Afghanistan and Iraq—$2 Trillion Dollar Graveyards of Armies

By

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Abstract

This thesis explores the projection of violent direct action in the case of Iraq and Afghanistan since 2007 through May 2011. Machine-coded events data from the free, publicly available, on-line Reuters archives was fitted to both regressor and time series models to test the hypothesis of self-feeding, vicious cycle of violence that grapples both of these countries up through 2011, even as US troops are moving out. The models offering the best statistical fit were used to generate forecasts for the number of expected hostile attacks in June 2011.

Acknowledgements

I would like to thank the members of my committee for their help

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I. Introduction

The September 11 terrorists attacks propelled the United States and its allies into at least two wars—Iraq and Afghanistan. Ten years later, the United Stated spent more than $2 trillion dollars and counting, thousands of American services members are dead/injured, and millions of Iraqi and Afghan innocent civilians are dead/injured too, according to the Costs of War project at Brown University. This thesis addresses the research question: Is the number of violent acts per month influenced by the number of (re-)deployed, leaving, and/or killed US troops? Answering this research question would shed more light on the extended duration of the two wars—lasting up through 2011 with no easy end in sight even after the planned withdrawals of American troops in 2011 and 2014. These questions are important on multiple levels. First, we need to have a better understanding of the intractable nature of the ongoing wars since there is no clear "victory" in sight and at the same time the US is bleeding both in terms of dollars and lives. This thesis, using the theory of asymmetric, net warfare as well as direct action, demonstrates that fully-connected, terrorist networks—explained in appendix C—cannot be totally terminated event with massive, conventional military force over prolonged periods of time; nuclear weapons are off the table as well. Second, given the intractable nature of terrorist networks the primary questions should be of minimization and violence projection. This thesis addresses this projection question; section 2 does a literature review, section 3 presents data and its generation, section 4 contains models and results, and section 5 concludes the discussion. Appendix A contains further details on events data and its auto-generation using sparse parsing techniques. Appendix B presents statistical diagnostics for the estimated models, and appendix C presents technical details of asymmetric netwar waged by terrorists against regular armies.

II. Literature Review

How do we project levels of current (terrorist) violence for the cases of Afghanistan and Iraq after the September 11 attacks through the present? This research question falls under the theoretical realm of (counter-)terrorism, insurgency, and more generally asymmetric, networked warfare or even more generally direct action against a state actor by a (non-)state one most of the time. Although these phenomena have existed for thousands of years there is no single universally agreed definition of terrorism in both academia and government. Hoffman classifies the existing definitions as "unsatisfying" in 1998 and notes on the lack of a single definition:

"It is not only individual agencies within the same governmental apparatus that cannot agree on a single definition of terrorism. Experts and other long-established scholars in the field are equally incapable of reaching a consensus. "(Hoffman 1998, 2006) Authors in the intelligence community adopt more practical approach and define terrorism as:

"Premeditated, politically motivated violence perpetrated against noncombatant targets by subnational groups or clandestine agents, usually intended to influence an audience" (Pillar, 2001)

Whereas the academic community still debates the definition of terrorism in historical descriptive terms, practitioners take a more simplified approach and define it in terms of intentional political violence against non-combatants. Such a practical definition is a good starting point but it is a little bit reductionist since it excludes (violent) attack against combatants. Other authors point to the pejorative, double standard-y, negative emotive connotations conjured up by the words "terrorism" and "terrorist." In 1985, President Reagan received a group of mujahedeen who were introduced to the media corps as "freedom fighters" against the "Evil Empire" in Afghanistan; after September 11 these very mujahedeen were labeled "terrorists" to be killed by whatever means necessary, including extra-judicial executions of American citizens. "Mr. bin Laden, at whom fifteen American missiles were fired to hit in Afghanistan, was only a few years earlier the moral equivalent of George Washington and Thomas Jefferson." (Ahmad, 1998)

Like terrorism, asymmetric guerrilla-warfare has existed for a long time, but its systematic study has been relatively "new" and slow compared to the study of conventional war among states. (Arquilla, Ronfeldt, 2001) Writing against the turbulent backdrop of the student movement of the 1970s and the Vietnam war fallout Arendt noted: “And as of actual warfare, we have seen in Vietnam how an enormous superiority in the means of violence can become helpless if confronted with an ill-equipped but well-organized opponent who is much more powerful. This lesson, to be sure, was there to be learned from the history of guerrilla warfare, which is at least as old as the defeat in Spain of Napoleon’s still unvanquished army” (Arendt, 1970). Other scholars have described the nature of low intensity conflicts (Liddell, 1971), and of asymmetric direct action (Sharp 1973). Mack notes that “In the earlier era, the industrial powers used minimal force to achieve rapid success, whereas in the post-World War II conflicts, the same industrial powers confronted the same Third-World countries with massive forces and lost.” (Mack, 1975). Furthermore, these seemingly “unexpected losses” can be explained by the characteristics of spread-out, flat, “leaderless” guerrilla networks (Arquilla, Ronfeldt, 2001). Moreover, Arreguín-Toft shows that “weak actors have won with increasing frequency over time” culminating in the period 1950-1998 during which 55% of the time the “weak actor” won against an industrial power in an asymmetric warfare. (Arreguín-Toft, 2001) Polk asserts that “For more than a century, insurgency has been a focal point in foreign affairs; its principal tactics—terrorism and guerrilla warfare—have been employed from Indonesia to Ireland and from Colombia to China.” (Polk, 2007) My thesis aims at capturing and extending the theoretically backed proposition that “Terror begets terror” in any direction. Given the re-generative nature of terrorism it is not surprising that some authors characterize fighting terrorists as "eating soup with a knife." (Nagl, 2005) and this fighting happens after the soup has been spilled all over.

For the purposes of this thesis terrorism, asymmetric warfare, and (counter-) insurgency are defined in terms of routine and direct action operating within the context of networked warfare. Routine action refers to all political, institutionalized, regularized activities among/between state and/or (non-)state actors. Examples of routine actions include bi-lateral visits, summits, conferences, elections, political campaigns, primaries, etc. By contrast, direct action refers to all activities that are non-routine and are "outside" the "system." Examples of direct action include car-bombs, suicide bombings, sit-ins, park occupations, hi-jackings, etc. In the CAMEO protocol, described in greater details in appendix A, all event codes above 170 are direct action whereas those below are routine like expressing support for government policies. Section III contains a list of the violent direct actions counted in this thesis for purposes of statistical analysis. The advantages of using the idea of direct action are numerous—the reductionism of field practitioners is avoided without loss of meaningful events, for example. The idea of direct action also avoids the overly descriptive historicism of the many academics who by looking at hundreds of possible definitions come up with "unsatisfactory" ones as Hoffman puts it. Direct and routine action definitions are emotive-free and pejorative-free thus avoiding the clumsiness of dealing with terrorism in moralistic terms since our goal is violence projection not pulpit preaching. Last, but not least, direct/routine action definitions theoretically encompass virtually all forms of terrorism done by virtually any actor. Thus regardless of who Islamic terrorists take as hostages—high school students and/or military personnel—it is still a codeable terrorist act. In short the dichotomy of direct/routine action combined with CAMEO machine coding allows for emotion-free, value-free generation of events. The ideas of routine/direct action were formalized by Sharp from 1970s onward.

Arquilla and Ronfeldt pioneered the theory of asymmetric net-war in which terrorist groups organize along decentralized, "leaderless", flat, networks comprised of loosely connected cells that attack and operate (semi-)independently in accordance with the specific ground, local conditions but within the grand framework of their ideology. Thus the Taliban in Afghanistan are a loosely connected umbrella organization of drug-dealers, smugglers, attackers, recruiters, etc held together by the common goal of attacking US forces until they are out of Afghanistan with the subsequent goal of toppling the Karzai government which the Taliban see as a left-over puppet of the Bush era. In more technical terms the guerrillas is both Iraq and Afghanistan use a (hybrid) of hub-network and/or all channel network. A more detailed technical description of asymmetric networks and their properties is given in appendix C.

The cases of Iraq and Afghanistan illustrate the self-feeding dynamics of terrorism-fueled counter-insurgencies. As US/NATO troops poured into Iraq from 2001 through 2008 both the number of killed troops and the number of violent acts surged on. As US troops began re-deploying into Afghanistan from Iraq after 2008 the number of violent acts in Iraq subsided considerably, but did not die away completely and recently doubled. Concurrently, after 2008, as the number of US/NATO troops in Afghanistan surged to 150 000, a dramatic increase in troops' casualties and terrorist acts--virtually zero before 2008—followed as chats below illustrate. Stated differently, guerrilla terrorist attacks subside and counter-insurgencies lose their edge the moment foreign troops leave and puppet government are replaced since the guerrillas have achieved their goal—to drive occupying troops out and take over the perceived puppet government. Conversely, once US/NATO troops start massively increasing we see corresponding massive jumps in unabating counter-insurgency powered by asymmetric guerrilla warfare. Thus terror-powered guerrilla insurgency feeds on both the presence of foreign troops and the topology of networks. The more troops there are the more violent acts we would expect and conversely. The notions of "quick and decisive victory" and "mission accomplished" are not supported by the raging asymmetric guerrilla warfare in Afghanistan and the uneasy, violence-disturbed "peace" in Iraq as of 2011. In short, there is no easy, quick victory in situations of self-feeding cycles of terrorist guerrilla, drugs-funded warfare as the British and the former Soviets discovered the very hard way in Afghanistan

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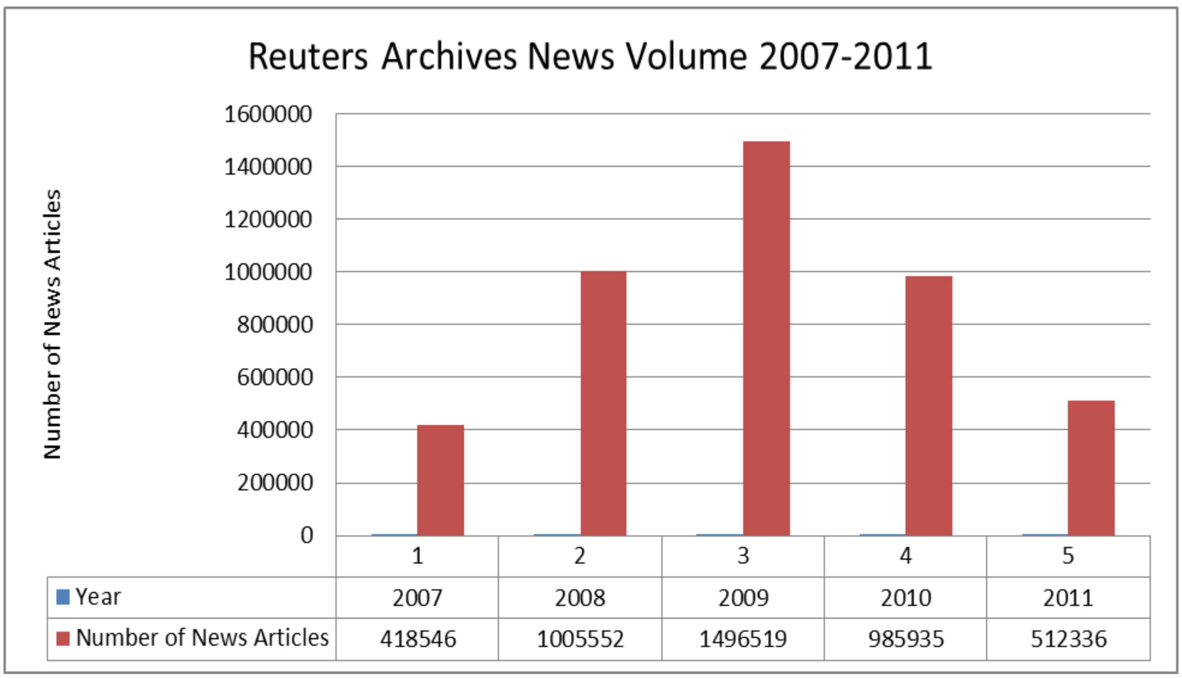
III. Data and Data generation

