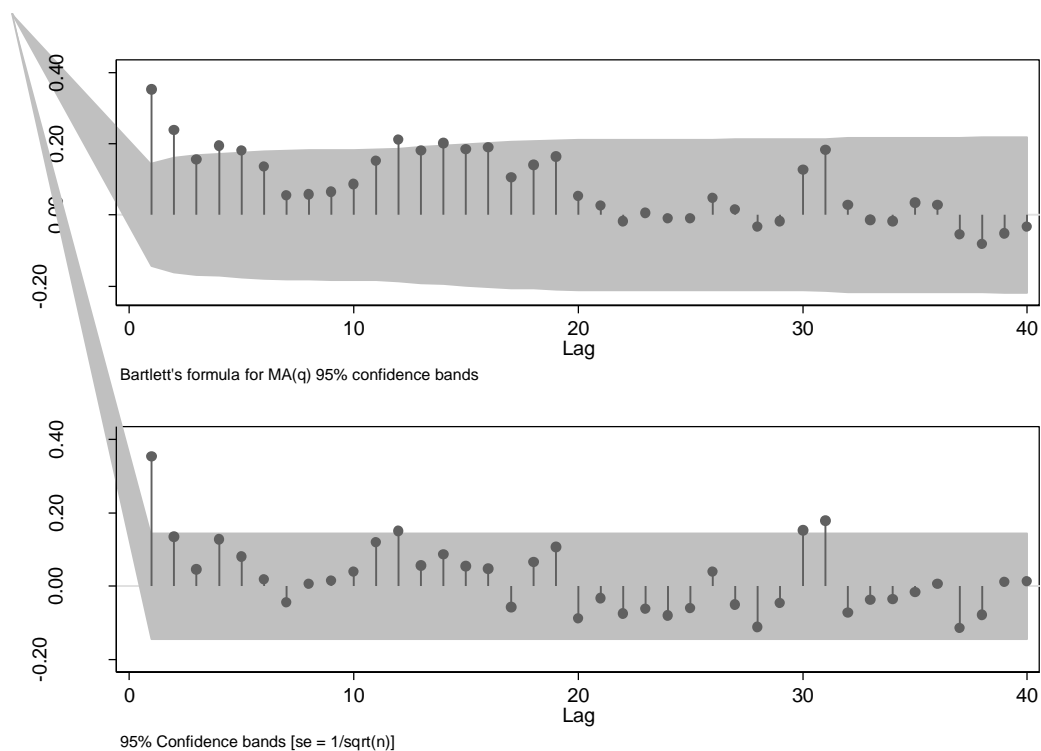


table 2 model 2

	(1)	(2)	(3)	(4)	(5)	(6)
	Log Serb v~v	Log Serb v~v	Log Serb v~v	Log Serb v~v	Log Serb v~v	Log Serb v~v
Log Serb victims o~v						
L.(max) dumnato	-0.682 (-1.29)	-0.525 (-0.93)	-0.539 (-0.90)	-0.435 (-0.69)	-0.384 (-0.48)	-0.424 (-0.60)
L.UN sanctions	-0.495 (-0.64)	-0.412 (-0.52)	-0.628 (-0.99)	-0.521 (-0.72)	-0.337 (-0.37)	-0.590 (-0.91)
L.UN condemnation	0.285 (0.65)	0.151 (0.34)	0.277 (0.69)	0.158 (0.34)	0.107 (0.23)	0.145 (0.33)
L.UN tribunal	0.404 (0.49)	0.507 (0.78)	0.331 (0.48)	0.407 (0.66)	0.448 (0.68)	0.307 (0.53)
L.UNPROFOR	-0.330 (-1.33)	-0.278 (-1.12)	-0.311 (-1.30)	-0.272 (-1.12)	-0.199 (-0.75)	-0.316 (-1.28)
ARMA						
L.ar	0.480*** (11.07)	0.413*** (9.01)	0.381*** (7.02)	0.347*** (6.31)		0.911*** (19.54)
L2.ar			0.199*** (3.09)	0.172** (2.44)		
L.ma					0.289*** (5.36)	-0.674*** (-8.86)
sigma						
Constant	1.243*** (39.50)	1.218*** (34.03)	1.220*** (40.08)	1.202*** (34.91)	1.247*** (33.54)	1.185*** (33.10)
ARMA12						
L.ar		0.233*** (3.72)		0.198*** (2.97)	0.307*** (5.55)	0.142** (2.21)
Observations	186	186	186	186	186	186
ll	-304.550	-301.056	-301.003	-298.530	-305.572	-295.837
aic	623.100	618.113	618.006	615.060	627.145	609.674
bic	645.680	643.919	643.812	644.092	652.951	638.706

t statistics in parentheses
 * p<0.1, ** p<0.05, *** p<0.01

Table 2, Model 3:

