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Causality between Defense Spending GDP and Economic Growth

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Abstract
This paper addresses whether or not the government members of the "Coalition of the Willing" military expenditure as a participant in the war in Iraq will help to generate domestic economic growth on the eve of an impending recession. This paper analyzes the findings during the time period 1989-2006 regarding military expenditure as a percentage of GDP, and its effect on GDP growth, through comparing that relationship between studies and in different political, socioeconomic circumstances. It also performs the same tests on the most recent and complete set of data available for the 31 member nations of the Coalition, to see the result of past spending activities and whether or not there is a causal relationship. The paper concludes that there is no Granger-causality between military expenditure as a percentage of GDP and economic growth in any of 24 the countries for which regression analysis could be performed.

JEL Classification: H59, O41

Keywords: military expenditure, economic growth

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"Every gun that is made, every warship launched, every rocket fired signifies, in the final sense, a theft from those who hunger and are not fed, those who are cold and not clothed. This world in arms is not spending money alone. It is spending the sweat of its laborers, the genius of its scientists, the hopes of its children. This is not a way of life at all in any true sense. Under the cloud of threatening war, it is humanity hanging from a cross of iron."
~President Dwight D. Eisenhower, April 16, 1953

1.0 INTRODUCTION

The most recent estimates of the cost of the U.S. led war in Iraq range from $1.2 trillion (Leonhardt, 2007) to $3 trillion (Stiglitz and Bilmes, 2008), each from some of the most highly regarded authorities on the topic. The Pentagon's proposed budget for annual military spending, if fully approved, will have reached a level unseen since WW II after adjusting for inflation (Shanker, 2008). President Bush told the Today Show, "I think actually the spending in the war might help with jobs…because we're buying equipment, and people are working. I think this economy is down because we built too many houses and the economy's adjusting," as many experts predict an impeding recession: former Treasury head, Larry Summers, prominent global bank, Goldman Sachs, and president and chief executive of the National Bureau of Economic Research, Martin Feldstein, among others (Reuters, 2007; Reuters, 2008; Wingfield, 2008). A study by Global Insight (2008) attributes close to one-third of U.S. economic growth in 2003 to the war in Iraq, however not many other economic analyses have made conclusions about the war and its effect on economic growth.

Using Granger-causality (GC) testing on the variables, military expenditure as a percentage of GDP, and economic growth in the United States, this study concludes that neither variable Granger-causes the other in any of the countries involved in the war, and so therefore, claims that the current high level of national defense spending in the U.S. will help contribute to growth are unsubstantiated in economic fact.

Most of the previous studies of this nature were performed in the 1970s and 80s with earlier data, and utilized cross-sectional evidence across different countries, and employed ordinary least squares (OLS) equations based on the assumption that defense spending causes economic growth, without testing for whether the reverse assumption could be true: economic growth causes defense spending. Joerding (1986) concluded that it is equally plausible for the latter to occur. This study

is different from others because it uses GC testing and not the OLS estimation, in an attempt to compare the directions of causality between military expenditure and economic growth in the U.S.

Furthermore, other studies take nominal military expenditure into consideration, and do not look at the changes in military expenditure as a percentage of GDP. As some countries' GDP increases, so too does their military expenditure, however when we observe this as a percentage of GDP, we receive a different estimation than other studies have shown by not taking into account how GDP growth may be affected by the percentage of military expenditure as a percentage of GDP instead of simply a nominal amount that may or may not go up at a rate proportional with GDP growth. Accordingly, this study takes the log of military expenditure as a percentage of economic growth as a variable instead of nominal military expenditure.