The data I use to test the self-feeding and/or re-enforcing nature of guerrilla warfare is machine generated—using a program called TABARI described in appendix A—from Reuters, the largest news provider in the world for the last five years. Bar chart 1 below summarizes the total volume of publicly available, free, archived, on-line news reports from January 1 2007 through May 31, 2011 on the Reuters web site:



Bar Chart 1

Bar chart 1 shows that since 2007 Reuters has increased their output to about 1 million news reports per year, virtual doubling from the initial year. There are more news reports for the first five month of 2011 than for the entire 2007, for example. The total number of news articles for the period under consideration is 4,418,888. Not only the total volume has virtually doubled but also the amount of international political news has been doubled to about 8-10% of the total monthly volume due to the rebellions in Tunisia, Egypt, Libya, Yemen, Syria, Bahrain, Occupy Wall Street Movement, Gaza violence, government anti-Islamic offensive in the Philippines, etc. In short, the news feed since 2010 is thicker both in terms of quality and quantity due to increased direct action in the Middle East, East Asia, Europe, and the US.

Events data consists of who did what to/with whom per country for a given point in time. Events data is widely used in international relations research—for example, coding protocols (McClelland, 1978), regional and international sources (Gerner, Schrodt, Francisco, Weddle, 1994), social conflict (Bond, Jenkins, Taylor, Schock, 1997), textbook-level introduction to the general topic of event data analysis (Schrodt, 1994). Since Reuters reports daily, events data is generated daily initially. It is aggregated weekly, bi-weekly, or monthly in order to avoid the "weekend effects" and/or media fatigue. Such effects refer to the fact that during public holidays, weekends, breaks reporters do report less than business days. Conversely, during widely publicized events--like the World Cup, NATO summits—there is a surge of reporting. Weekly, bi-weekly, monthly aggregations do not change the statistical analysis, since we are linear transforming a random variable with its underlying statistical properties unchanged, but scaled. In technical terms, we have over/under-dispersion of daily events data (King, 1998). Media fatigue refers to the fact that virtually all news organizations rarely follow through to the end of a story. For example, What exactly happened to Ben Ali after he was kicked out? His end is not that important compared to the fact that Muammar Quadaffi was shot dead in a sewage canal by raging mobs a week ago or so as of October 30, 2011. To mitigate "weekend effects" and/or media fatigue, troops' casualties most often are reported on a monthly basis thus events can be aggregated by month as well.

TABARI uses the CAMEO protocol—described in appendix A—to capture the following types of violent events:

Code	**Description**
170	Coerce
171	Seize or damage property
1711	Confiscate property
1712	Destroy property
172	Impose administrative sanctions
1721	Impose restrictions on freedoms of speech and expression
1722	Ban political parties or politicians
1723	Impose curfew
1724	Impose state of emergency or martial law
173	Arrest, detain, or charge with legal action
174	Expel or deport individuals
175	Use violent repression
180	Use unconventional violence
181	Abduct, hijack
182	Physically assault
1821	Sexually assault
1822	Torture
1823	Kill by physical assault

183	Conduct suicide, car, or other non-military bombing
1831	Carry out suicide bombing
1832	Carry out car bombing
1833	Carry out roadside bombing
184	Use as human shield
185	Attempt to assassinate
186	Assassinate
190	Use conventional military force
191	Impose blockade, restrict movement
192	Occupy territory

Any news report containing these events is coded as to who inflicted the violence on whom. The following general steps were used to manually (re-)generate the data used in this thesis:

1. Download the whole of Reuters free, publicly available archive from 2007 through May 31, 2011. In June/July of 2011 Reuters changed their web site thus their archive is not directly visible as it used to be—but might be indirectly accessible. On the top of that change, 300 Gigs of news reports had to be re-downloaded over multiple computers all over again due to server disappearance. Thus it took months and months to re-create data that was automatically streaming ready to be fed into a statistical program for further analysis. Due to this Reuters changes data in this thesis is from January 1, 2007 through May 31, 2011.

2. Extract only international political news from the total of more than 4 million.

3. Extract the human readable text from the HTML files that were downloaded from Reuters
4. Format the human readable text into format suitable for machine processing
5. Generate events data under Mac using TABARI
6. Combine all years and months into a database
7. Run numerous SQL queries to extract only Afghanistan and Iraq related data from the total
8. Format and aggregate the Iraq and Afghanistan data monthly
9. Export Afghan and Iraq data into text files and get casualties from web sites listed in references
10. Format and feed Afghan and Iraqi data into a statistical program for further analysis

For greater details on events data refer to appendix A.

IV. Results and Models

Afghanistan Case

Is the number of violent acts per month influenced by the number of (re-)deployed, leaving, and/or killed US troops? This thesis will test the hypothesis that the number of US casualties influences the number of violent events per month. Additional dummy variables include a binary one for winter/non-winter conditions since asymmetric guerrilla-warfare tends to be seasonally adjusted as well. Given that US troops are (re-)deployed and/or withdrawing from Iraq to Afghanistan regressor models seem suited to test the hypothesis that the number of violent direct action per month is correlated with the troop casualty levels. Mathematically expressed the regressor model for Afghanistan looks like:

$$Y= b_0 + b_1*X_1 + b_2*X_2 + noise$$

where Y is the number of violent events per month, X_1 is the number of killed US troops per month in hundreds, X_2 is a dummy for winter or non-winter. B_0, b_1, and b_2 are coefficients to be estimated. Moreover, since US troops are scheduled for a phased withdrawal from Afghanistan in mid-2011 the effects of troops reductions can be captured with newly coded data. Fox provides a standard treatment of regressor models. (Fox, 2008).

Economic factors, actor power capabilities, military spending, etc are poor descriptors of violence acts in Afghanistan and Iraq. These factors do not fit the asymmetric nature of guerrilla warfare since the Taliban do not post on the Internet—or anywhere else—their net, untaxed revenues from drug-trafficking/blackmail or disclose their numbers, tactics, or any other reliable information that could be used against them. Thus, the best available predictor of the insurgent behavior is the number of terrorist acts they actually mount against the deployed US troops. Data on the number of killed Taliban tends to be unreliable and/or non-existent as well. Similarly, reliable data on the number of killed civilians is very hard to find since governments "tone it down" whereas NGOs "pump it up" thus for Iraq tentative estimates of civilian casualties range anywhere from half a million to 2 million total. Similarly US military budgets are known, but they change so little from year to year that there is virtually no variance to explain. In more technical terms—under conditions of no direct observation of the phenomena under consideration signal processing is the only other available method for gaining understanding of the underlying physical mechanism generating the data. In this thesis the underlying physical mechanism is the guerrilla warfare in Afghanistan and Iraq whereas the signal is reported news of killed in action military personnel.

Figure 1 below is a scatterplot of the monthly number of US casualties versus the monthly number of hostile acts carried out by the Taliban from January 1, 2007 through May 31 2011. Several characteristics are obvious—there are about 8 outliers in and above 100 killed troops per month. This author chose not to remove these outliers since they convey important information about the conflict under investigation—namely the increase of Taliban militant subversion since July 2010 up through 2011. Practically speaking the insurgents have doubled the amount of aggressive acts since the summer of 2010 since the Obama administration and NATO announced a transitional phase out to be completed by 2014. If the outliers were to be removed modeling would be easier but not meaningful and/or accurate. In short, in order to preserve accuracy and increase usefulness outliers were kept in the analysis.