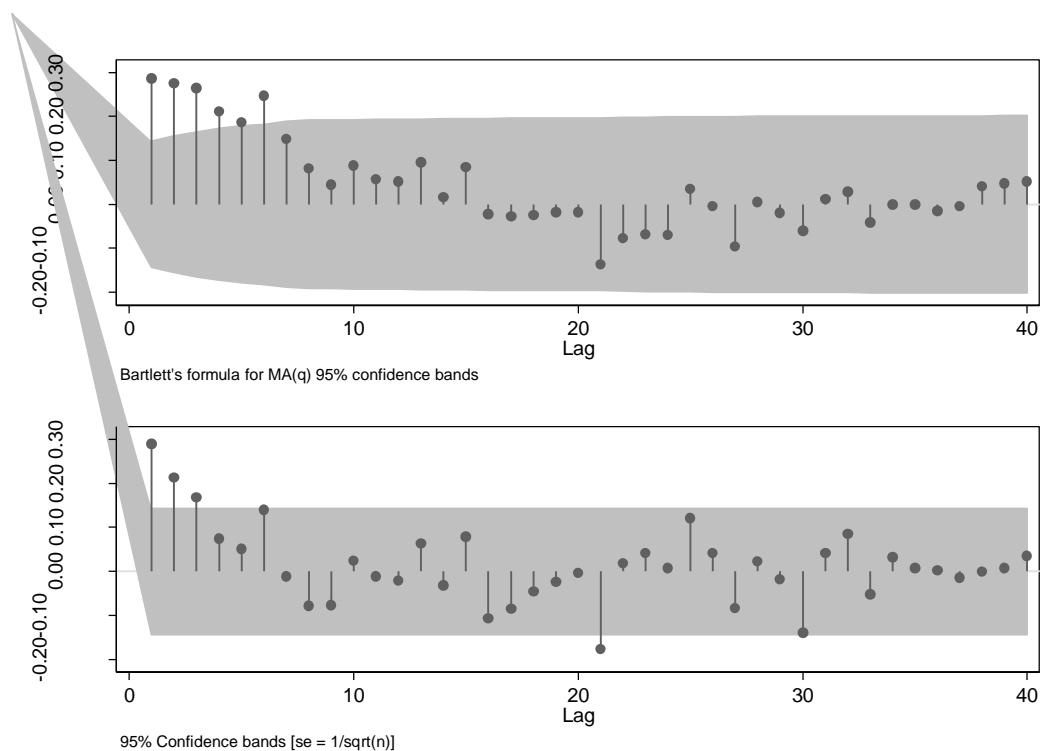


table 2 model 3

	(1)	(2)	(3)	(4)	(5)	(6)
	Log Bosnia~V	Log Bosnia~V	Log Bosnia~V	Log Bosnia~V	Log Bosnia~V	Log Bosnia~V
Log Bosnia victim-V						
Agreements USA-Serbs	-0.600 (-0.78)	-0.356 (-0.49)	-0.222 (-0.31)	-0.547 (-0.70)	-0.350 (-0.47)	-0.294 (-0.39)
Agreements EU-Serbs	-0.403 (-0.55)	-0.614 (-0.83)	-0.758 (-1.04)	-0.076 (-0.10)	-0.660 (-0.95)	-0.660 (-0.94)
Agreements UN-Serbs	0.808* (1.92)	0.679* (1.67)	0.638 (1.61)	0.754* (1.77)	0.752* (1.92)	0.725* (1.80)
Agreements Russia--s	-1.229 (-1.55)	-1.564* (-1.94)	-1.649** (-2.06)	-1.134 (-1.35)	-1.420* (-1.76)	-1.485* (-1.83)
Agreements USA-Bos~s	0.364 (0.74)	0.114 (0.22)	0.154 (0.29)	0.307 (0.56)	0.134 (0.26)	0.081 (0.15)
Agreements EU-Bosn~s	0.496 (0.84)	0.451 (0.81)	0.382 (0.69)	0.435 (0.68)	0.313 (0.58)	0.293 (0.54)
Agreements UN-Bosn~s	-0.018 (-0.04)	-0.081 (-0.21)	-0.152 (-0.39)	-0.092 (-0.21)	-0.135 (-0.35)	-0.168 (-0.43)
Agreements Russia--s	-0.468 (-0.73)	-0.196 (-0.28)	-0.252 (-0.38)	-0.620 (-0.96)	-0.159 (-0.24)	-0.137 (-0.20)
Constant	2.470*** (9.08)	2.522*** (7.68)	2.539*** (6.56)	2.492*** (10.51)	2.495*** (5.38)	2.509*** (5.46)
ARMA						
L.ar	0.346*** (4.33)	0.260*** (3.11)	0.216*** (2.64)		0.890*** (13.66)	0.815*** (4.28)
L2.ar		0.233*** (2.73)	0.190** (2.20)			0.059 (0.47)
L3.ar			0.184** (2.47)			
L.ma				0.250*** (3.11)	-0.665*** (-6.52)	-0.620*** (-3.76)
sigma						
Constant	2.115*** (12.02)	2.063*** (12.58)	2.029*** (12.71)	2.153*** (11.62)	2.022*** (12.76)	2.020*** (12.81)
observations	187	187	187	187	187	187
ll	-405.522	-400.916	-397.833	-408.799	-397.198	-397.044
aic	833.044	825.832	821.667	839.598	818.395	820.088
bic	868.586	864.605	863.671	875.140	857.169	862.093

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 2, Model 4:

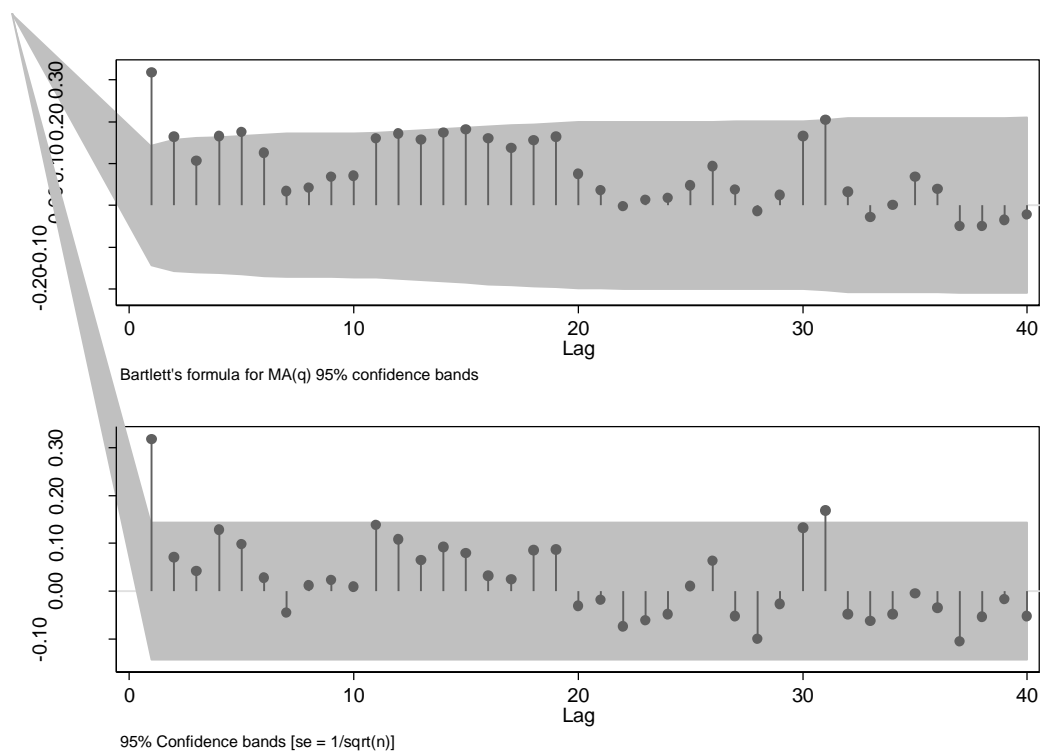


table 2 model 4

	(1)	(2)	(3)	(4)	(5)	(6)
	Log Serb v~v	Log Serb v~v	Log Serb v~v	Log Serb v~v	Log Serb v~v	Log Serb v~v
Log Serb victims o~v						
Agreements USA-Serbs	0.679 (1.48)	0.731 (1.59)	0.581 (1.32)	0.631 (1.42)	0.811* (1.72)	0.556 (1.30)
Agreements EU-Serbs	0.599 (1.64)	0.263 (0.62)	0.137 (0.33)	-0.053 (-0.11)	0.322 (0.74)	0.107 (0.22)
Agreements UN-Serbs	0.277 (1.26)	0.186 (0.89)	0.308 (1.43)	0.230 (1.12)	0.241 (1.12)	0.177 (0.90)
Agreements Russia--s	-0.720 (-0.85)	-0.746 (-0.95)	-0.689 (-0.79)	-0.703 (-0.87)	-0.816 (-1.11)	-0.567 (-0.60)
Agreements USA-Bos~s	0.819** (2.13)	0.806** (2.35)	0.930** (2.41)	0.904** (2.58)	0.827** (2.53)	0.757** (2.00)
Agreements EU-Bosn~s	0.198 (0.45)	0.184 (0.44)	0.095 (0.24)	0.106 (0.27)	0.213 (0.50)	0.163 (0.36)
Agreements UN-Bosn~s	-0.180 (-0.69)	-0.069 (-0.27)	-0.363 (-1.33)	-0.255 (-0.96)	-0.089 (-0.32)	-0.178 (-0.60)
Agreements Russia--s	-0.039 (-0.08)	-0.064 (-0.14)	0.038 (0.07)	0.022 (0.05)	-0.040 (-0.09)	-0.018 (-0.04)
ARMA						
L.ar	0.400*** (9.01)	0.359*** (7.38)	0.358*** (7.67)	0.334*** (6.74)		0.883*** (13.49)
L4.ar			0.236*** (3.73)	0.213*** (3.15)		
L.ma					0.286*** (4.90)	-0.666*** (-6.60)
sigma						
Constant	1.200*** (37.00)	1.178*** (31.83)	1.171*** (36.12)	1.156*** (30.79)	1.194*** (31.38)	1.162*** (32.23)
ARMA12						
L.ar		0.224*** (3.62)		0.185*** (2.69)	0.255*** (4.47)	0.165*** (2.58)
Observations	187	187	187	187	187	187
ll	-299.529	-296.382	-295.030	-292.754	-298.900	-293.740
aic	619.058	614.765	612.060	609.507	619.799	611.480
bic	651.369	650.307	647.602	648.281	655.341	650.253

t statistics in parentheses
 * p<0.1, ** p<0.05, *** p<0.01

Additional model and robustness check (dependent variable: killed and harmed victims of OSV – as in the article)