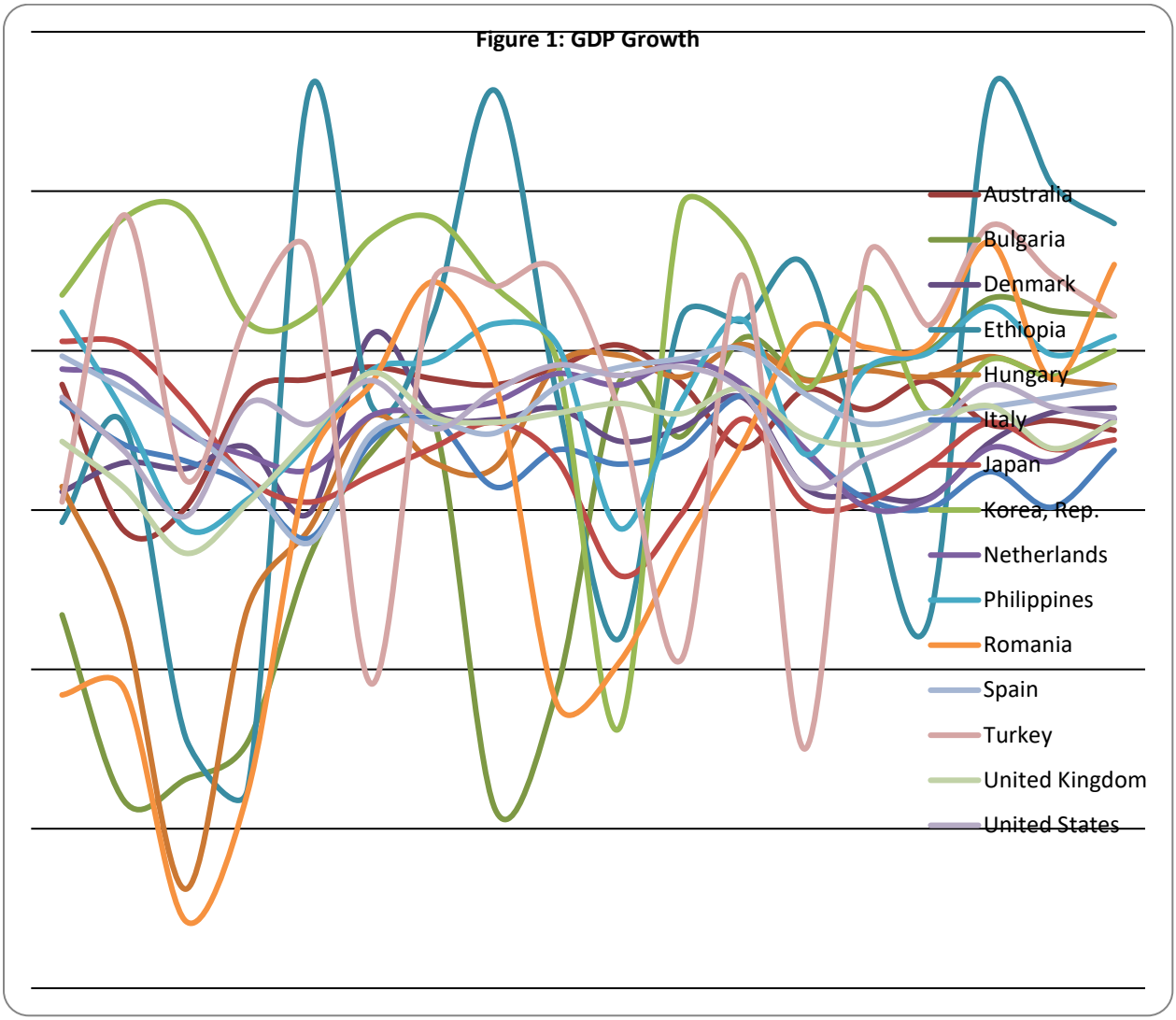
All of the countries included in this study are a part of the "Coalition of the Willing," the group of 30 nations in addition to the United States, who according to the U.S. State Department participated in initial invasion of Iraq: Afghanistan, Albania, Australia, Azerbaijan, Bulgaria, Colombia, the Czech Republic, Denmark, El Salvador, Eritrea, Estonia, Ethiopia, Georgia, Hungary, Italy, Japan, South Korea, Latvia, Lithuania, Macedonia, the Netherlands, Nicaragua, the Philippines, Poland, Romania, Slovakia, Spain, Turkey, United Kingdom and Uzbekistan (Schifferes).