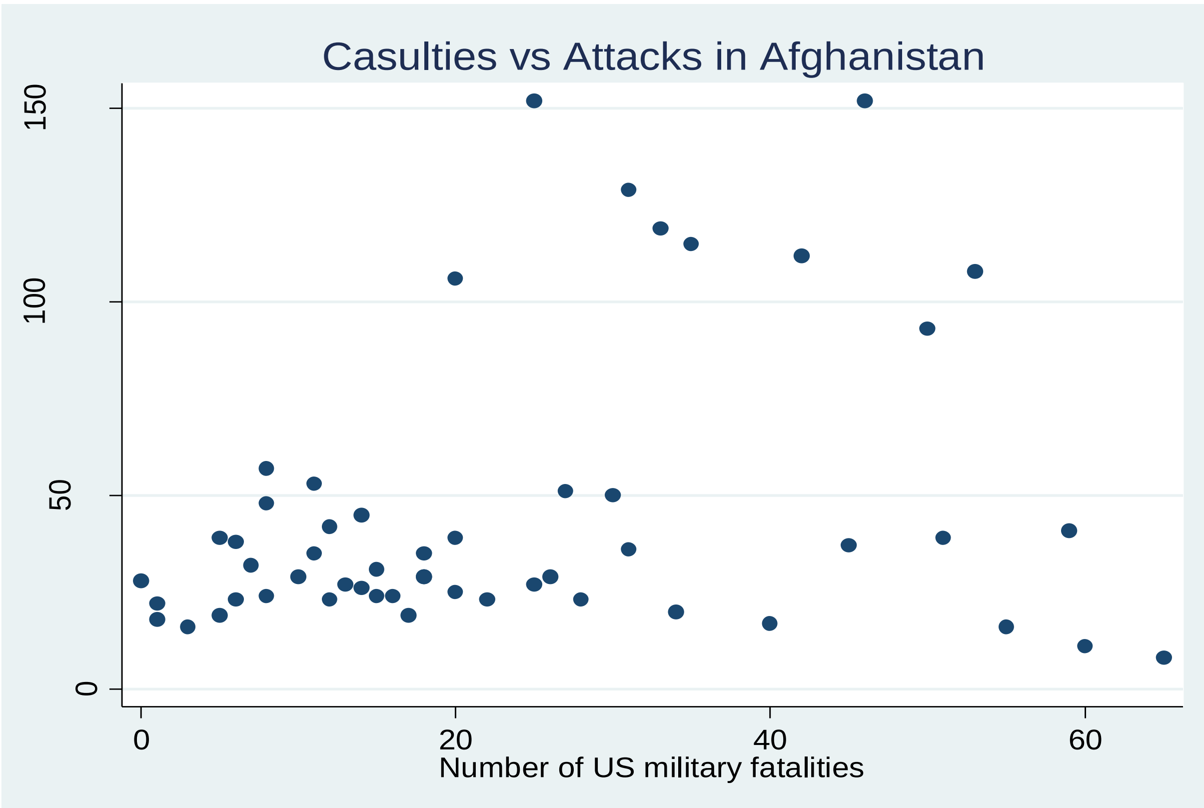


Figure 1

A linear model was fitted and is presented in Table 1 below. Since the winter dummy variable is insignificant the model implies that the Taliban are happy and capable of mounting violent attacks regardless of winter conditions or not. The number of killed US troops is statistically significant implying that the number of US casualties and the number of Taliban attacks are correlated. The constant term suggests that we would expect that the Taliban mount about 25 attacks per month against the Karzai government which they regard as a puppet Western "appointed" one. The adjusted coefficient of correlation is only about 0.07—that is this model explains only 7% of the variation and the rest 93% is considered "noise/error." Such a low explained variation should not be a surprise since the scatter plot contains numerous outliers and the relationship between the variables does not seem to be linear although two out of three of the estimated parameters are statistically significant.

Source	SS	df	MS
Model	7461.19471	2	3730.59735
Residual	62714.0128	50	1254.28026
Total	70175.2075	52	1349.52322

Number of obs	=	53
F(2, 50)	=	2.97
Prob > F	=	0.0602
R-squared	=	0.1063
Adj R-squared	=	0.0706
Root MSE	=	35.416

violence	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
usdeaths	.698947	.2966385	2.36	0.022	.1031311	1.294763
winter	14.47255	11.48668	1.26	0.214	-8.599129	37.54423
_cons	25.2867	9.652992	2.62	0.012	5.898099	44.67531

Table 1

Since the linear model explains so little of the variation this author fitted a curve that better captures the correlation between the number of killed US troops and hostile acts against them in Afghanistan since 2007. Given that there are numerous outliers that are observed in case there are at least 20 fatalities a quadratic curve was fitted since this particular model has a peak. A quadratic model, mathematically expressed, looks like this:

$$Y = b_0 + b_1 * X + b_2 * X^2 + noise$$

where Y is the number of violent events per month, X is the number of killed US troops per month in hundreds, b_0, b_1, and b_2 are coefficients to be estimated. The dummy winter variable was not included since the linear model above suggests that it is not statistically significant thus irrelevant and unnecessarily complicating the modeling process. Table 2 summarizes the results for the quadratic model whereas Table 3 gives the correlation coefficient:

Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
USDeaths	3.090	.982	1.450	3.146	.003
USDeaths ** 2	-.042	.016	-1.218	-2.643	.011
(Constant)	8.039	11.880		.677	.502

Table 2

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.437	.191	.159	33.697

Table 3

All the coefficients are statistically significant. If there were no US troops in Afghanistan it is expected that the Taliban would still mount about 8 attacks per month since they regard the fragile government of Ahmed Karzai as a Western puppet one, the president being a Bush-era political appointee who lived in exile most of his life and served as an oil executive. The statistical significance of the coefficients implies that there is correlation between the number of US military fatalities and the number of hostile acts against them. In less technical terms as Figure 2 below shows the number of hostile attacks peaks at around forty or so military deaths. Below 20 and above 60 military fatalities the number of guerrilla attacks is less or around fifty per month. The adjusted coefficient of correlation is about 16%, that is, the quadratic model explains more than twice the variation when compared to the linear one. The second model captures the fact that the number of violent attacks peaks for certain range of values; outside this range the numbers gradually decrease. As expected the quadratic model is more flexible, explains more variation, and captures in a more realistic way the observed dynamic of guerrilla warfare in Afghanistan since 2007. Although the quadratic model explains twice the amount of variation about 84% of the variance is considered "noise/error." Figure 2 is a plot of observed values and the fitted curve. The limited nature of resources of both the US military and the Taliban insurgents suggests diminishing-type of activity. That is, the Taliban can mount only so many attacks per month given the numbers of deployed US military thus polynomial models explain more variation than linear ones. Appendix C presents further cost constraints on both the terrorists and the military in terms of number of terrorist cells, traversal times, as well as organizational structure.

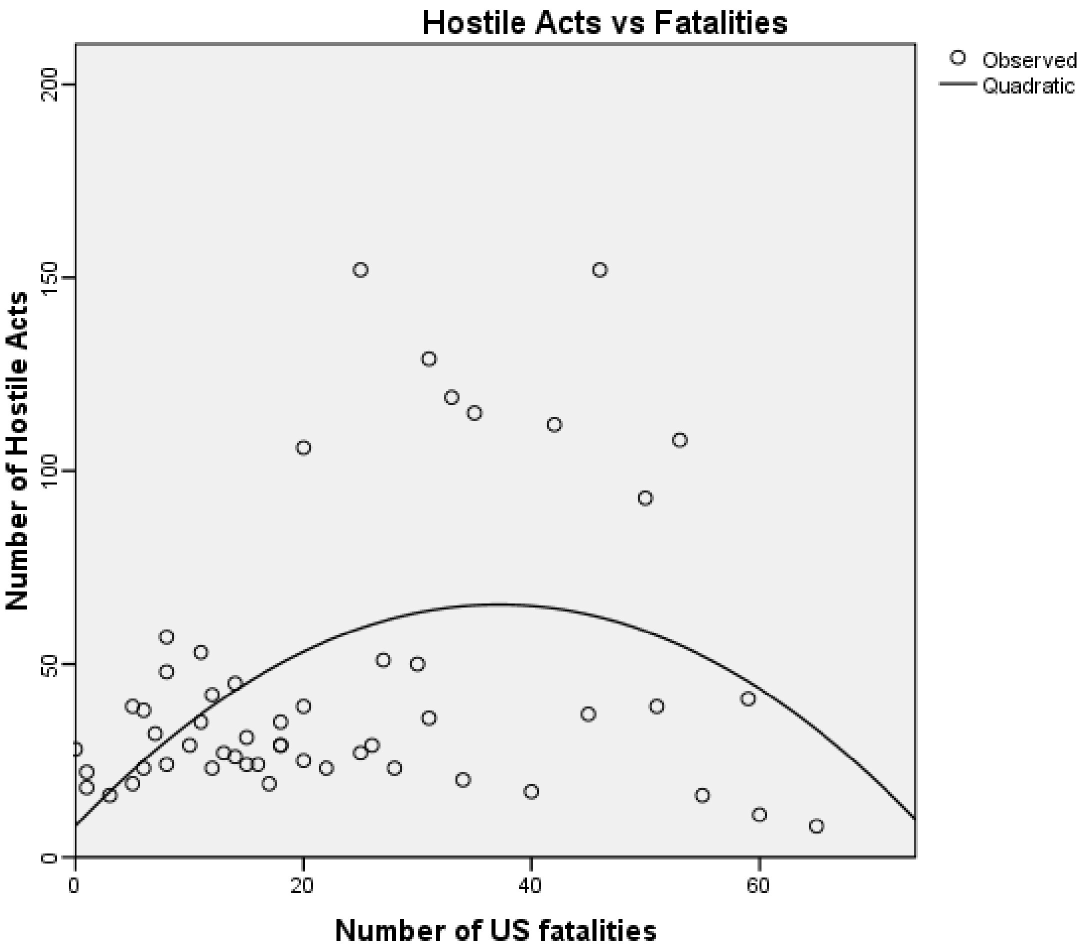


Figure 2

Time series models of Afghan attacks. Time series literature has exploded since its introduction in the mid-1970s by Box and Jenkins. For further references on time series models see (Box and Jenkins, 1994), (Brockwell and Davis, 2002), (Priestley, 1988), (Ruberti, d'Allessandro, 1972), (Hamilton, 1994, 2008). Time series analysis is particularly well-suited for this this thesis since it directly captures the chronological nature of unfolding events in a regularly spaced fashion as opposed to the indirect approach in regressor models. Figure 3 below plots the auto-correlation function. Looking at the exponential, slow decay of the coefficients an auto-regressive model would be a possible fit as recommended by Box and Jenkins. The order of the autoregressive model is at most four. In less technical terms the number of Taliban hostile attacks this month depends on at most the last four months, not necessarily all of them. Stated differently, Figure 3 in appendix B suggests the upper limit of the autoregressive terms; the exact order of the model is to be determined experimentally—there is no analytic way to know in advance exactly what the most fitting order would be.

By contrast, Figure 4 in appendix B illustrates that the moving average part of the auto-regressive paradigm is zero since virtually all coefficients of the partial auto-correlation function are within the 95% lower and upper confidence limits. In less technical terms, the time series model under consideration does not need white noise process—a moving average—to describe the observed sequence thus the proposed model below is parsimonious. The first coefficient is always out of the confidence limits by definition thus it does not count.

All auto-regressive models of orders one through four have been estimated and tried and the first degree model explains the most variation while having all estimated coefficients statistically significant. First order auto-regressive model also has the advantage of being parsimonious and simple. Mathematically speaking a first order auto-regressive process without white noise component looks like this:

$$X_t = \delta + \varphi_1 X_{t-1} + A_t,$$

where X_t is the time series, A_t is noise, φ_1 is a coefficient to be estimated, and

$$\delta = (1-\varphi_1)\mu,$$

with μ denoting the process mean.

Table 4 summarizes the parameters of the auto-regressive, integrated moving average (ARIMA) model of order one. All the coefficients are statistically significant thus the number of hostile acts this month strongly depends on the number of attacks last month, the lag one being 0.849. If the US troops were to disappear from Afghanistan we would expect that the Taliban would attack the Ahmed Karzai government with about 50 (types of) hostile attacks per month. Such a number rings realistic. The current Afghan President has nearly escaped two assassination attempts so far; his half-brother was assassinated from close range by one of his long-term body-guards in his fortified compound in broad day-light. In short, there is little reason to believe that the Taliban would start liking Ahmed Karzai or his relatives any time soon so when the US troops leave by 2014 the presently embattled President might share the faith of Soviet-era, communist-appointed-then Afghan President and be hanged from a lamp post by the rebels within 5 years or less from troops withdrawal.