Table B1: Effect of agreements or talks with international actors (dependent variables are logged victim counts)

international logic/including talks		
	(1)	(2)
	Log Bosnia-V	Log Serb v-V
main		
Talks USA-Serbs	0.084 (0.21)	0.345 (1.51)
Talks EU-Serbs	0.796* (1.93)	0.901*** (4.75)
Talks UN-Serbs	-0.268 (-0.88)	0.087 (0.39)
Talks Russia-Serbs	0.603 (1.28)	-0.163 (-0.53)
Agreements USA-Serbs	-0.174 (-0.24)	1.029** (2.40)
Agreements EU-Serbs	-0.784 (-1.18)	0.624 (1.50)
Agreements UN-Serbs	0.700 (1.60)	0.276 (1.14)
Agreements Russia~s	-1.717** (-1.99)	-1.034 (-1.54)
Talks USA-Bosniacs	-0.384 (-0.78)	-0.723** (-2.05)
Talks EU-Bosniacs	0.422 (1.02)	0.591** (2.48)
Talks UN-Bosniacs	0.391 (1.17)	0.029 (0.15)
Talks Russia-Bosni~s	-0.767 (-1.16)	0.523 (1.46)
Agreements USA-Bos~s	0.398 (0.71)	0.987** (2.44)
Agreements EU-Bosn~s	0.182 (0.31)	-0.003 (-0.01)
Agreements UN-Bosn~s	-0.262 (-0.67)	-0.394 (-1.33)
Agreements Russia~s	-0.365 (-0.51)	-0.121 (-0.24)
Constant	2.353*** (4.88)	
ARMA		
L.ar	0.886*** (12.10)	0.262*** (3.93)
L.ma	-0.674*** (-6.15)	
sigma		
Constant	1.961*** (12.22)	1.100*** (27.51)
Observations	187	187
ll	-391.419	-283.151
aic	822.838	602.302
bic	887.460	660.462

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table B2: Testing all significant variables in one model (dependent variables are logged victim counts)

all significant variables		
	(1)	(2)
	Log Bosnia~V	Log Serb V~V
main		
Log Serb victims o~v	0.177 (1.20)	
L.serb territorial~i	-0.182** (-2.04)	
Serb territorial w~i		-0.252*** (-3.22)
L.UN tribunal	1.111 (1.21)	
L.UNPROFOR	-0.683** (-2.11)	
Agreements UN-Serbs	0.760** (1.99)	
Agreements Russia~~s	-1.482** (-1.98)	
Talks EU-Serbs	0.400 (0.91)	0.669*** (3.32)
Log Bosniac victim~v		0.063 (1.55)
L.Log Bosniac vict~v		0.003 (0.08)
number of battles		0.225*** (6.69)
Bosniac territoria~e		-0.217** (-2.44)
L.Bosniac territor~e		0.133 (1.54)
Agreements USA-Serbs		0.843*** (2.75)
Talks USA-Bosniacs		-0.231 (-0.82)
Talks EU-Bosniacs		0.212 (1.16)
Constant	2.474*** (5.58)	
ARMA		
L.ar	0.882*** (13.10)	0.224*** (3.21)
L.ma	-0.639*** (-5.96)	
sigma		
Constant	1.945*** (12.69)	1.090*** (21.25)
Observations	186	186
ll	-387.856	-279.940
aic	797.713	583.880
bic	833.196	622.589

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Robustness checks (dependent variable: only killed victims of OSV)

Table B3: Massacre and military models (all dependent variables are logged casualty counts)

table 1, but only killed victims

	(1) Log Bosnia~0	(2) Log Serb c~0	(3) Log Bosnia~0	(4) Log Serb c~0
main				
Log Serb casaltie~0	0.397*** (3.16)			
L.Log Serb casalt~0	0.138 (1.57)			
Log Bosniac casual~0		0.151*** (4.00)		
L.Log Bosniac casu~0		0.066* (1.85)		
number of battles			0.141 (1.44)	0.239*** (9.33)
Bosniac territoria~e			0.291 (1.31)	-0.122 (-1.63)
L.Bosniac territor~e			0.088 (0.38)	0.072 (0.87)
Serb territorial w~i			0.041 (0.24)	-0.244*** (-4.17)
L.Serb territorial~i			-0.135** (-2.52)	0.027 (0.53)
Constant	1.476*** (4.95)		1.401*** (3.87)	
ARMA				
L.ar	0.236*** (3.51)	0.246*** (5.44)	0.224*** (2.72)	0.239*** (5.76)
L3.ar	0.251*** (3.75)			
L2.ar			0.145* (1.83)	
L7.ar			0.208*** (2.92)	
L6.ar				0.102* (1.93)
sigma				
Constant	1.659*** (17.60)	1.012*** (30.26)	1.602*** (18.88)	0.969*** (32.23)
ARMA12				
L.ar		0.178*** (3.92)		0.173*** (3.01)
observations	186	186	186	186
ll	-358.224	-266.418	-351.827	-258.230
aic	728.447	542.836	723.654	534.459
bic	747.802	558.965	755.911	563.491

t statistics in parentheses

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

Tabelle B4: International influence model (all dependent variables are logged casualty counts)

table 2, but only killed victims

	(1) Log Bosnia~0	(2) D.Log Serb~0	(3) Log Bosnia~0	(4) Log Serb c~0
main				
L.(max) dumnato	0.404 (0.53)			
LD.(max) dumnato		-0.034 (-0.03)		
L.UN sanctions	-0.141 (-0.18)			
LD.UN sanctions		-0.462 (-0.85)		
L.UN condemnation	-0.199 (-0.46)			
LD.UN condemnation		-0.082 (-0.27)		
L.UN tribunal	0.614 (0.90)			
LD.UN tribunal		0.358 (0.74)		
L.UNPROFOR	-0.312 (-1.04)			
LD.UNPROFOR		-0.222 (-1.20)		
Agreements USA~Serbs			0.245 (0.40)	-0.010 (-0.02)
Agreements EU~Serbs			-1.034* (-1.68)	0.604* (1.76)
Agreements UN~Serbs			0.291 (0.85)	0.322* (1.73)
Agreements Russia~~s			-1.166* (-1.96)	-0.181 (-0.10)
Agreements USA~Bos~s			0.146 (0.33)	0.289 (0.76)
Agreements EU~Bosn~s			0.467 (1.13)	0.217 (0.52)
Agreements UN~Bosn~s			0.119 (0.35)	-0.156 (-0.60)
Agreements Russia~~s			-0.155 (-0.23)	-0.012 (-0.02)
Constant	1.709*** (4.87)		1.635*** (4.44)	
ARMA				
L.ar	0.335*** (4.07)	0.235*** (5.23)	0.328*** (4.30)	0.394*** (10.55)
L2.ar	0.206*** (2.75)		0.243*** (2.97)	
L.ma		-0.937*** (-27.52)		
sigma				
Constant	1.722*** (17.63)	1.021*** (32.21)	1.691*** (16.87)	1.068*** (43.86)
ARMA12				
L.ar		0.141*** (2.62)		
observations	186	185	187	187
ll	-365.193	-267.162	-363.730	-277.662
aic	748.386	552.323	751.460	575.325
bic	777.418	581.306	790.233	607.636

t statistics in parentheses

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

Appendix C: Vector autoregression models

This appendix provides additional information on the model construction for which we proceeded again in a stepwise fashion: i) determination of the number of lags; ii) estimation of the model; iii) Check whether stability requirements are met; iv) tests whether the residuals are white noise; v) test for Granger causality. We add to this as indicated the full information on the models reported in the main text and also report on how we included the international actor information to the model estimation.