First, this paper discusses the trends regarding GDP growth rate, military expenditure as a percentage of GDP, and exhibits graphical analysis of each plotted against an many countries at once and simply one country's respective rates alone. The trends section suggests that GDP growth rate is extremely volatile, however military expenditure as a percentage of GDP has been decreasing since 1989. Next, the literature review discusses previous papers on the topic and emphasizes that many studies have shown different results depending on which countries were tested, where those countries were in their development stage, what time periods were included, what political state was implemented, among others. The data and empirical methodology section explains the steps in used to test the data using Granger Causality testing, but first the data must be tested with the Augmented Dickey Fuller test and the Johansen test. Finally, the empirical analysis and conclusion conclude that the countries tested show no Granger Causality between the two variables.

2.0 TRENDS

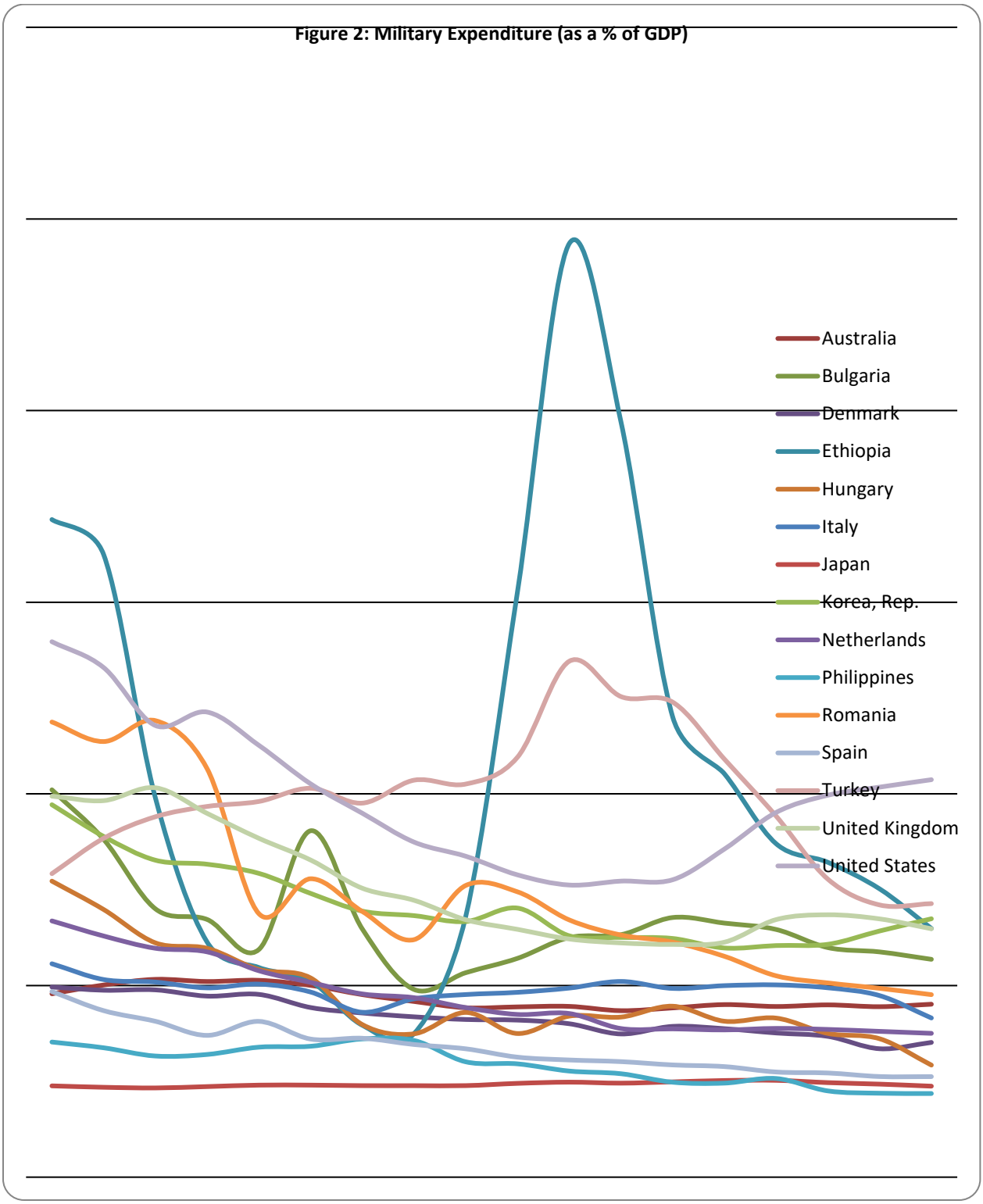
Most countries have an average GDP growth rate of between .5% and 4.5%, however most have at one point or another, experienced growth outside of that spectrum. Particularly, Romania, Turkey, Japan, Hungary, and South Korea, and Italy have experienced some of the most volatile growth. There are many factors that contribute to GDP growth rate volatility including political instability, openness and susceptibility of smaller countries to foreign shocks, recessions, level of technology, among others (Canning, et al., 1998). The causes of each country's specific GDP growth rate and if applicable, its volatility, is beyond the scope of this paper, however they are graphed in Figure 1 to exhibit the trend and average of a sample of the countries tested.

