Exploring Conflict and Oil Prices: Myths, Realities, and Implications for the Department of Defense

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Introduction

The Department of Defense (DoD) has good reason to be concerned with energy and fuel efficiency. The February 2008 report of the Defense Science Board (DSB) Task Force on DoD Energy Strategy declared that "[t]he Department of Defense is the largest single consumer of energy in the United States" ("More Fight Less Fuel" DSB p. 11 2008). The United States Energy Information Administration (EIA) of the Department of Energy (DoE) has calculated that the United States consumes approximately 100 quadrillion BTUs[1] of energy each year ("U.S. Primary Energy Consumption by Source and Sector, 2008." EIA 2009). It consumes more than any other country on the planet. This means that the Department of Defense is most likely the top energy-consuming organization in the top energy-consuming nation in the world. In 2006, the DoD spent approximately $15 billion on energy with 25 percent of all energy consumed powering facilities and the remaining 75% powering vehicles and deployed bases in warzones ("More Fight Less Fuel" DSB p. 11 2008). This paper argues that the DoD's posture on fuel consumption is a strategic weakness for two reasons. First, the DoD has no protection against higher oil prices. Second, conflict appears to have a positive and statistically significant effect on oil prices over both long periods of time (such as years) and shorter periods of time (such as days, weeks, and months). Oil will cost the most when the DoD needs it the most -- during times of conflict. After adjusting for inflation, the DoD's fuel costs increased 373% from FY 1997 – 2007 (Andrews p. 3 2009).

This study is distinctive for two reasons. The first is that it analyzes the link between conflict and oil prices over longer periods of time, incorporating annual data that includes multiple conflicts and international confrontations over different decades while also accounting

[1] BTU stands for British Thermal Unit, a measurement of thermal energy. It is equivalent to 1/3 of a watt of electrical power or 1055.06 Joules. A BTU is the amount of energy needed to heat one pound of water one degree Fahrenheit. To provide a frame of reference, one gallon of gasoline provides 124,000 BTUs.

for macroeconomic data during these periods. This contrasts with studies that focus on the behavior of oil prices only in relation to one or two specific wars such as the Persian Gulf or Iraq War (Lee and Cheng 2007), or only in relation to generalized macroeconomic drivers such as GDP growth or oil market fundamentals (Hamilton 2009). The second distinctive attribute of this study is that it contains a shorter term higher-frequency analysis of daily oil prices in response to the December 2008 - January 2009 Gaza conflict. This differs from other studies in that it analyzes daily oil prices in relation to smaller scale conflicts in the Middle East, rather than in relation to a full scale war such as the Iraq War of 2003 (Looney 2003).

Besides being structurally different from other works on oil prices, the methods and conclusions of this study also differ in two smaller ways. Firstly, this paper differs in its chosen methods for capturing oil price data. Oil price data was entered as a percent change (either in day/day or year/year periods), such as 3.3% for the year 2002 rather than in dollar terms such as $60.55 a barrel in 2001 and $62.55 in 2002. The figures used to calculate the percentage were all inflation-adjusted into 2008 dollars. Entering the data as a percent change was done in an effort to more intuitively capture and display the volatility and response of oil prices to the conflict variable while also dampening the potential impact of trending prices. Capturing the data as a percent change rather than a dollar figure seemed more appropriate for graphing purposes as well. Secondly, this paper differs in the nature of its conclusions from other works. Rather than attempting to conclude with a generalized link between oil price and conflict (Looney 2003), or an extremely complicated analysis of the "jump" volatility of crude oil prices to war (Lee and Cheng 2007), this study falls in between by building a simple but statistically-relevant model to help predict conflict's impact on oil prices. The conclusions are that: (1) over longer periods of time, one can expect annual price jumps of 25-55% in world oil prices in the presence of significant large-scale conflict involving the United States and (2) over shorter periods of time, conflict in oil-sensitive regions has the potential to cause daily price jumps of 8-12% in world oil prices.