The following commands were used to specify the VAR-models using Stata 9 and 11:

```
varsoc [endogenous variables]           //lag-order selection
var [endogenous variables], lag(1/p)     //estimating VAR with p lags

varstable                               //check whether stability
                                         // condition are satisfied

varlmar                                 //check whether residuals display
                                         // no serial autocorrelation

predict r1, resid equa(#1)             //obtain residuals of each
sum r1                                  // equation, calculate
scalar s_mean = r(mean)                 // standardized residuals
scalar s_sd = r(sd)                     // ->visual inspection
gen r1_s = (r1-s_mean)/s_sd
hist r1_s, kdens normal
wntestq r1                               //Portmanteau test for white noise
.
.

drop r1 r1_s ...                         //dropping variables

vargranger                              //performing Granger causality
                                         // test
```

The full model includes as endogenous variables each side's logged victim count due to the opponents OSV as well as the military variables of number of battles, number of territorial gains and losses. Additionally, the variables documenting actions by external actors are included as exogenous variables. Aside from theoretical considerations, this choice is rooted in the fact that most of these variables are dummy variables.

In order to address concerns of limited degrees of freedom, we reran the model with fewer parameters. The general pattern of the results remained the same.

The entire process of the model specification is documented below:

All additional endogenous variables are stationary:

unit root tests

	Augmented Dickey Fuller	Phillips-Perron
Number of battles	-9.003*	-129.535* -9.368*
Bosniac territorial wins	-9.297*	-130.258* -9.535*
Serb territorial wins	-11.396*	-176.287* -11.692*

* $p < 0.01$; Null hypothesis states that series has a unit root.

The lag-order selection statistics computed by Stata 11 suggest either none, one or four lags, when exogenous variables are specified:

Selection-order criteria
 Sample: 1992w16 - 1995w42 Number of obs = 183

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-1607.44				47.9657	18.0595	18.3794	18.8487*
1	-1542.64	129.61	25	0.000	31.0798	17.6244	18.1221*	18.8521
2	-1502.54	80.191	25	0.000	26.4125	17.4595	18.1348	19.1256
3	-1479.04	47.003	25	0.005	26.9519	17.4758	18.3289	19.5804
4	-1446.55	64.97*	25	0.000	24.9812*	17.394*	18.4249	19.9371

Endogenous: logsmwt logmswt battle terrwinms terrwinms
 Exogenous: usaser_agree russer_agree usabos_agree unobos_agree
 unsanctions uncondem untribunal ununprofor _cons

Without exogenous variables one or four lags are suggested:

Selection-order criteria
 Sample: 1992w16 - 1995w42 Number of obs = 183

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-1635.5				42.0813	17.929	17.9645	18.0167
1	-1569.63	131.75	25	0.000	26.9231	17.4823	17.6955*	18.0084*
2	-1528.82	81.619	25	0.000	22.6647	17.3095	17.7005	18.2741
3	-1506.96	43.71	25	0.012	23.4928	17.3438	17.9126	18.7469
4	-1476.44	61.046*	25	0.000	22.1797*	17.2835*	18.0299	19.125

Endogenous: logsmwt logmswt battle terrwinms terrwinms
 Exogenous: _cons

Theoretically, there is no justification that merely the violence or events in the previous week matter.

Below we compare a VAR(4) to a VAR(1) and VAR(2).

All models satisfy the stability condition:

. *VAR(4) stability condition
 . varstable

Eigenvalue stability condition

Eigenvalue	Modulus
.8232772 + .04222788 <i>i</i>	.824359
.8232772 - .04222788 <i>i</i>	.824359
-.4949536 + .6018248 <i>i</i>	.779213
-.4949536 - .6018248 <i>i</i>	.779213
.2560506 + .6453547 <i>i</i>	.694294
.2560506 - .6453547 <i>i</i>	.694294
.491589 + .4500693 <i>i</i>	.6665
.491589 - .4500693 <i>i</i>	.6665
-.2652992 + .5957029 <i>i</i>	.652109
-.2652992 - .5957029 <i>i</i>	.652109
-.648818	.648818
.6175895	.617589
-.5854301 + .08928516 <i>i</i>	.592199
-.5854301 - .08928516 <i>i</i>	.592199
.4949109 + .2980026 <i>i</i>	.577704
.4949109 - .2980026 <i>i</i>	.577704
-.2670263 + .4506824 <i>i</i>	.523849
-.2670263 - .4506824 <i>i</i>	.523849
-.01907429 + .3428079 <i>i</i>	.343338
-.01907429 - .3428079 <i>i</i>	.343338

All the eigenvalues lie inside the unit circle.
 VAR satisfies stability condition.

. *VAR(2) stability condition
 . varstable

Eigenvalue stability condition

Eigenvalue	Modulus
.7767054	.776705
.5062341	.506234
.3478502 + .3675889 <i>i</i>	.506084
.3478502 - .3675889 <i>i</i>	.506084
-.3756306 + .2715227 <i>i</i>	.46349
-.3756306 - .2715227 <i>i</i>	.46349
.3401083	.340108
-.3073958 + .1230468 <i>i</i>	.331108
-.3073958 - .1230468 <i>i</i>	.331108
-.04009245	.040092

All the eigenvalues lie inside the unit circle.
 VAR satisfies stability condition.

. *VAR(1) stability condition
 . varstable

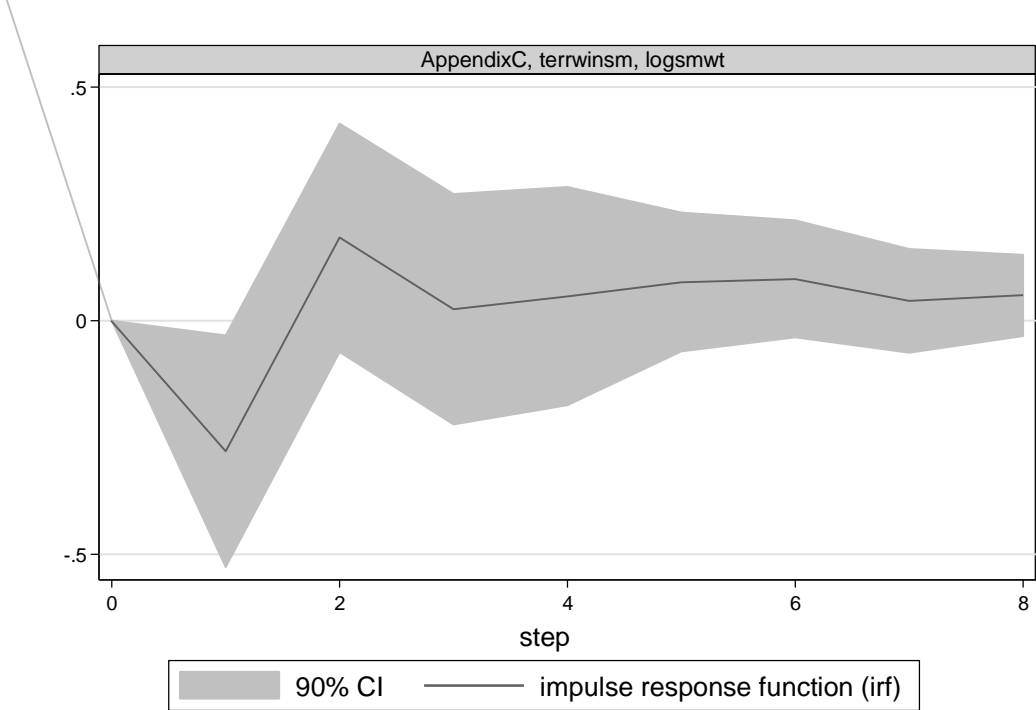
Eigenvalue stability condition

Eigenvalue	Modulus
.5666673	.566667
.2448554	.244855
.1333933 + .1344375 <i>i</i>	.189386
.1333933 - .1344375 <i>i</i>	.189386
.1172692	.117269