ARIMA Model Parameters

					Estimate	SE	T	Sig.
Violence-Model_1	Violence	No Transformation	Constant		50.090	17.239	2.906	.005
			AR	Lag 1	.849	.080	10.647	.000

Table 4

Table 5 below illustrates that the explained variation is about 70% of the total. In other words the first order auto-regressive, integrated moving average explains 10 times more variance than the linear model and about 4 times more variation than the quadratic model. Given the noticeable increase in explained variation the auto-regressive, integrated moving average is much more suitable for predictions of number of violent acts per month. Appendix C gives cost considerations in terms of traversal time and resources as well as theoretical justification of terrorist recursive self-feeding, direct action. The greater percentage of explained variation in the time series models is not due to chance but due to recursive characteristics of violence.

Model Statistics

Model	Number of Predictors	Model Fit statistics	
		Stationary R-squared	R-squared
Violence	0	.693	.693

Table 5

Figure 5 and Table 6 plot the observed data, the fitted model, June 2011 forecast, 95% upper, and lower confidence intervals for the entire period under consideration. According to the first order auto-regressive, integrated moving average model we would expect between 64 and 146 aggressive acts by the Taliban in June of 2011. There is only 5% chance that we would observe more than 146 or less than 64 hostile events in June of 2011; the point forecast is 105 or more than 3 attacks each single day for a month. Figure 5 also demonstrates that the first order auto-regressive, integrated moving average model captures the sharp spike of militant activity in the summer of 2010. This doubling of Taliban offensive activities have been observed ever since.

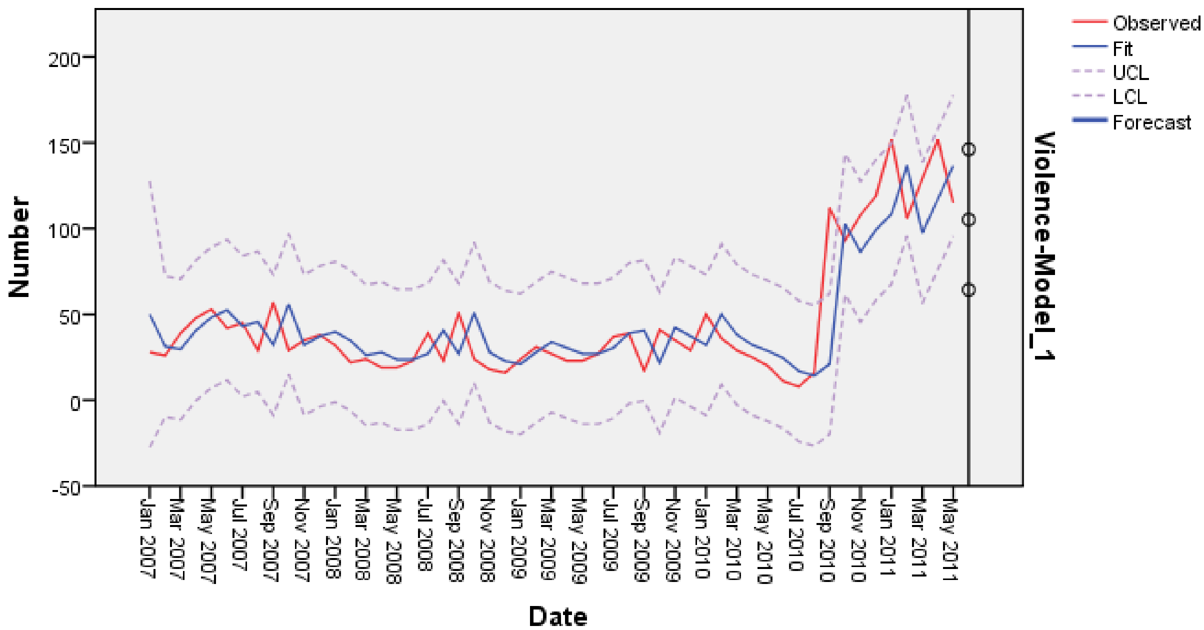


Figure 5

Forecast

Model		Jun 2011
Violence-Model_1	Forecast	105
	UCL	146
	LCL	64

Forecast

Model		Jun 2011
Violence-Model_1	Forecast	105
	UCL	146
	LCL	64

For each model, forecasts start after the last non-missing in the range of the requested estimation period, and end at the last period for which non-missing values of all the predictors are available or at the end date of the requested forecast period, whichever is earlier.

Table 6

Figure 6 in appendix B plots the residual auto-correlation and partial auto-correlation functions of the first order auto-regressive, integrated moving average model. All of the residuals are within the confidence interval thus indicating that the estimated model does describe the observed data. This author additionally tested about 20 (non-)stationary/non-linear models such as bi-linears but in virtually all cases these sophisticated models were either statistically insignificant or failed to converge during repeated estimation attempts thus indicating that higher-order, more complex time series models do not describe the observed data well, if at all.

Iraqi Case

Figure 7 below is a sctter plot of casulties versus hostile acts in Iraq since January

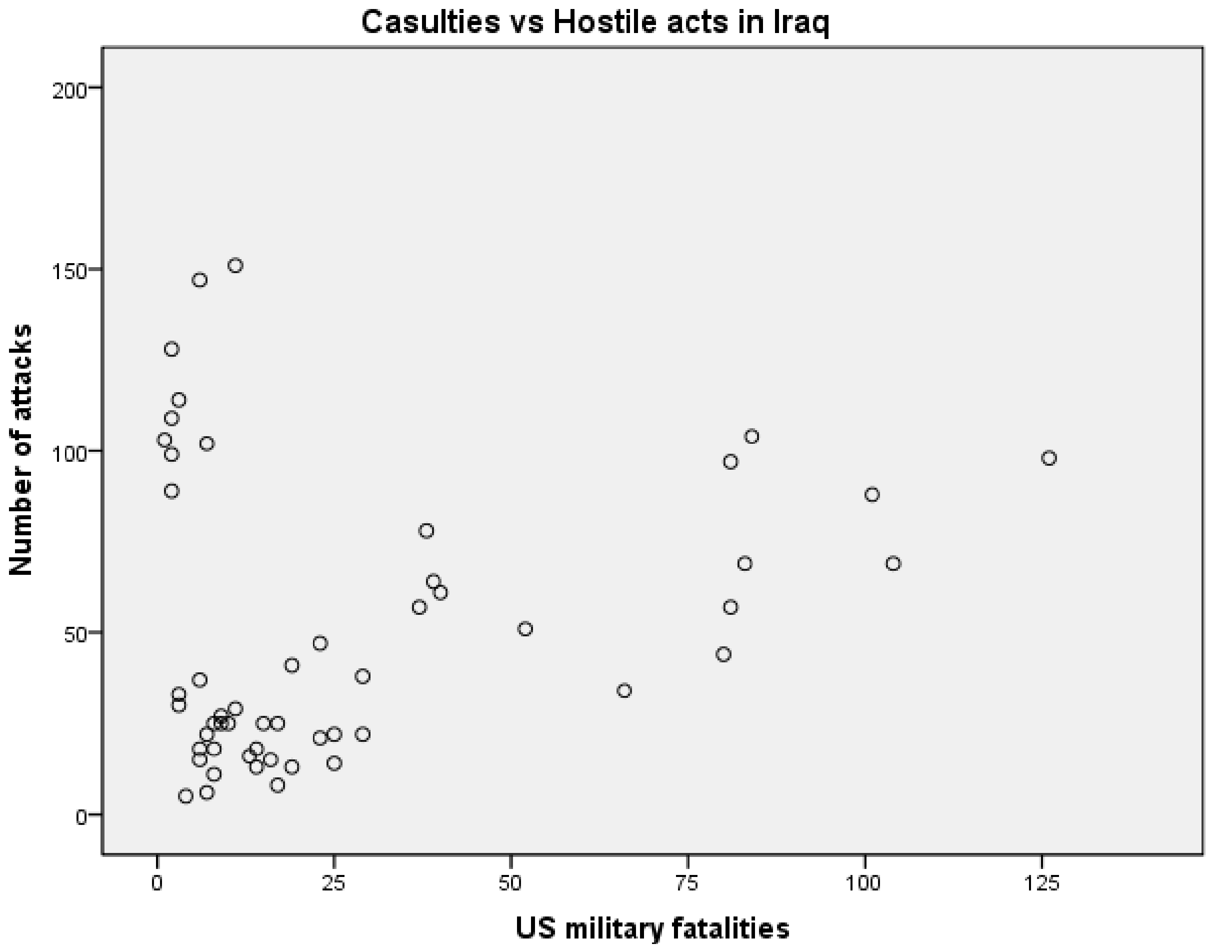


Figure 7

2007 through May 2011. Figure 7 illustrates the fact that there are numerous outliers. They were kept in the model since deleting them would miss the increased number of attacks since the summer of 2010. Given that the Obama administration announced in October of 2011 that all US would be pulled out of Iraq by the end of 2011 it should not comes as a surprise that reactionary elements, terrorists, and Baathist renegades are stepping up their suicide bombing, hijackings, etc.

Figure 7 shows that there is no point in fitting a line to the data since if there is correlation between the variables it would be in a non-linear form. Since there is trough in the lower left corner and outliers in the upper right one of Firuge 7 a cubic model was fitted. Mathemically speaking a cubic model looks like this:

$$Y = b_0 + b_1X + b_2X^2 + b_3X^3 + \text{noise},$$

where Y is the number of violent events per month, X is the number of killed US troops per month in hundreds, b_0, b_1, b_2 and b_3 are coefficients to be estimated. Table 7 below illustrates the fact that all coefficients are statistically significant thus the number of US military fatalities and the number of violent attacks are correlated.

Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	T	Sig.
USDeaths	-3.011	1.130	-2.402	-2.665	.010
USDeaths ** 2	.062	.024	5.295	2.605	.012
USDeaths ** 3	.000	.000	-2.756	-2.188	.033
(Constant)	69.834	11.074		6.306	.000

Table 7

Table 8 lists the adjusted correlation coefficient as 15%--that is the cubic model explains that much variation, leaving the rest as “noise/error.” The realistic features of the cubic model are the capture of peaks and troughs of attacks but at the same time its variance explanation must be taken with a grain of salt when it comes to forecasting.

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.450	.202	.153	36.117

Table 8

Figure 8 on the next page plots the observed data and the fitted cubic curve.