First Strategic Weakness: Price Vulnerability

The first reason the DoD's posture on fuel is a strategic weakness is because it is extremely vulnerable to oil price fluctuations. Many believe that the DoD is protected from the market price of fuel. However, this is untrue. The Congressional Research Service reports that the "Defense Energy Support Center (DESC), the primary agency responsible for procuring DoD's ground and air transportation fuels, buys bulk energy commodities and 'resells' the fuel to various military customers — with a price markup to cover its cost of operation (e.g. storage, transportation, and maintenance)" (Andrews and Schwartz p.1 2008). In this way, DESC can be seen as a middleman, buying fuel from the wholesalers and supplying it to the customer -- in this case, the U.S. military. DESC charges the armed forces a standard price of fuel. However, the price DESC pays for the fuel is tied to the market price, and when prices rise, the DoD's Defense Working Capital Fund (DWCF) must cover the difference (DESC "Standard Prices Main Page" Feb 2009). So ultimately, when fuel prices rise, the DoD's budget has to cover the cost increases somehow, even if this increased cost is not apparent to the armed forces themselves. When prices do rise rapidly, there is no good short term recourse for the DoD. It does not hedge its contracts or store oil. In the past, the "DoD's only recourse has been to request supplemental appropriations to pay for the increased costs and supplies" (Andrews p.17 2009). In 2008, rapidly escalating oil prices caused a multi-billion dollar shortfall and emergency requests for more funds (Zavis 2009). Furthermore, the operational costs of delivering the fuel from purchasing points to units in the field are significant but are not reported in the official purchase price of the fuel (Andrews p. 14 2009). For example, in 2007, DESC spent $400 million on contracts for storage and distribution, $350 million for bulk fuel transportation, $371 million for port, depot storage, and pipeline service, and $4.8 billion on multi-year contracts to power posts, camps, and stations (DESC FY07 Fact Book p. 23-52 2007). Finally, there is a general belief that the Strategic Petroleum Reserve (SPR) would save the military during a fuel crisis, but this belief may be misplaced. During 2006, 40% of the crude oil refined in the U.S. was heavier than the oil stored in the SPR (Rusco p. 5 2008). Nearly half of the nation's refineries are geared toward oil that is heavier than what we have stored inside our SPR. It would take time to retool these refineries and set up large scale refining of the SPR stockpile. For all of these reasons the DoD is vulnerable to oil price swings.

Second Strategic Weakness: Oil Prices and Conflict

The second reason that the DoD's posture on fuel is a strategic weakness is because oil costs the most during times of conflict. In general, there is an extremely large and diverse body of studies that attempts to describe movements in oil prices. These reports range from those that look at a number of macroeconomic factors such as commodity price speculation, demand, geological limitations, and OPEC pricing (Hamilton 2009), to inflation and investment factors (Yeyati 1996), to geopolitical tensions (Rush 2008). Still others look at internal and regional conflicts over oil itself (Lujala, Rod, and Thieme 2007) or the relationship between oil price shocks and the business cycle (Raymond and Rich 1997). The challenge was to determine what variables were relevant and applicable to this study.

Admittedly, the relationship amongst the variables is often fuzzy. Hamilton (2009) says that:

> [w]e have reviewed a number of theories as to what produced the high price of oil in the summer of 2008, including commodity price speculation, strong world demand, time delays or geological limitations on increasing production, OPEC monopoly pricing, and an increasingly important contribution of the scarcity rent. Rather than think of these as competing hypotheses, one possibility is that there is an element of truth to all of them (28-29).

It is a solid hypothesis that a large variety of macroeconomic and geopolitical factors affect the movement of oil prices. For this reason, a specific set of economic data was used in the study both in the long-term and short-term studies in an attempt to account for economic drivers of the price of oil. Of course, there are factors beyond economics that influence the movement of oil prices as well.

Some authors have found that there is a definite correlation between political conflict and oil prices. Lee and Cheng (2007) says that "[t]he political conflicts among oil production countries are the main reasons for causing sharply higher oil prices since 1985" (912). Lee and

Cheng studied oil prices during the first Gulf War and then the 2003 U.S. invasion of Iraq. They found that the start of the wars in each case lead to large jumps in spot oil prices but that eventually, as the wars ended, the price of oil slowly fell back to "normal" prices levels (911).

Other authors have analyzed the effect of the first Persian Gulf War and agree that conflict, or the threat of conflict, seems to impact oil prices. In "Oil Prices and the Iraq War: Market Interpretations of Military Developments", Robert Looney (2003) says that:

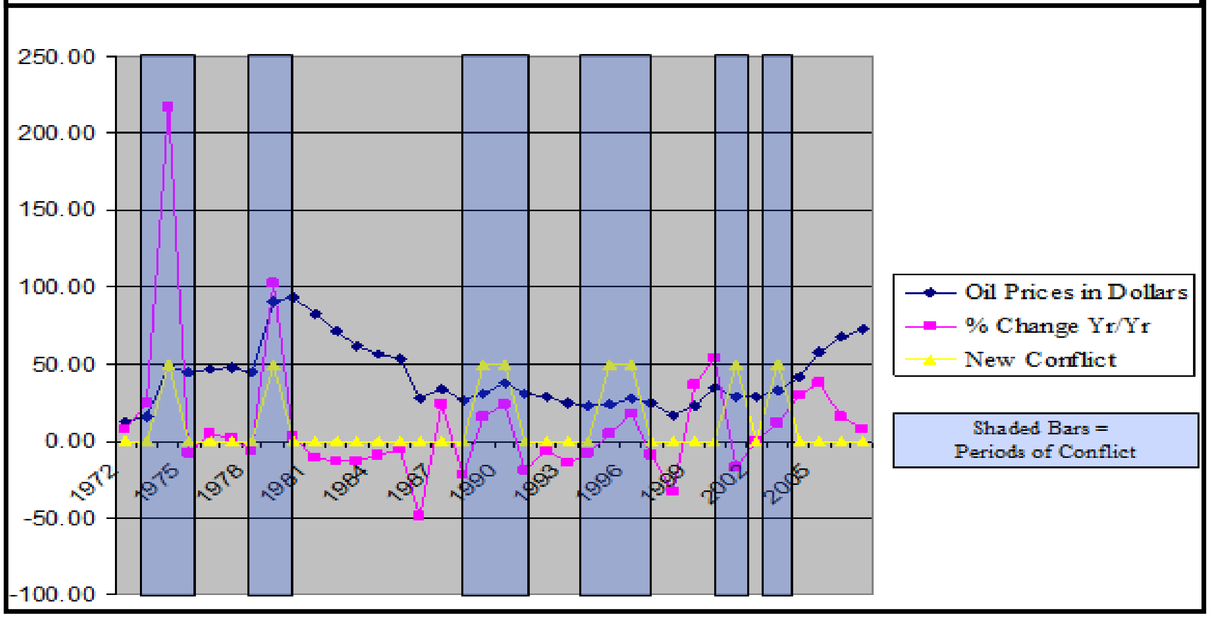
> [i]n sum, oil prices were steadily declining throughout 1990 up to about a month before the invasion of Kuwait. This was a period of excess stocks, rather slack demand, and over-capacity among the major producers. There was little upward pressure on prices until signs of Iraq's belligerence became more and more apparent in July. As noted above, this was also a period of upward sloping futures curves, indicating no risk premium was associated with concerns over future availabilities of oil. In other words, we can safely attribute most of the price increases from mid-July 1990 up to January 17 of 1991 as strictly associated with military-related events in Kuwait. In retrospect, it is also safe to say that the oil markets were good interpreters of military events as they pertained to future availabilities of oil.

It is apparent that the Persian Gulf conflict did have some effect upon oil prices. As Looney points out, even in a period of excess oil stocks, weak demand, and overcapacity, the threat of war drove a large increase in the price of oil.

First Regression Analysis: Annual Oil Price Movements and Conflict: 1972-2007

What about the effect of different conflicts, or the threats of conflict, on oil prices over a longer period of time? Is this something with which the Department of Defense should concern itself? The answer is yes, definitely. This paper first examined oil prices and major world conflict from 1900 through 2007 and found that a general relationship was not apparent in the period of 1900-1971. However, the 1972 Oil Embargo seems to have altered, or at least reflected, a new underlying reality of world politics. This new reality is a geo-political link between large-scale American military action and oil prices. For every year between 1972 and 2007, this paper gathered the following data: the difference between world oil production and consumption, percent of U.S. net oil imports from OPEC countries, economic recessions, U.S. and world G.D.P. growth, and the initiation or threat of initiation of major conflicts. From 1972 onward, it appears that large scale U.S. military action, or the threat thereof, has a statistically significant and positive effect on oil prices. Figure 1 below graphs oil prices in dollars and the annual percent change in oil prices against periods of conflict as represented by the shaded boxes and yellow conflict line. Other than during the 2001 recession, it appears that there is a significant relationship between the onset of conflict and average annual oil prices. The model built in this paper mimics works by Hamilton (2009) and Brook, Price, Sutherland, Westerlund, and Andre (2004). To further investigate the appearance of Figure 1, a detailed regression analysis was performed.

Figure 1: Oil Prices and Conflict Chart 1972-2007



Conflict Data

As previously mentioned, this study gathered data from 1972 to 2007 on major conflicts, or threats of conflict, throughout the world that involved the United States. Specifically, the data set accounted for the following conflicts: the 1972 Oil Embargo, the Iran Hostage Crisis, the U.S. invasion of Panama, the Persian Gulf War, the Taiwan Straight Crisis, the start of Operation Enduring Freedom, and the start of Operation Iraqi Freedom.

Oil Price Data

The dependent variable for each year was the percent change in average oil prices from the previous year. This percent change was calculated from the average annual prices listed in the British Petroleum 2008 Statistical Review. All financial figures listed in the Statistical Review and used for calculation were inflation adjusted and given in terms of 2008 dollars.

Economic Data

For each year from 1972-2007, the following economic information was gathered and entered into the calculation: the difference between world oil production and consumption, percent of U.S. net oil imports from OPEC countries, economic recessions, and U.S. and world G.D.P. growth. These datasets were chosen to represent macroeconomic drivers that are commonly judged to affect oil price movements. All data and sources are described in Table 1 on the following page.