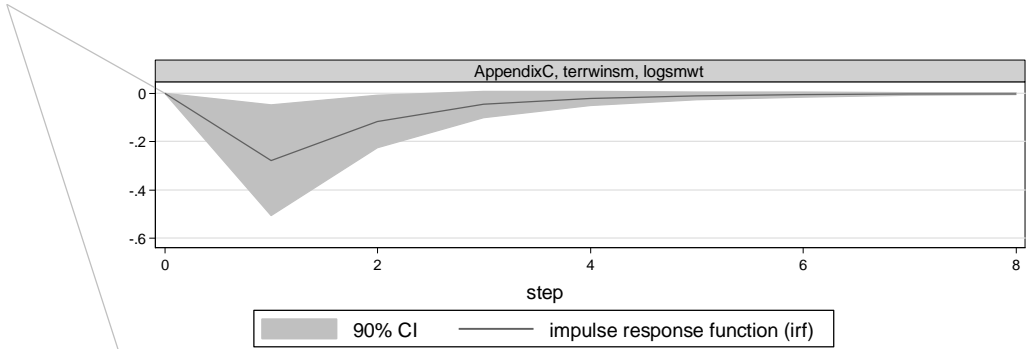
All the eigenvalues lie inside the unit circle.
 VAR satisfies stability condition.

Impulse response functions for model presented in Table 4 (smaller plots depict results of VAR(1) and VAR(2)):

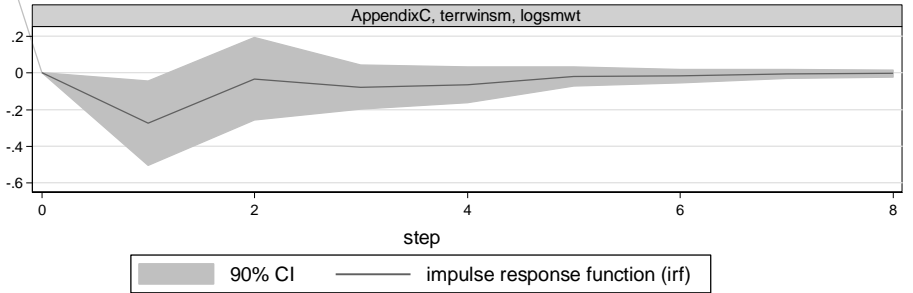
Figure C1: Impulse response function: effect of one additional (exogenous) territorial win by Serbs on the (log) number of Bosniac victims of Serb OSV



Graphs by irfname, impulse variable, and response variable

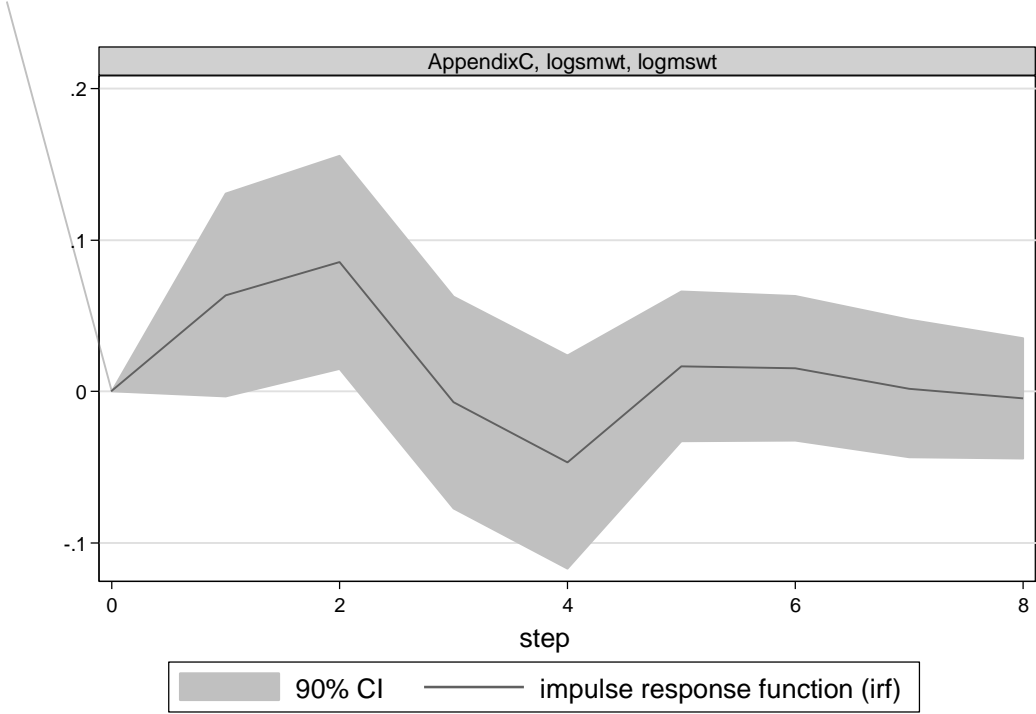


Graphs by irfname, impulse variable, and response variable

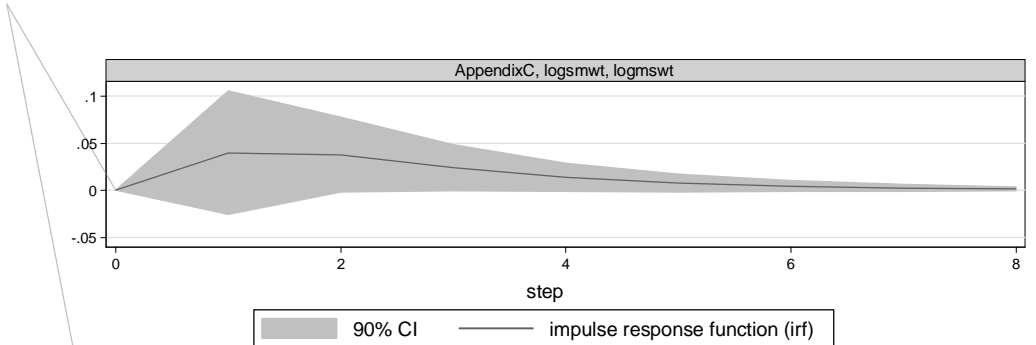


Graphs by irfname, impulse variable, and response variable

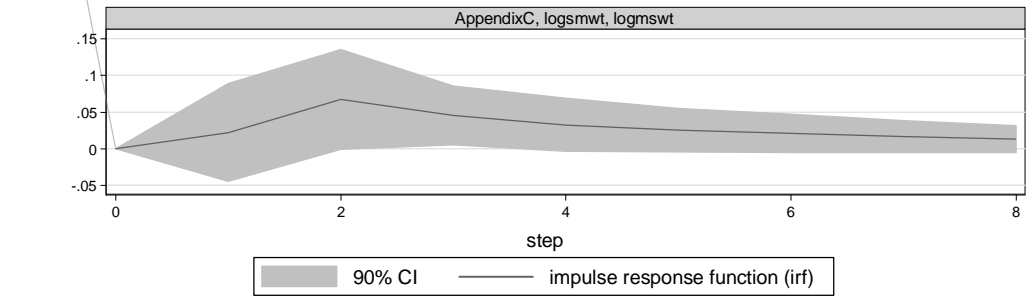
Figure C2: Impulse response function: effect of an (exogenous) one-unit increase in the (log) number of Bosniac victims of Serb OSV on the (log) number of Serb victims of Bosniac OSV