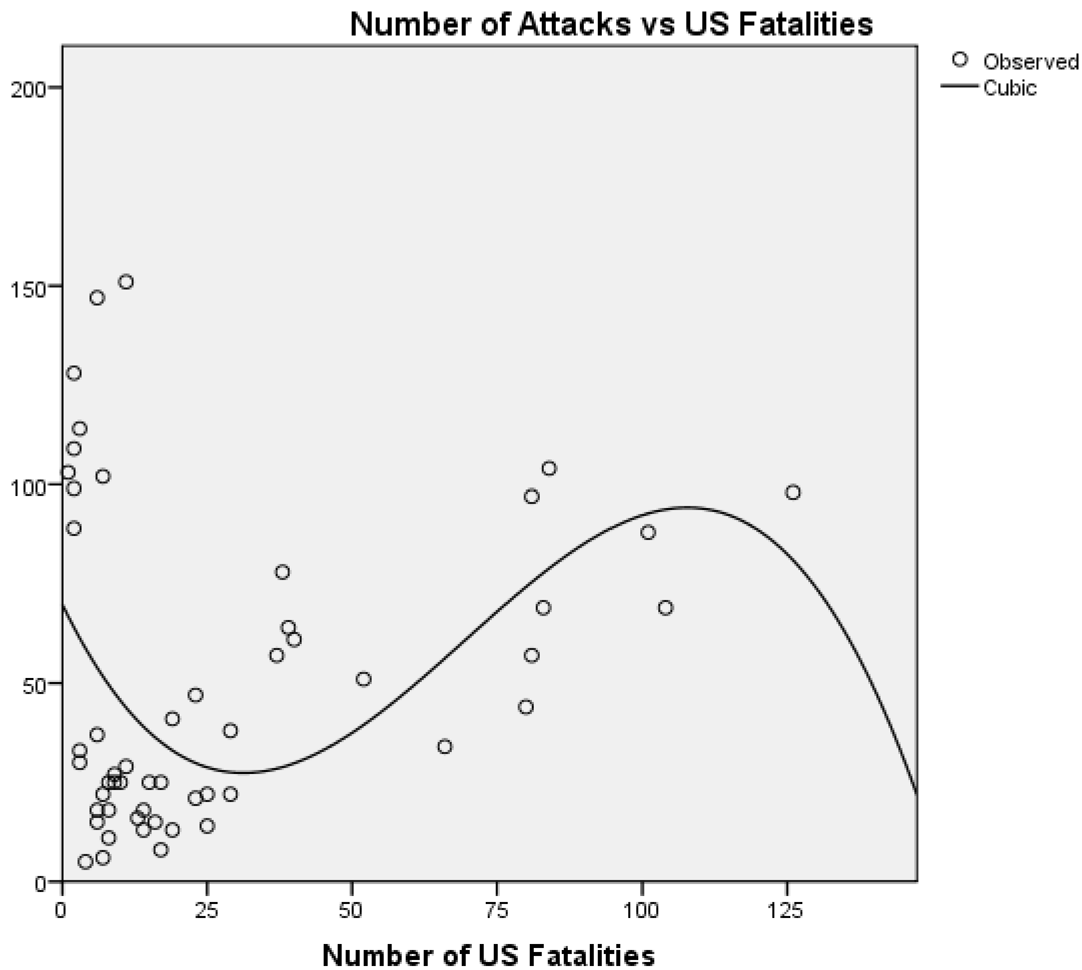


Figure 8

Figure 9 in appendix B shows the acuto-correlation fucntion together with 95% confidence intervals for the number of violent acts in Iraq. The characteristic slow esponential decay of the auto-correlation function suggests an auto regressive model of at most order of five. In less technical terms the number of attacks in Iraq this month could be depenant on at most the last five months. The exact order of the autro-regressive model is to be determined emperically since there is no pre-cooked, “in-advance” analytic procedure allowing to know how many months would be sufficient and enough to desctibe the number of monthly attacks in Iraq.

By contrast, Figure 10 in appendix B illustrates the fact that moving average component of the auto-regressive inegrated moving average paradigm is zero. That is, the process under consideration can be described just by using an auto-regressive equation. Figure 10 shows that all coefficients of the partial auto-correlation function are virtual random zeros thus there is no need to include a moving average process. In less technical terms it means that the number of Iraqi attacks per month depend mostly on their past monthly values without the white noise component influencing the observed levels.

ARIMA Model Parameters

				Estimate	SE	T	Sig.
Violence-Model_1	Violence	Constant		68.068	27.727	2.455	.018
		AR	Lag 1	.460	.129	3.556	.001
			Lag 2	.446	.136	3.278	.002

Table 9

After experimenting with all possible auto-regressive models up to order five it was found that a second order equation maximizes the explained variation and has all coefficients statistically significant. Mathematically speaking, a second order auto-regressive process looks like this:

$$X_t = \delta + \varphi_1 X_{t-1} + \varphi_2 X_{t-2} + A_t,$$

where X_t is the time series, A_t is noise, φ_1 and φ_2 are coefficients to be estimated, and

$$\delta = (1 - \varphi_1 - \varphi_2)\mu,$$

with μ denoting the process mean. In less technical terms, a second order auto-regressive model means that the levels of Iraqi attacks per month are mostly dependent on the last two months. The second order auto-regressive moving average process explains slightly more than 70% of the variation as Table 10 below shows. Table 9 lists all statistically significant coefficients which imply that the levels are violence this month are almost equally dependent on the last two months since the values of the coefficients are similar in magnitude. Interestingly, in the absence of US army to be attacked we would expect that terrorists, Sunni Baathist reactionary renegades, criminals, etc would mount about 68 attacks against the Shia Malaki government—more than two attacks every day per month. Rumor on the Arab Street has it that after the US army withdrawal to Afghanistan and/or home by the end of 2011, former Saddaam Hussein Sunni Baathists elements would happily fill the power vacuum of the Shia Malaki government. These rumors got so loud and impossible to ignore that on October 29 2011 Nuri al-Malaki went public on Reuters to state that “Baathists would never be in power again.” Up through October of 2011 these optimistic personal opinions of Malaki have not been actually materialized since rebel elements in Iraq launch attacks into the hundreds per month as depicted in Figure 10. In short, Iraq is anything but a wonderfully shining “beacon of democracy” in the Middle East as former US President Bush would proclaim publicly. In the absence of a functioning central authority factions appear and “duke it out” using brutal force—Baathist Sunnis against Shiites are just another example in a post-Saddaam unstable Iraq that might plunge into the abyss the way Afghanistan has been for at least fifty years now.

Model Statistics

Model	Number of Predictors	Model Fit statistics	
		Stationary R-squared	R-squared
Violence-Model_1	0	.701	.701

Table 10

Table 11 on the next page contains the forecast for June of 2011. We would expect between 80 and 168 attacks mounted by Baathist Sunni insurgents according to the second order auto-regressive integrated moving average model. The point forecast would be 124 hostile attacks; there is only 5% chance that the observed number of hostilities would go above 168 or below 80. Figure 11 is a plot of the residual auto-correlation and partial auto-correlation functions and since all the residuals are within the limit in a random fashion it can be concluded that the proposed second order auto-regressive, integrated moving average fits the data adequately.

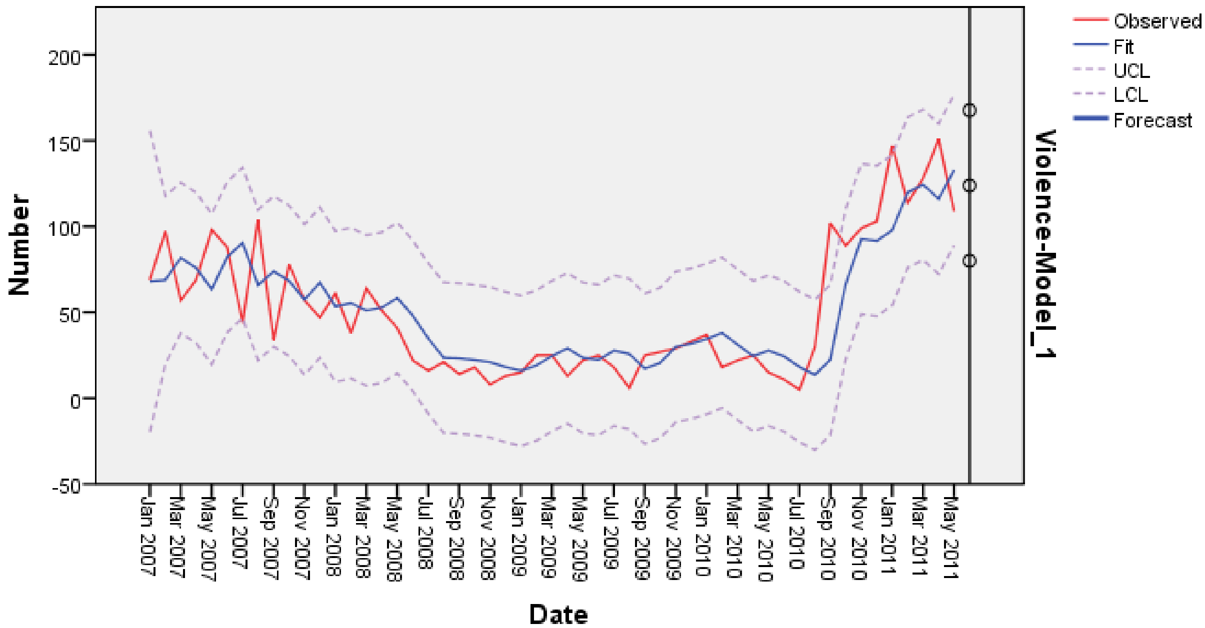


Figure 10

Forecast

Model		Jun 2011
Violence-Model_1	Forecast	124
	UCL	168
	LCL	80

For each model, forecasts start after the last non-missing in the range of the requested estimation period, and end at the last period for which non-missing values of all the predictors are available or at the end date of the requested forecast period, whichever is earlier.

Table 11

V.Conclusions

This thesis confirms that drug-funded guerrilas—backed by potent, radical Islam—who exploit the recursive, self-feeding, asymetric reinforcing nature of hostilities can effectively push out much stronger, materially superior armies operating on foreign soil in the long run. In other words, due to the topology of all channel networks—examined in appendix C—the insurgents can wage long term wars that conventional armies have very hard time crashing. Given imperfect information and limited resources the terrorsits set up an all cahannel network that is lot less costly to maintain than the 150 000 US and NATO troops over ten years and counting. Whereas the terrorsits have "nothing to lose but everythig to win" the conventional armies keep loosing material resources while there is no victory in sight, just containment of what apprears to be a headless terrorist structure that keeps on fighting as long as there are troops at a reachable distance. The slowly retrearing armies are bled drop by drop to virtual exhaustion by decade(s) of un-winnable (civil) war of attrition that amounts to "David knocking out a huge Goliath" by punching him infinite number of times with a little more than a sling-shot. Short of nuclear annihilation—or use of brutal, indiscriminate force—the regular army has no other realistic recourse to victory and unfotunately even such an approach is not politically possible in practical terms.

Stated differently since conventional armies have limited resources, imperfect intelligence information it becomes too time-consuming and very costly to wage an asymmetric war of attrition that the terrorists are capable of maintaining as long as there are troops to be targeted thus maintaining a vicous circle of violence.