Table 1: 1972-2007 Oil and Conflict Regression Analysis Variables

Variable Name	Definition	Source
WAR-START	Independent variable, 1 for years that the US engaged in a major conflict, or faced the threat thereof such as the Taiwain Straight Crisis. 0 in years with no conflict, or years of an on-going but previously initiated conflict (such as year 2 of war in Iraq would equal 0	Various
OPEC	This figure was entered as a percentage and represents the percent of oil imported to the U.S. that came from OPEC nations	From the Energy Information Agency, Dept of Energy, Table 5.7 "Petroleum Net Imports by Country of Origin 1960-2007" http://www.eia.doe.gov/emeu/aer/pdf/pages/sec5_17.pdf
RECESSIONS	This figure was entered as a 1 for the years that the National Burea of Economic Research (NBER) reported the economy to be in contraction, 0 for years it was not	Recession years were identified as reported by NBER on their website http://www.nber.org/cycles.html
CONSUMED	This variable was the percent consumed of all oil produced throughout the world in that year. This ranged from 95% in years of surplus to 105% in years that reserves were consumed	The figures for consumption and production came from British Petroluem Statistical Review of World Energy 2008 http://www.bp.com/productlanding.do?categoryId=6929&contentId=7044622
USGDP	Annual GDP growth of the United States	All data came from the Earth Trends Environmental Data Base with the exception of 2007 which came from Indexmundi online data base http://earthtrends.wri.org/text/economics-business/variable-227.html http://www.indexmundi.com/united_states/
WGDP	Annual GDP growth of the world	All data came from the Earth Trends Environmental Data Base with the exception of 2007 which came from Indexmundi online data base http://earthtrends.wri.org/text/economics-business/variable-227.html http://www.indexmundi.com/world/
CHANGE	Percent change in average oil price from previous ye	Calculated from average annual prices given in the British Petroleum 2008 Statistical Review http://www.bp.com/productlanding.do?categoryId=6929&contentId=7044622
All online sources accessed June 2009		

After entering all the data and running the regression analysis, the following equation was generated (standard error figures in parenthesis under coefficients):

$$CHANGE = \underset{(357.2238)}{975.9500795} + \underset{(15.25766)}{40.1221546}*WAR\_START - \underset{(.850284)}{1.17176301}*OPEC$$

$$- \underset{(19.28818)}{13.65122692}*RECESSIONS - \underset{(319.2517)}{898.4729775}*CONSUMED - \underset{(6.303208)}{10.4255037}*USGDP$$

$$+ \underset{(8.134185)}{10.39905618}*WGDP$$

Regression analysis with this dataset produced the following figures specifically:

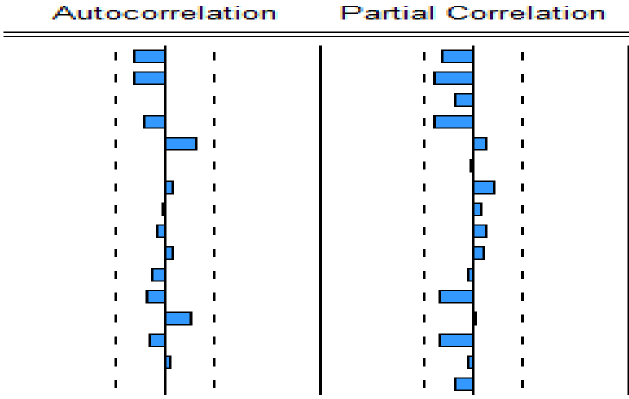
Table 2: 1972-2007 Oil and Conflict Regression Analysis Results Summary

Table 4: 1972-2007 Oil and Conflict Regression Analysis Results Summary				
Dependent Variable: CHANGE Method: Least Squares Sample: 1972 2007 Included observations: 36				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	975.9501	357.2238	2.732041	0.0106
WAR_START	40.12215	15.25766	2.62964	0.0135
CONSUMED	-898.473	319.2517	-2.814309	0.0087
OPEC	-1.171763	0.850284	-1.378084	0.1787
RECESSIONS	-13.65123	19.28818	-0.707751	0.4847
USGDP	-10.4255	6.303208	-1.654	0.1089
WGDP	10.39906	8.134185	1.278439	0.2112
R-squared	0.436502	Mean dependent var		10.93083
Adjusted R-squared	0.319916	S.D. dependent var		44.23949
S.E. of regression	36.48308	Akaike info criterion		10.20424
Sum squared resid	38599.43	Schwarz criterion		10.51215
Log likelihood	-176.6763	F-statistic		3.744036
Durbin-Watson stat	2.35931	Prob(F-statistic)		0.007022

Overall, the results point to a relationship between conflict and rises in the price of oil. The growth equation generated is significant in its ability to capture oil price movements with the coefficient of determination, or R-squared, equal to 0.4365. A Durbin-Watson stat value of 2.35931 would seem indicative of no serial auto-correlation amongst the error terms. To further investigate this, the residuals for each year were analyzed to make sure that auto-correlation was not occurring within the results. As shown in the figure below, the auto-correlation stays within confidence intervals meaning that it is not statistically significant. It would seem that the error terms do not have a systematic pattern. In other words, the residuals do not fall into a specific pattern and do not demonstrate any first order serial correlation. This indicates that the model has not failed to capture the relevant data.