Graphs by irfname, impulse variable, and response variable

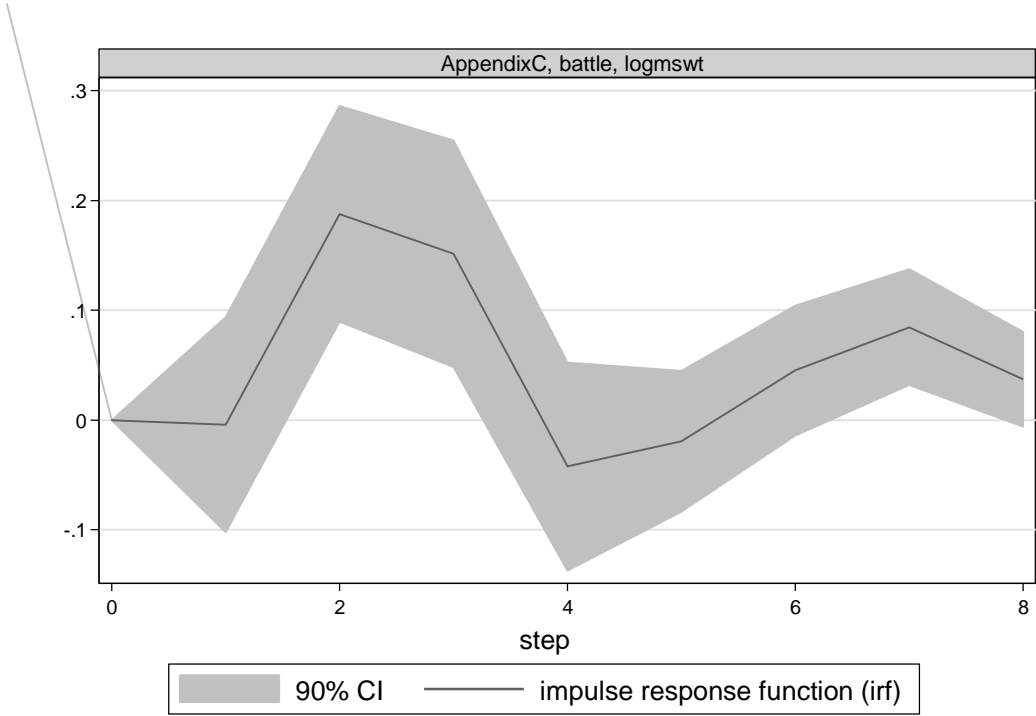


Graphs by irfname, impulse variable, and response variable

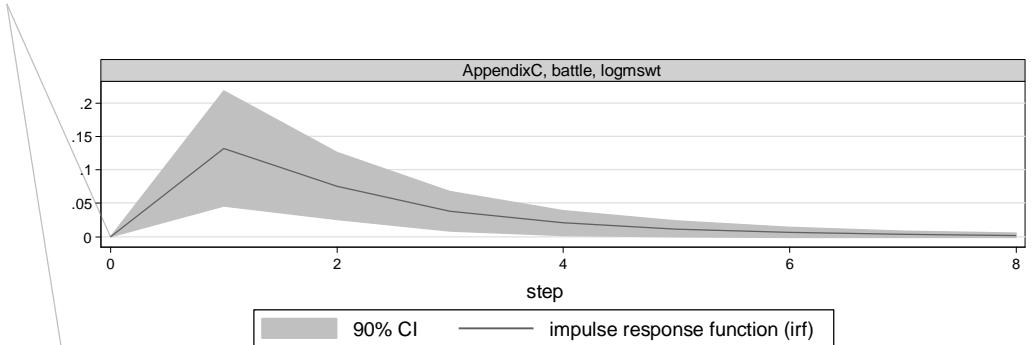


Graphs by irfname, impulse variable, and response variable

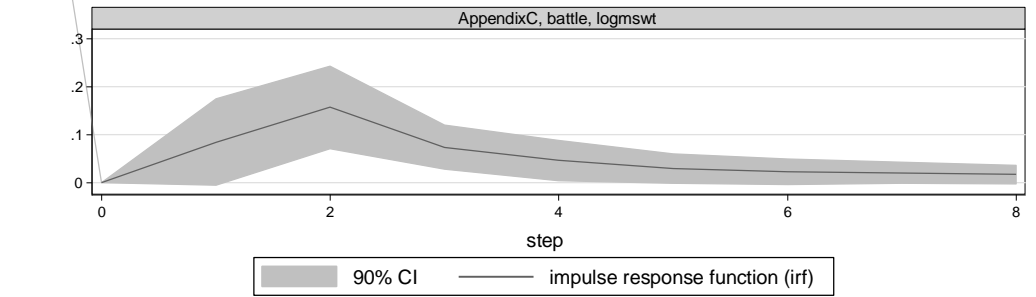
Figure C3: Impulse response function: effect of one additional (exogenous) battle on the (log) number of Serb victims of Bosniac OSV