Appendix A—Automated Events Data Description

Events data is one of the most widely used in quatitative international relations research. (Andriole and Hopple 1984; Azar and Ben-Dak 1975; Burgess and Lawton 1972; Daly and Andriole, 1980; Laurance 1990; Marlin-Bennett and Roberts 1993; Merritt, Muncaster and Zinnes 1994; Munton, 1978; Schrodt 1994; Sigler, Field and Adelman 1972; Schrodt 2001) McClelland (1967, 1967) in multiple papers and projects defines international events:

"Event-interaction is meant to refer to something very discrete and simple—to the veritable building blocks of international politics. They are the specific elements of streams of exchange between nations. Here are a few examples for hypothetical Nations A and B: Nation A proposes a trade negotiation, Nation B rejects the proposal, Nation A accuses B of hostile intentions, Nation B denies the accusation, Nation B deploys troops along a disputed boundary, Nation A requests that the troops be withdrawn, ... Each act undertaken by each actor in this illustration is regarded as an event-interaction."

Automated events data is generated by using three necessary components:

1. News provider. The first ingredient in events data generation is a news provider. For academic purposes Reuters is most oftenly used since it is the largest, free, publicly available news source in the world. (Schrodt and Gerner 1994; Schrodt and Gerner 1997; Davies and McDaniel 1994) Other smaller news sources like the New York Times or Agencie France Presse charge for their content thus making it prohibitively expensive without dedicated subscription. For example the

New York Times as of 2011 charges anywhere between $1 and $5 per single article; the costs increase for archived content. Not only it is expensive to use New York Times but its converage is much smaller than Reuters thus not covering as much territory. In other words, the total downloaded Reuters content is approximately worth in todays New York Times prices more than $4 million for more than 4 million articles. Using the largest, free, publicly accessible news source eliminates the crucial difficulty of differenting between two reports of the same event from two different sources thus avoiding duplication of data referring to the same physically observed report. Last, but not least, Reuters can afford to send ground crews to virtually all major hotspots thus the news feed is from (near) on-site, verified reporting as opposed to re-printing and secondary reporting.

2. Protocol. The Conflict and Mediation Event Observations Codebook (CAMEO) protocol is a set of actors, verbs, and rules for the mapping of event forms from text strings representing lead Reuters news sentences. Stated differently the protocol is the “lens” through which TABARI, described in section 3 below, “sees” the political world of (violent) conflict/cooperation. The categories for "use of force" have been expanded and can therefore make better distinctions between reported levels of violence within the Reuters news leads. This expansion of the “use of force” is well-suited for the goals of this thesis since hostilities are the focus. The actors dictionary contains countries—United Nations list of standard three-letter country codes are

used—territories, IGOs, NGOs, as well as religious, ethnic groups not represented by states. The actors dictionary contains hundreds of verbs describing the interactions between/among actors. All dictionary descriptions can be found in the CAMEO codebook given in a link in the reference section. In more technical terms a protocol is a "function E that maps text strings into codes [E: S _ Pow(C)] where Pow(C) is the power set of C." (Schrodt 1994)

3. Software. With the advent of advanced personal computers the generation of events data has been gradually rendered to automated machine coding. The pioneering work in machine (auto-)coding began in the late 1980s at the University of Kansas with the start of the Kansas Events Data System (KEDS) funded by numerous National Science Foundation projects as well as US government contracts. In 2000 Schrodt and his associates developed an improved parser dubbed TABARI ("Textual Analysis by Augmented Replacement Instructions"). This thesis uses TABARI to generate the data since the improved coder is about 70 times faster than KEDS. On a 650Mhz Dell Pentium III, the speed is around 3000 events per second which translates into millions of coded events for a 24 hour period, given an auto-downloading and formatting software of news reports.

Both TABARI and KEDS use sparse paring to map the Reuters lead sentences into coded data. Sparse parsing refers to a computational technique for breaking natural language text into its constituent parts so that they can be converted into data. TABARI uses the Conflict and

Mediation Event Observations Codebook (CAMEO) protocol to sparsely parse Reuters leads into events data. An instance of TABARI and CAMEO at work for event code 051— Express support for, commend, approve policy, action, or actor.—can be exemplified with the following actual Reuters news lead sentence:

```
110512 reu46176-1307079809.93212-105
```

```
KABUL (Reuters) - Indian Prime Minister Manmohan Singh, on a visit to Afghanistan Thursday, said India strongly supported a plan by Kabul to reconcile with Taliban-led insurgents, New Delhi's first public backing of the plan.
```

The above report was filed by Reuters reporters in the field—Kabul—where they witnessed the visit in question. "`Indian Prime Minister Manmohan Singh`" is the initiating source agent in this example thus is coded to "IND"—a short code for India. The Indian Prime Minister is expressing his support so TABARI codes it as 051 which is a number for "Express support for, commend, approve policy, action, or actor" in the CAMEO codebook. The target of this example Reuters lead is "`Kabul`" thus it is coded to Afghanistan or "AFG." TABARI uses YYMMDD date format so the string "110512" is May 12, 2011. Literal in Table 1A refers to the specific words used in the sentence—in this case the Indian Prime Minister "SAID INDIA SUPPORTED KABUL," capitalization is machine generated. The id column refers to a news article identifier for easier tracking of thousands of events out of millions of downloaded Reuters articles. Table 1A summarizes the TABARI data output the way it gets out of the machine:

date	Source	Code	Target	Description	Literal	Id
110512	IND	051	AFG	(Praise or endorse)	SAID INDIA SUPPORTED KABUL	reu46176-1307079809.93212-105

Table 1A

Thus TABARI, using the CAMEO protocol, converts a natural languge news report into data for the purposes of statistical analysis. Whereas this thesis uses only violent event types for the exploration of guerrilla warfare both TABARI and CAMEO incorporate the full gamut of inter-state interactions from peaceful cooperative exchanges to all out nuclear war. All violent events involving Afghanistan, Iraq, and the United States have been collected into a database and the number of violent ones per month has been recorded for statistical analysis in the preceding sections. A practical guide for events data can be found at: http://web.ku.edu/~keds/papers.dir/gdthomas.ISA00.pdf.

Appendix B—Statistical Diagnostics

Figure 3 and 4 show the auto-correlation and partial auto correlation functions for the Afghan case—their technical interpretation is in the body of this thesis.