The conflict (WAR-START) variable has a statistically significant effect on the price of oil. It has a t-stat of 2.62964 and a p value of .0135. The p value indicates that there is only a 1.3% chance the conflict variable has a coefficient of 0 and does not affect oil prices. Within the equation generated, the conflict variable has a coefficient of 40.12 and a standard error of 15.2 Therefore, we can expect the price of oil to rise between 25 and 55 percent (40.1 ± 15.2) in years that America initiates large scale military conflict. Using 2006 as a sample year with $10,056,343,400 spent on fuel (FY 2006 ENERGY MANAGEMENT DATA REPORT), a new conflict could cost the DoD between $2,514,085,850 (25 percent) and $5,530,988,870 (55 percent) extra each year. In a worst case scenario, the DoD could pay $5.5 billion extra in fuel costs that year for initiating a new conflict. The DoD should incorporate these apparent relationships

Figure 2: Autocorrelation Chart for 1972-2007 Regression Analysis



	AC	PAC	Q-Stat	Prob
1	-0.208	-0.208	1.6877	0.194
2	-0.210	-0.264	3.4540	0.178
3	-0.004	-0.128	3.4546	0.327
4	-0.141	-0.264	4.3017	0.367
5	0.215	0.085	6.3401	0.275
6	0.003	-0.017	6.3405	0.386
7	0.052	0.146	6.4663	0.486
8	-0.011	0.054	6.4722	0.594
9	-0.048	0.098	6.5889	0.680
10	0.048	0.064	6.7083	0.753
11	-0.088	-0.040	7.1326	0.788
12	-0.124	-0.228	8.0044	0.785
13	0.170	0.021	9.7230	0.716
14	-0.109	-0.228	10.466	0.727
15	0.039	-0.041	10.566	0.783
16	-0.003	-0.119	10.566	0.835

between conflict and long term oil prices into its daily operating procedures, plans and programs, and long-term strategic vision.

Second Regression Analysis: Oil Price and Conflict: Short Term Correlations

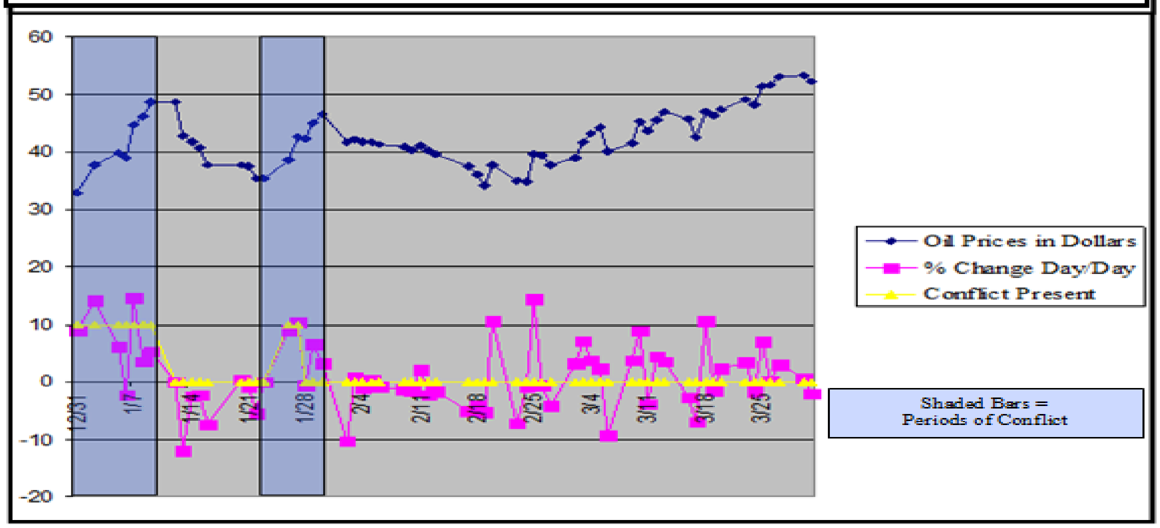
It appears that there may also be a relation between oil prices and international conflict during shorter periods of days, weeks, and months as well. Shorter term oil price regression analyses are important for two reasons. Firstly, a lot can happen within one year, so an effort was made to see if oil prices and conflict also seemed linked on a shorter time scale. Secondly, the DoD continually purchases fuel throughout the year, so even a price rise lasting one to two weeks can add up to a significant amount of money. It will be shown in a later section that even though the DoD contracts its fuel prices, there are clauses in the contracts that link the price the DoD pays to the market price of fuel, meaning higher prices ultimately do cost the DoD more money. Figure 3 contains a graphical representation of the data being investigated.