Graphs by irfname, impulse variable, and response variable

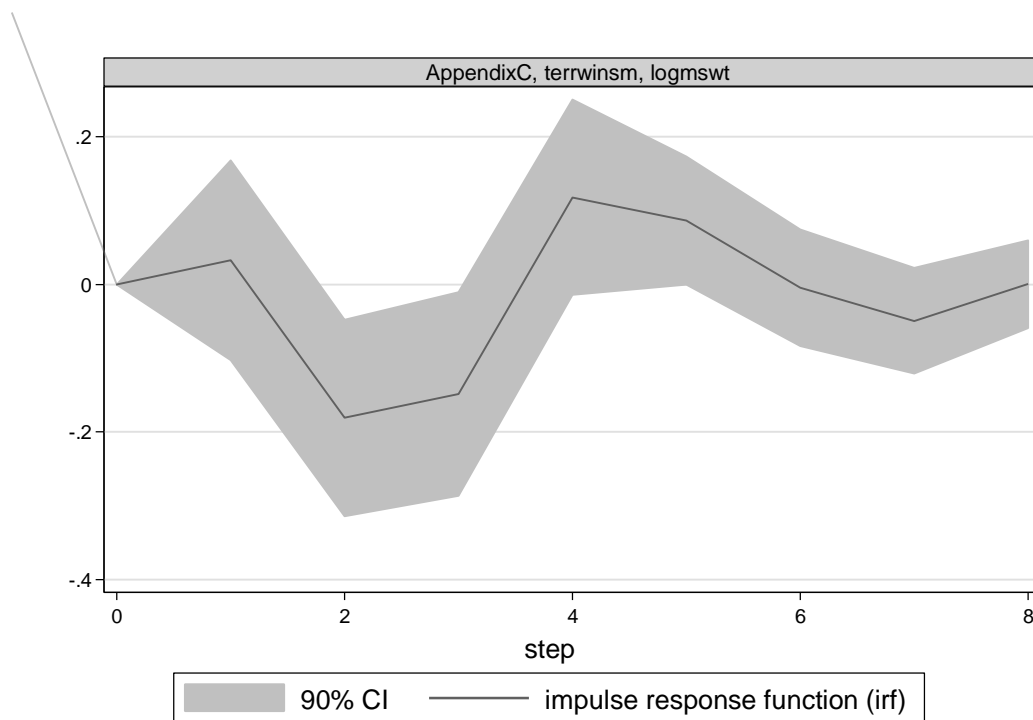


Graphs by irfname, impulse variable, and response variable

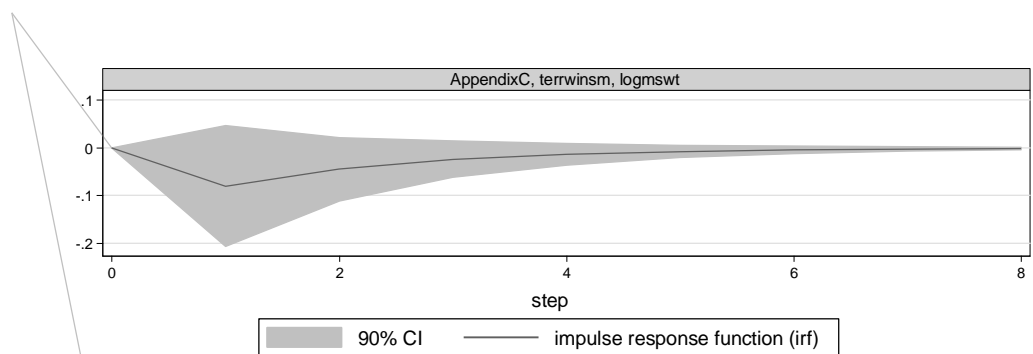


Graphs by irfname, impulse variable, and response variable

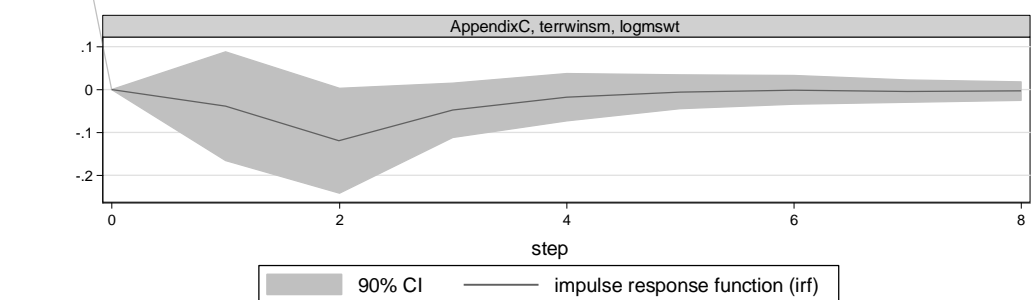
Figure C4: Impulse response function: effect of one additional (exogenous) territorial win by Serbs on the (log) number of Serb victims of Bosniac OSV



Graphs by irfname, impulse variable, and response variable



Graphs by irfname, impulse variable, and response variable



Graphs by irfname, impulse variable, and response variable

Effect of exogenous interventions on endogenous conflict variables

Table C1: The impact of international interventions on the usage of one-sided violence and the military developments of the Bosnian civil war (vector autoregression, interventions are exogenous variables)

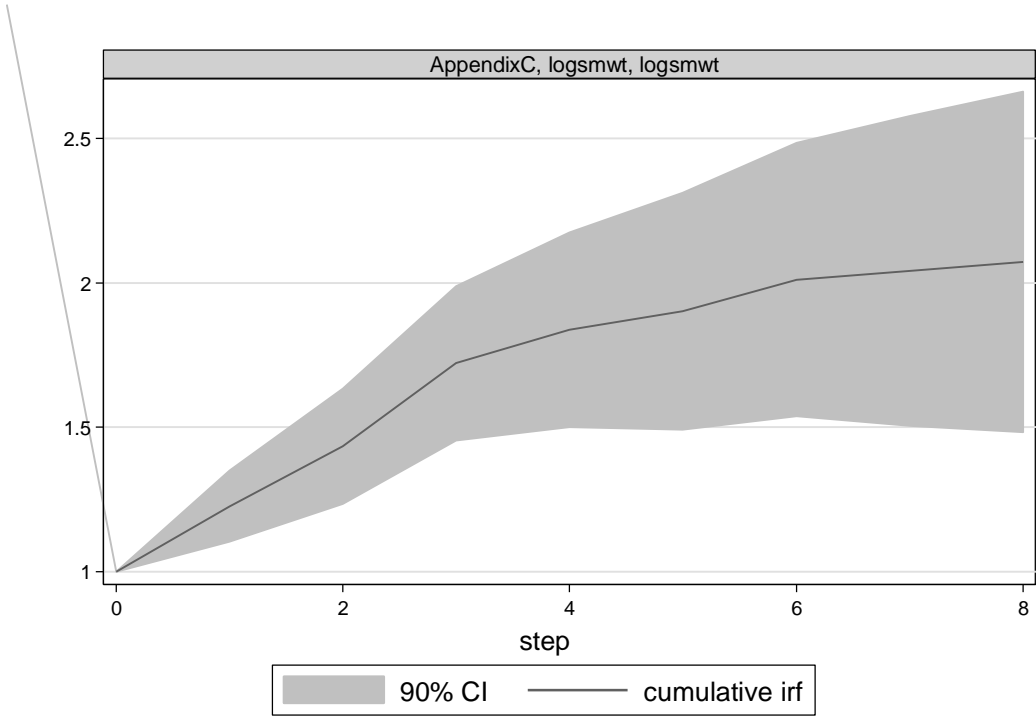
<i>Endogenous variable</i>	Bosniac victims of Serbian OSV (1)	Serbian victims of Bosniac OSV (2)	Bosniac territorial wins (3)	Serbian territorial wins (4)	Number of battles (5)
<i>Exogenous variables</i>					
Agreement USA-Serbs	-0.378 (-0.58)	0.530 (1.46)	-1.095 (-1.42)	-0.282 (-1.28)	-0.304 (-0.56)
Agreement Russia-Serbs	-1.754** (-2.48)	-0.661* (-1.68)	0.384 (0.46)	0.009 (0.04)	0.445 (0.75)
Agreement USA-Bosniacs	0.339 (0.67)	0.723** (2.57)	-0.384 (-0.64)	-0.083 (-0.49)	-0.165 (-0.39)
Agreement UN-Bosniacs	-0.528 (-1.34)	-0.429* (-1.96)	0.424 (0.91)	-0.022 (-0.17)	0.554* (1.68)
UN sanctions	-0.149 (-0.17)	-0.305 (-0.63)	0.464 (0.45)	0.162 (0.55)	-0.188 (-0.26)
UN condemnations	0.336 (0.56)	0.011 (0.03)	0.948 (1.33)	0.553*** (2.72)	0.957* (1.91)
UN tribunal	-0.543 (-0.68)	-0.607 (-1.37)	-1.630* (-1.73)	-0.502* (-1.87)	-0.921 (-1.39)
UNPROFOR	0.597 (1.27)	0.083 (0.32)	-0.024 (-0.04)	-0.390** (-2.45)	-0.151 (-0.38)
Constant	1.097*** (3.66)	0.182 (1.09)	0.113 (0.32)	0.011 (0.11)	0.252 (1.00)
N	183				
Log likelihood	-1446.554				
AIC	3183.109				
BIC	3648.484				

Note: t-ratios in parentheses, VAR(4) coefficients not reported. * p<0.1, ** p<0.05, *** p<0.01

The exogenous variables model international interventions as a one-time influence on endogenous variables. Due to the autocorrelation of the endogenous variables, however, such an effect influences the level of these variables over several periods. The cumulative effect of a one-unit exogenous shock on the overall level of civilian victims is depicted in Figures C5 and C6.