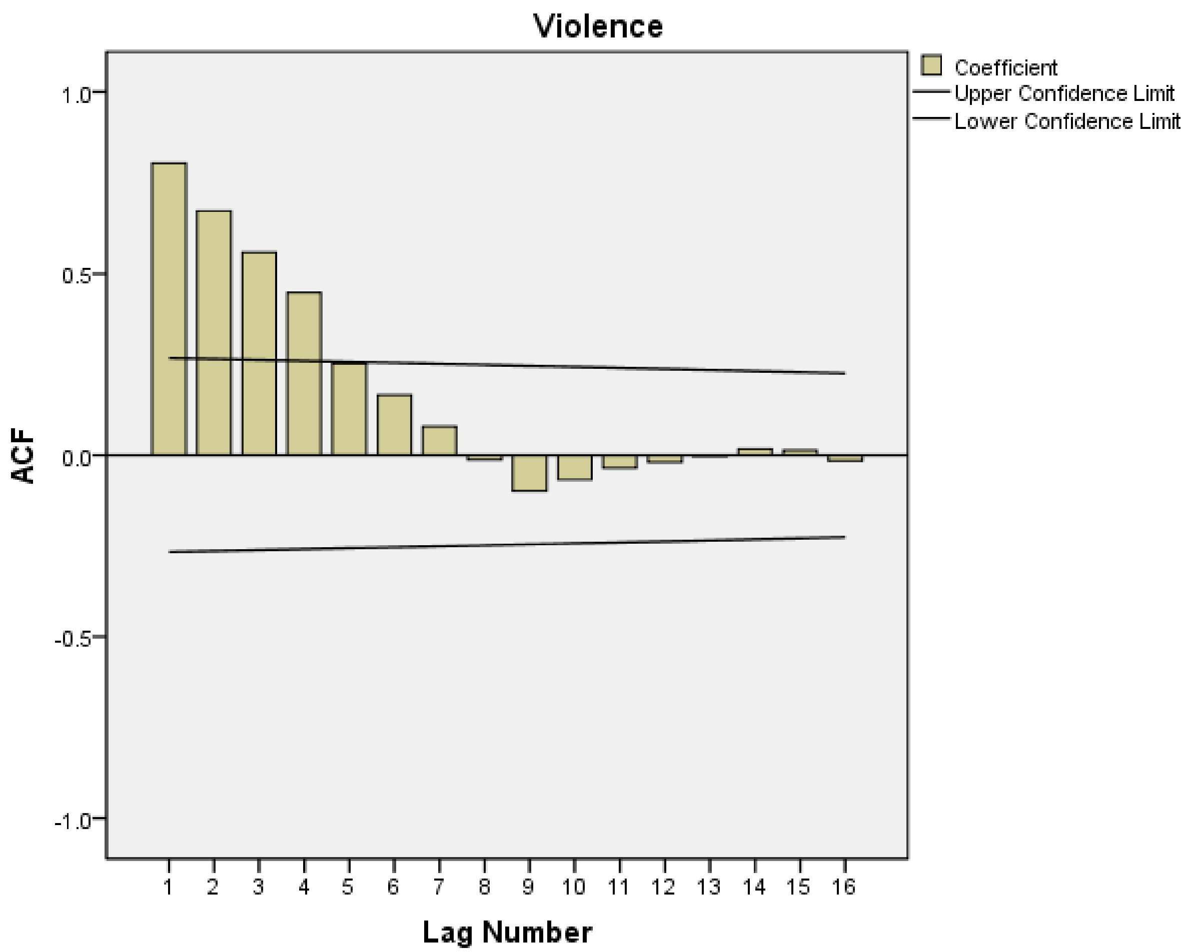


Figure 3

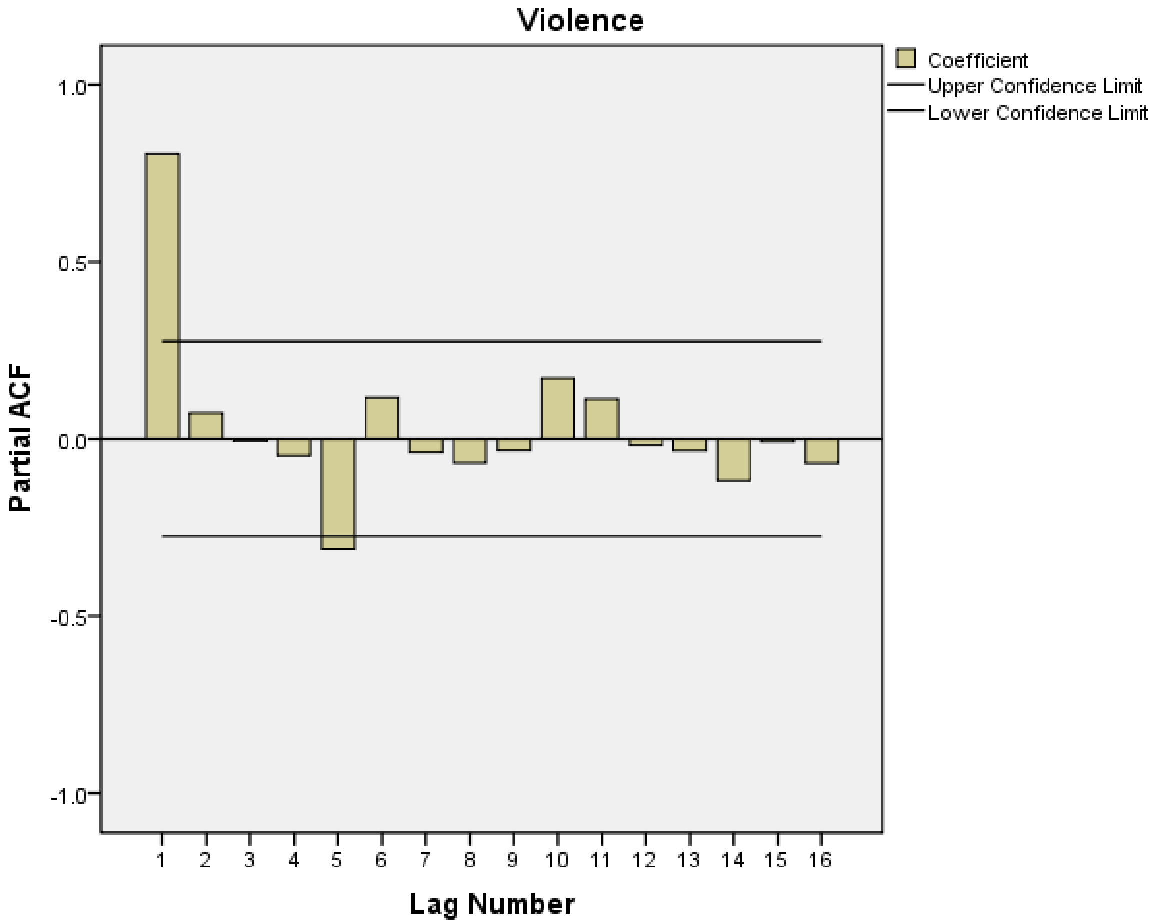


Figure 4

Residual auto-correlation and partial auto-correlation for the Afghan case in Figure 6:

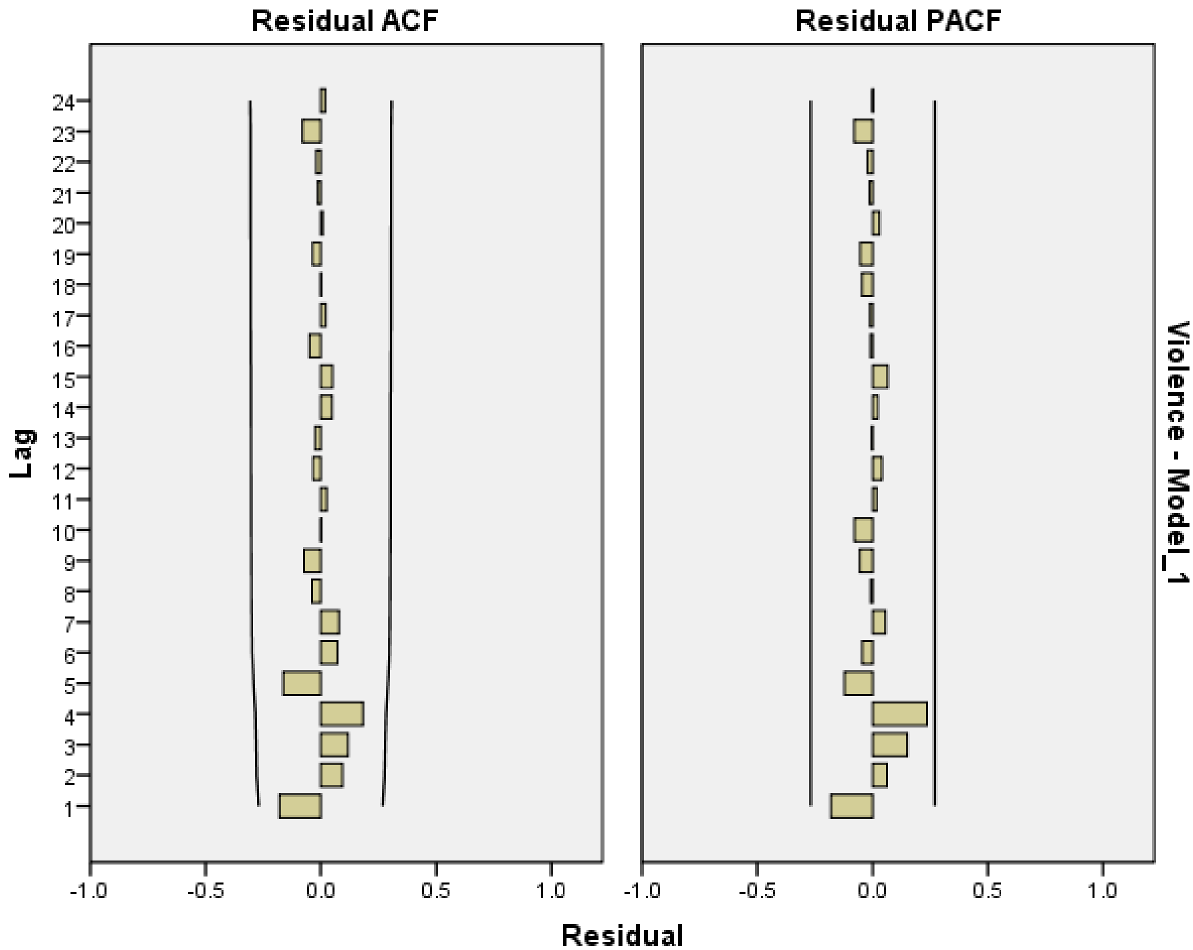


Figure 6

Figures 9 and 10 illustrate auto-correlation and partial auto correlation functions for the Iraqi case.

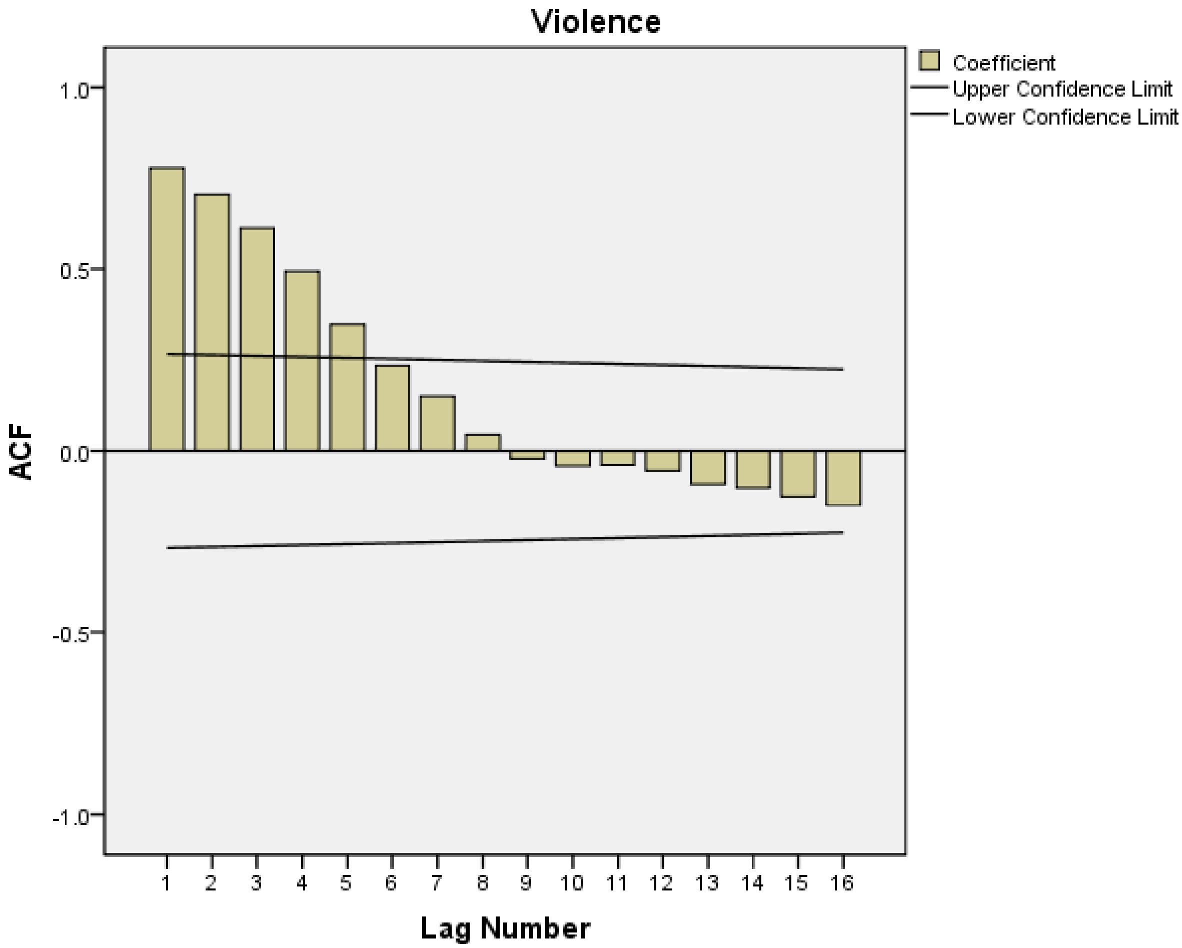

Violence
Coefficient
Upper Confidence Limit
Lower Confidence Limit
1.0
0.5
0.0
-0.5
-1.0
ACF
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Lag Number