In order to study short term correlations, a regression analysis was performed that covered the last week of December 2008 through the entire first quarter of 2009. These dates were chosen to include the Israeli-Hamas conflict in Gaza which overtly started in late December 2008 and continued through late January 2009. The regression study encompassing price data and economic reports from the whole first quarter of 2009 was done even though conflict was absent two out of three of the months to see if conflict still emerged as statistically significant variable. In this higher frequency study, conflict again emerged as a statistically significant and relevant variable when analyzing short term movements of oil prices.

Conflict Data

Conflict data was entered as 1 or 0 depending upon the event. Trading days from December 24th through January 5th were all entered as 1 to reflect conflict, as this was the period that Hamas initiated high levels of rocket attacks into Israel, which retaliated with air strikes and a full ground invasion. January 7th was entered as 0 because Israel agreed to halt bombing to allow civilian aid into Palestine and it was hoped that this marked the start of the end of the conflict. The first two trading days after Israel and Palestine agreed to a ceasefire were also marked as 1 to represent conflict because it was during this period Hamas continued its rocket attacks and Israel continued its airstrikes, giving rise to a fear that the conflict would escalate (even though a ceasefire had been agreed upon). All other days without significant new war news, or after the conflict finally did end, were marked as 0s on the conflict table. Entries of conflict came from timelines of the conflict as reported by major news sources ("Last Israeli Troops Leave Gaza" "Timeline – Israeli-Hamas Violence Since Truce Ended" "Gaza Crisis: Key Maps and Timelines" Dec 2008-Jan 2009).

Figure 3: Oil Prices and Conflict Chart 1st Quarter of 2009



Oil Price Data

The daily spot price of oil was analyzed for the first quarter of 2009 in light of the Gaza War. Daily prices were entered using the Energy Information Administration's database of crude oil spot prices at the Cushing, Oklahoma pricing point. Cushing is a major trading hub for oil and is known as a price settlement point for West Texas Intermediate and the New York Mercantile Exchange.

Economic Data

The results of the following economic reports were entered into the regression analysis: Leading Economic Indicators, Nonfarm Payroll report, Retail Sales, and changes in crude oil stockpiles. All the economic reports except changes in crude stockpiles were entered as 0 if they matched the market expectations, or as a 1 if they were a positive surprise. For economic reports that had negative surprises in that period, a separate variable was created in which a negative 1 was entered for the negative surprises. The change in crude stockpiles was entered as the percent change in crude stockpiles each month as there was no available information at what the market expectation was each month for that report.

The conflict variable emerged as statistically significant, showing a positive effect on oil prices, in the regression covering the entire first quarter of 2009. The following three pages contain summary charts of the variables used as well as summary charts of the regression

Table 3: Higher Frequency Oil and Conflict Regression Analysis Variables

Variable Name	Definition	Source
CONFLICT	Independent variable, 1 on days major conflict occurred, 0 for all other days	As reported through major network news centers. Articles cited in the conflict variable section of regression analysis.
LEI	Leading Economic Indicators report released by The Conference Board the first few business days of each month. 1 was entered for a positive surprise and 0 entered if the report matched current market expectations	The Conference Board website http://www.conference-board.org/economics/bci/
PAYROLL	Nonfarm payrolls report released by the Bureau of Labor Statistics the first Friday of every month. -1 entered if report was significantly worse than market expectations and 0 entered if the report matched current market expectations (No positive surprises in this period).	Bureau of Labor Statistics website http://stats.bls.gov/news.release/empsit.toc.htm.
POS_SALES	Retail Sales report released by the Census Bureau of the Department of Commerce around the 13th of every month. 1 was entered for a positive surprise and 0 entered if the report matched current market expectations	Dept. of Commerce, Census Bureau website http://www.census.gov/svsd/www/advtable.html
NEG_SALES	Retail Sales report released by the Census Bureau of the Department of Commerce around the 13th of every month. -1 was entered for a negative surprise and 0 entered if the report matched current market expectations	Dept. of Commerce, Census Bureau website http://www.census.gov/svsd/www/advtable.html
STOCKPILE	Changes in U.S. crude oil stockpiles, released weekly by the Energy Information Administration. Percent fluctation in stockpiles was entered directly into data sheet.	Energy Info. Administration oil data website http://www.eia.doe.gov/oil_gas/petroleum/data_publications/weekly_petrol
PRICE	Percent change in price from the previous day as calculated from the Energy Information Administration's oil price and data website.	Energy Info. Administration oil data website http://tonto.eia.doe.gov/dnav/pet/pet_pri_spt_s1_d.htm
All online sources accessed in June 2009		

After entering all the data and running the regression analysis, the following equation was generated for the 1st Quarter 2009 data (standard error figures in parenthesis under coefficients):

$$\begin{aligned} \text{PRICE} &= \underset{(.697876)}{-0.1428952682} + \underset{(2.11626)}{9.996611525}*\text{CONFLICT} + \underset{(3.491049)}{10.68023143}*\text{LEI} \\ &+ \underset{(4.882463)}{0.2309173443}*\text{NEG\_SALES} + \underset{(3.488523)}{2.737895268}*\text{POS\_SALES} \\ &+ \underset{(4.883908)}{2.067104732}*\text{PAYROLL} - \underset{(1.172012)}{1.422128074}*\text{STOCKPILE} \end{aligned}$$