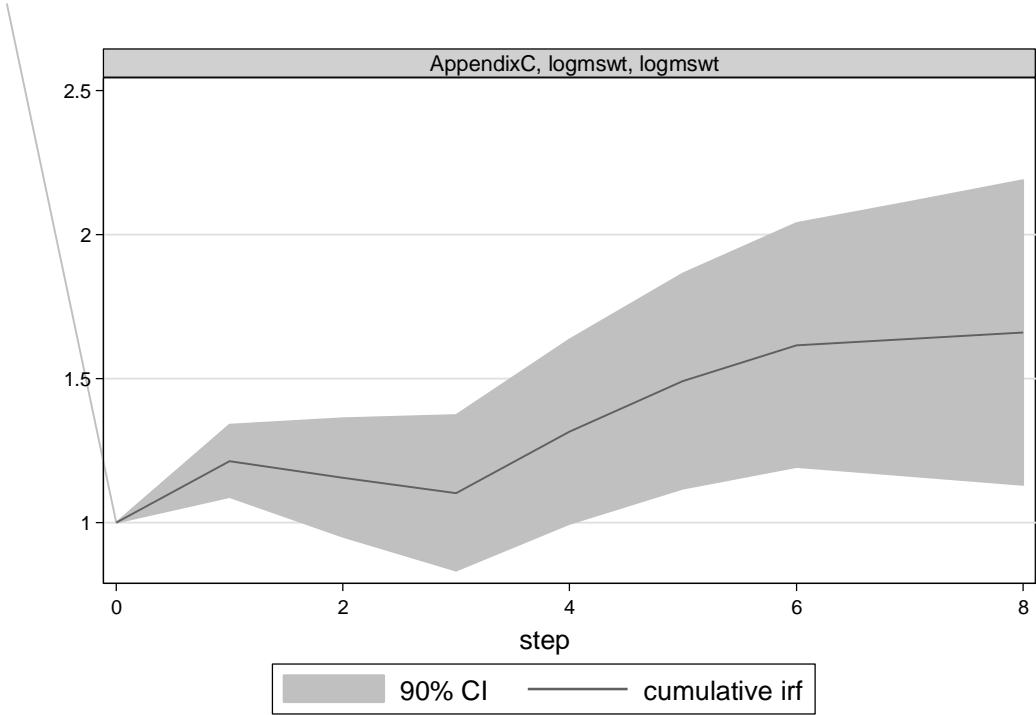
Impulse response functions for model presented in Table C1:

Figure C5: Impulse response function: cumulative effect of an one-unit exogenous shock to the (log) number of Bosniac victims of Serb OSV



Graphs by irfname, impulse variable, and response variable

Figure C6: Impulse response function: cumulative effect of an one-unit exogenous shock to the (log) number of Serb victims of Bosniac OSV



Graphs by irfname, impulse variable, and response variable

Robustness of Granger Causality tests depending on lag-order chosen:

The following outputs document the Granger Causality tests after a VAR(4), VAR(2) and a VAR(1):

```
. *VAR(4) granger causality
. vargranger
```

Granger causality wald tests

Equation	Excluded	chi2	df	Prob > chi2
logsmwt	logsmwt	10.443	4	0.034
logsmwt	battle	2.5851	4	0.629
logsmwt	terrwinms	11.372	4	0.023
logsmwt	terrwinms	7.2494	4	0.123
logsmwt	ALL	29.817	16	0.019
logsmwt	logsmwt	8.8329	4	0.065
logsmwt	battle	15.347	4	0.004
logsmwt	terrwinms	3.834	4	0.429
logsmwt	terrwinms	8.1047	4	0.088
logsmwt	ALL	44.404	16	0.000
battle	logsmwt	4.9549	4	0.292
battle	logsmwt	12.193	4	0.016
battle	terrwinms	5.549	4	0.235
battle	terrwinms	3.0875	4	0.543
battle	ALL	34.498	16	0.005
terrwinms	logsmwt	2.4231	4	0.658
terrwinms	logsmwt	29.218	4	0.000
terrwinms	battle	4.3574	4	0.360
terrwinms	terrwinms	1.9175	4	0.751
terrwinms	ALL	56.714	16	0.000
terrwinms	logsmwt	6.2539	4	0.181
terrwinms	logsmwt	10.493	4	0.033
terrwinms	battle	2.517	4	0.642
terrwinms	terrwinms	5.05	4	0.282
terrwinms	ALL	21.841	16	0.148

```
. *VAR(2) granger causality
. vargranger
```

Granger causality wald tests

Equation	Excluded	chi2	df	Prob > chi2
logsmwt	logsmwt	.29561	2	0.863
logsmwt	battle	1.9244	2	0.382
logsmwt	terrwinms	2.5312	2	0.282
logsmwt	terrwinms	3.8352	2	0.147
logsmwt	ALL	9.7908	8	0.280
logsmwt	logsmwt	1.8728	2	0.392
logsmwt	battle	9.7326	2	0.008
logsmwt	terrwinms	.14333	2	0.931
logsmwt	terrwinms	2.3816	2	0.304
logsmwt	ALL	25.805	8	0.001
battle	logsmwt	2.9488	2	0.229
battle	logsmwt	.96091	2	0.619
battle	terrwinms	7.4815	2	0.024
battle	terrwinms	.01197	2	0.994
battle	ALL	13.149	8	0.107
terrwinms	logsmwt	1.497	2	0.473
terrwinms	logsmwt	25.557	2	0.000
terrwinms	battle	1.8872	2	0.389
terrwinms	terrwinms	3.9724	2	0.137
terrwinms	ALL	35.937	8	0.000
terrwinms	logsmwt	2.4285	2	0.297
terrwinms	logsmwt	.11452	2	0.944
terrwinms	battle	1.3337	2	0.513
terrwinms	terrwinms	.7361	2	0.692
terrwinms	ALL	4.4939	8	0.810

```
. *VAR(1) granger causality
. vargranger
```

Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
logsmwt	logsmwt	.39161	1	0.531
logsmwt	battle	2.0413	1	0.153
logsmwt	terrwinms	.0217	1	0.883
logsmwt	terrwinms	3.9476	1	0.047
logsmwt	ALL	6.6561	4	0.155
logsmwt	logsmwt	.99614	1	0.318
logsmwt	battle	6.3837	1	0.012
logsmwt	terrwinms	.17629	1	0.675
logsmwt	terrwinms	1.0932	1	0.296
logsmwt	ALL	16.72	4	0.002
battle	logsmwt	1.8397	1	0.175
battle	logsmwt	.06534	1	0.798
battle	terrwinms	1.3667	1	0.242
battle	terrwinms	.1808	1	0.671
battle	ALL	5.0454	4	0.283
terrwinms	logsmwt	.42462	1	0.515
terrwinms	logsmwt	24.804	1	0.000
terrwinms	battle	8.8e-06	1	0.998
terrwinms	terrwinms	.40583	1	0.524
terrwinms	ALL	32.636	4	0.000
terrwinms	logsmwt	.01659	1	0.898
terrwinms	logsmwt	.117	1	0.732
terrwinms	battle	.91206	1	0.340
terrwinms	terrwinms	.0406	1	0.840
terrwinms	ALL	1.0227	4	0.906

The results differ to some extent. However, as documented in the impulse response functions, the direction and pattern of the effect remain the same, regardless of the significance level of the Granger causality tests.

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