Figure 9

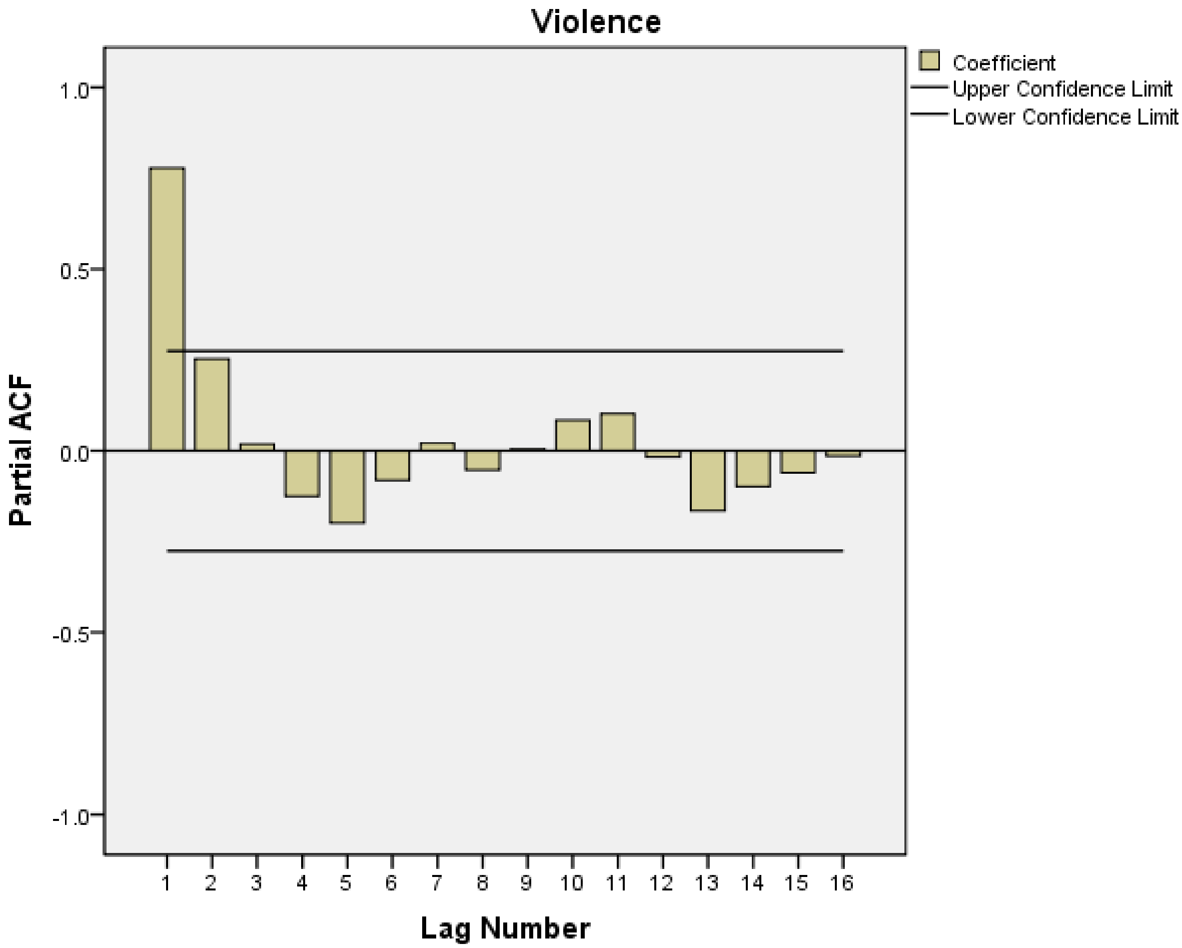


Figure 10

Residual plots for the Iraqi case in Figure 11 below:

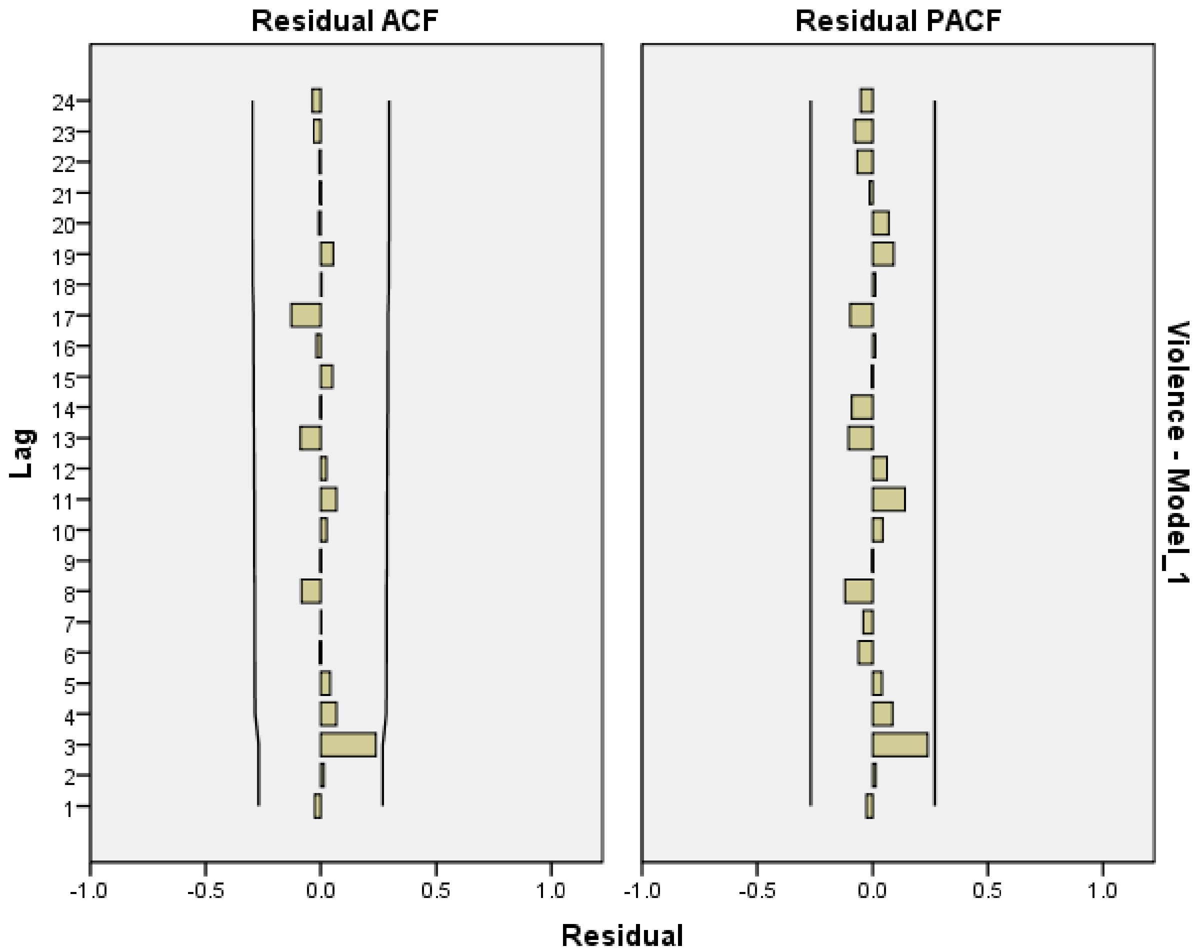


Figure 11

Appendix C—asymmetric netwar in greater details; graph properties and HP-hard time results can be found in any algorithms book (Sedgewick, 1999)

Arquilla and Ronfeldt describe three main types of networks and state that hybrdis are possible. In computer science such networks are called graphs. Each graph consists of nodes and edges among/between the nodes. A node in the context of this thesis is a (semi-)autonomous terrorist cell capable of mounting direct action against the US military. The edges between/among cells represent communication channels and/or physical routes for communication/supply/travel with associated differing costs to connect two or more nodes; each cell can be located on different continents and/or countries. Terrorist cells are usually comprised of less than ten terrorists since a larger nubmer would be easy to capture by the military. Terrorist cells are represented by circles in the figures below whereas edges are the lines connecting the nodes. The Figure 1C below shows a chain network--typified by smuggling, support networks, where end-to-end exchanges (information, contraband, drugs, etc.) must travel back and forth between intermediary nodes.

Figure 1C

Chain networks are the easiest to eliminate since the number of hits the military has to do roughly corresponds to the number of nodes in a polynomial fashion, As Arquilla notes terrorists are moving away from chain networks since it is easy to destroy them and moving towards all-channel; graph discussed below.

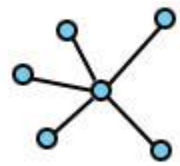


Figure 2C

Figure 2C depicts a star or hub network/graph in which cells are tied to a central (though not necessarily hierarchical) node, and all communication travels through that central node. Eliminating such a network is not possible in polynomial time—as was the case in the chain graph--and depends on the number of nodes, and associated costs of edges between cells.

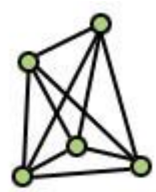


Figure 3C

Figure 3 depicts a fully connected graph in more technical terms where each cell communicates with every other in semi-autonomous fashion. Arquilla, Ronfeldt, and Zanini note that it is the all-channel model that is becoming increasingly significant as a source of organizational collaborative power thus terrorist destructiveness without being caught easily, if at all. The fully-connected graph has no central leadership and no key node whose removal might disrupt the entire organization. Thus, the network is completely decentralized, “allowing for local initiative and autonomy” in an organization that may at times appear “acephalous (headless), and at other times polycephalous (hydra-headed).” (Arquilla, Ronfeldt, Zanini, 1999)

So the key question is: given a fully-connected graph can the millitary fully destroy it by killing all the cells and their members? Unfortunately the answer is no thus a fully connected graph cannot be fully terminated. It is so due to the non-polymonial time involved into visiting and killing all cells in such a way that the associated costs with the edges is minimized. In more technical terms the problem of visiting and killing all the cells at the lowest possible cost of an all-channel network is non-deterministic polynomial time or NP-hard. That is, even if he had all the material resources in the world and had perfect information about the terrorist network we still won't be able to visit and kill all of them at the lowest possible cost due to excessive amount of time necessary to do it. For about 20 cells or so it would take hundreds of years to locate and kill all the cells at the lowest possible cost. For all channel networks with more than 20 cells in different cities/countries it would take eons to minimize costs. In the real world, of course, nobody has unlimited resources and perfect information let alone eons of time. Thus, the political implications of the NP-hard traversal time are that functioning fully connected terrorist networks cannot be fully eliminated in practical terms. Thus, once established all channel networks--like the Taliban's in Afghanistan and the insurgents in Iraq—are self-sustaining themselves by recruiting new members who keep attacking regular armies in different locations; in short terror begets terror and we can only minimize its impact by first projecting levels of expected attacks at the most likely places.

A recent practical, real life example would illustrate the intractable magnitude of NP-hard problems. In 2011 President Obama announced that, finally, Osama bin Laden has been killed—he has been traversed in technical terms—after 10 years of intense hunting involving the whole US intelligence apparatus. In other words, it takes a decade to eliminate a single cell—although the leading one—and millions of dollars. Even when bin Laden is killed his all channel network still operates, his leadership place has been taken by Zawahiri thus the elimination of leading cell does not stop the functioning of the network; in practical terms terror breeds terror since the dead cell is replaced by another and this re-generation process continues as long as there are willing recruits to join the cells and keep on fighting the present armies.

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