Regression analysis with the 1st Quarter 2009 data set produced the following figures specifically:

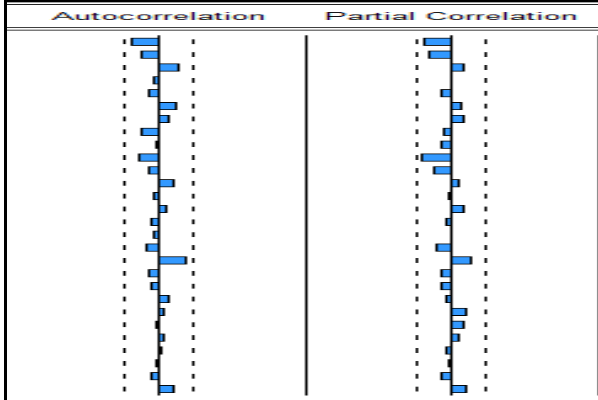
Table 4: 1st Quarter 2009 Regression Analysis

Dependent Variable: PRICE
Method: Least Squares
Sample(adjusted): 12/24/2008 3/31/2009
Included observations: 66 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.142895	0.697876	-0.204757	0.8385
CONFLICT	9.996612	2.11626	4.723716	0
LEI	10.68023	3.491049	3.059319	0.0033
NEG_SALES	0.230917	4.882463	0.047295	0.9624
POS_SALES	2.737895	3.488523	0.784829	0.4357
PAYROLL	2.067105	4.883908	0.423248	0.6737
STOCKPILE	-1.422128	1.172012	-1.213407	0.2298
R-squared	0.37777	Mean dependent var		0.916818
Adjusted R-squared	0.314493	S.D. dependent var		5.838237
S.E. of regression	4.83379	Akaike info criterion		6.089143
Sum squared resid	1378.566	Schwarz criterion		6.321379
Log likelihood	-193.9417	F-statistic		5.970047
Durbin-Watson stat	2.362317	Prob(F-statistic)		0.000064

For the first quarter study the coefficient of determination, or R-squared, for the growth equation was .377. The Durbin-Watson stat value was 2.36. As shown in Figure 4, the auto-correlation figures for the first quarter of 2009 stay within confidence intervals meaning that they are not statistically significant. The effect of the CONFLICT variable had a statistically significant effect on the price of oil with a t-stat of 4.72 and a p value approaching 0. This would indicate that the probability the conflict variable has a true coefficient of 0 is nearly 0%.

Figure 4: Autocorrelation Chart for 1st Qtr 2009 Regression Analysis



	AC	PAC	Q-Stat	Prob
1	-0.186	-0.186	2.3786	0.123
2	-0.122	-0.162	3.4249	0.180
3	0.144	0.093	4.9009	0.179
4	-0.028	0.001	4.9565	0.292
5	-0.081	-0.058	5.4356	0.365
6	0.115	0.077	6.4329	0.376
7	0.062	0.091	6.7209	0.459
8	-0.117	-0.055	7.7795	0.455
9	-0.023	-0.067	7.8198	0.552
10	-0.138	-0.210	9.3428	0.500
11	-0.066	-0.131	9.6994	0.558
12	0.113	0.049	10.759	0.550
13	-0.040	-0.012	10.897	0.619
14	0.049	0.095	11.100	0.678
15	-0.050	-0.040	11.317	0.730
16	-0.029	-0.005	11.395	0.784
17	-0.091	-0.106	12.156	0.791
18	0.191	0.132	15.584	0.622
19	-0.069	-0.077	16.040	0.655
20	-0.049	-0.067	16.270	0.700
21	0.077	-0.025	16.860	0.720
22	0.040	0.114	17.026	0.762
23	-0.024	0.083	17.087	0.805
24	0.036	0.044	17.227	0.839
25	0.015	-0.039	17.253	0.872
26	-0.011	-0.012	17.266	0.901
27	-0.045	-0.073	17.498	0.918
28	0.105	0.105	18.795	0.904

The CONFLICT variable has a positive and statistically significant effect on oil prices. For the regression study involving the first quarter of 2009, the CONFLICT variable had a coefficient of 9.96 and a standard error of 2.11. This means that days for which conflict is present, oil prices jump between 7.85 and 12.07% (9.96 ± 2.11). So in a scenario in which the DoD is spending $27,500,000 on fuel daily (2006 yearly expense divided into 365 days), a new conflict could cause extra expenses each day between $2.1 million (a 7.85% increase over $27.5 million) and $3.3 million (a 12.07% increase over $27.5 million). If the conflict lasted only one week, it could, in a worst case scenario, cost an extra $21 million ($3.3 multiplied by 7 days). Assuming a median base salary of $32,000 for an Enlisted Grade 6 (Staff Sergeant), this extra fuel expense is enough to pay the annual base salary for 665 Staff Sergeants.

It appears then that over both longer and shorter periods of time, conflict has a statistically significant and positive effect on oil prices. For all three studies the t-stat of the conflict variable ranged between 2.6 for longer terms and 4.5 for shorter terms. R-squared for the growth equations ranged between .37 and .436. Durbin-Watson values ranged from 2.35 to 2.36. There is enough strategic vulnerability as well as correlation between conflict and elevated oil prices that the DoD should reconsider its position of not hedging in the fuel markets (especially when it knows conflict is imminent), and should also re-evaluate its operating procedures, plans and programs, and long-term strategic plans and visions as they relate to fuel consumption.

Works Cited

Andrews, Anthony. "Department of Defense Fuel Spending, Supply, Acquisition, and Policy." CRS Reports for Congress. Mar 2009. 19 Jun 2009. http://www.fas.org/sgp/crs/natsec/R40459.pdf.

Andrews, Anthony and Moshe Schwartz. "Department of Defense Fuel Costs in Iraq." CRS Reports for Congress. Jul 2008. 15 Feb 2009. http://digital.library.unt.edu/govdocs/crs/data/2008/meta-crs-10776.tkl.

British Petroleum. Statistical Review of World Energy. June 2008. 30 Jan 2009. http://www.bp.com/productlanding.do?categoryId=6929&contentId=7044622.

Brook, Ann-Marie, Robert Price, Douglas Sutherland, Niels Westerlund and Christophe André. "Oil Price Developments: Drivers, Economic Consequences and Policy Responses." OECD Economics Department Working Papers, No. 412. Dec 2004. http://www.oecd.org/eco/.

Defense Energy Support Center (DESC) Standard Prices Main Page. "What Are Standard Prices." 15 Feb. 2009. http://www.desc.dla.mil/DCM/DCMPage.asp?PageID=722.

FY 2006 ENERGY MANAGEMENT DATA REPORT. Office of the Under Secretary of Defense for Acquisition Technology and Logistics. Dec. 2006. 20 Sep 2009. http://www.acq.osd.mil/ie/energy/energymgmt_report/fy06/energymgmt06.shtml.

"Gaza Crisis: Key Maps and Timeline." BBC News Website. 18 Jan 2009. 15 May 2009. http://news.bbc.co.uk/2/hi/middle_east/7812290.stm.

Hamilton, James D. "Understanding Crude Oil Prices." Department of Economics, University of California, San Diego. 22 May 2008. 21 May 2009. http://www.desc.dla.mil/DCM/DCMPage.asp?PageID=722.

"Last Israeli Troops Leave Gaza." BBC News Website. 21 Jan 2009. 15 May 2009. http://news.bbc.co.uk/2/hi/middle_east/7841902.stm.

Lee Ming-Chih and Wan-Hsui Cheng. "Correlated jumps in crude oil and gasoline during the Gulf War." Applied Economics. 39 (2007) 903-913.

Looney, Robert. "Oil Prices and the Iraq War: Market Interpretations of Military Developments." Strategic Insights. Volume II, Issue 4 (2003).

Lujala, Pavi, Jan Ketil Rod, and Nadja Thieme. "Fighting over Oil: Introducing a New Data Set." Conflict Management and Peace Science, Vol 24 (2007): 239–256.

"More Fight Less Fuel." Defense Science Board (DSB) Task Force on DoD Energy Strategy. Office of the Under Secretary of Defense for Acquisition Technology and Logistics. Feb. 2008.

Raymond, Jennie E. and Robert W. Rich. "Oil and Macro-Economy: A Markov State Switching Approach." Journal of Money, Credit, and Banking. Vol. 29, No. 2 (May 1997): 193-211.

Rusco, Frank. "Strategic Petroleum Reserve: Options to Improve Cost Effectiveness of Filling the Reserve." Government Accountability Office. Feb 2008. 19 June 2009. http://www.gao.gov/new.items/d08521t.pdf.

"Timeline – Israeli-Hamas Violence Since Truce Ended." Reuters UK Website. 5 Jan 2009. 15 May 2009. http://uk.reuters.com/article/idUKTRE50423320090105?sp=true.

"U.S. Primary Energy Consumption by Source and Sector, 2008." Energy Information Administration. 26 June 09. 9 Jul 09. http://www.eia.doe.gov/emeu/aer/pecss_diagram.html.

Yeyati, Eduardo Levy. "Investment in Inflationary Economies." International Monetary Fund Working Paper (1996).

Zavis, Alex and Ra. "Military embraces green energy, for national security reasons. Los Angeles Times. 26 April 2009. 19 June 2009. http://articles.latimes.com/2009/apr/26/local/me-army-green26.