Figure 1: GDP Growth

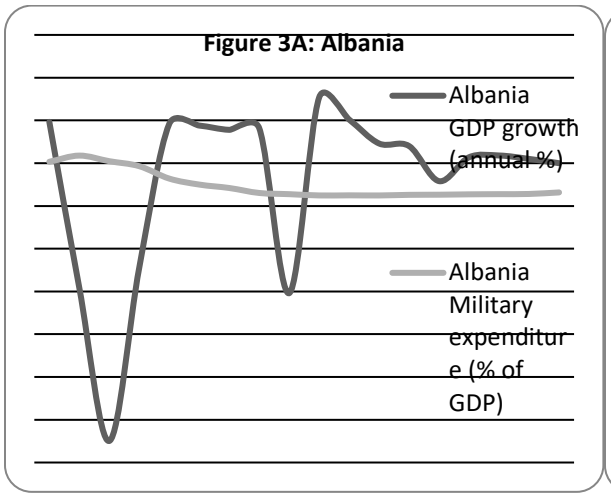


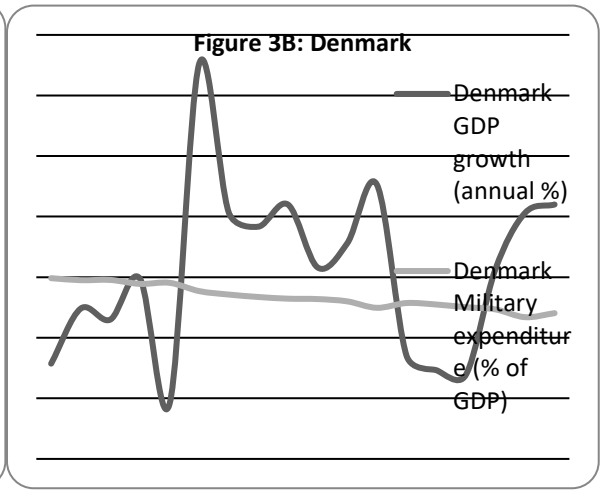
Most countries tend to keep military expenditure as a percentage of GDP between the 1%-3% range, but there also appears to be a trend since 1989 of military expenditure as a percentage of GDP decreasing slightly. This is depicted in Figure 2.

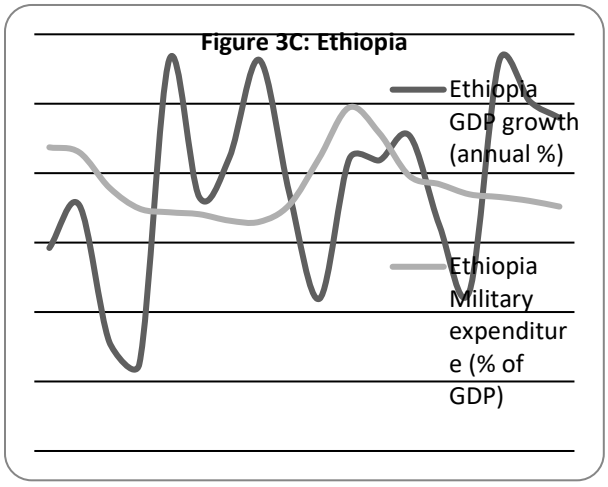
Figure 2: Military Expenditure (as a % of GDP)

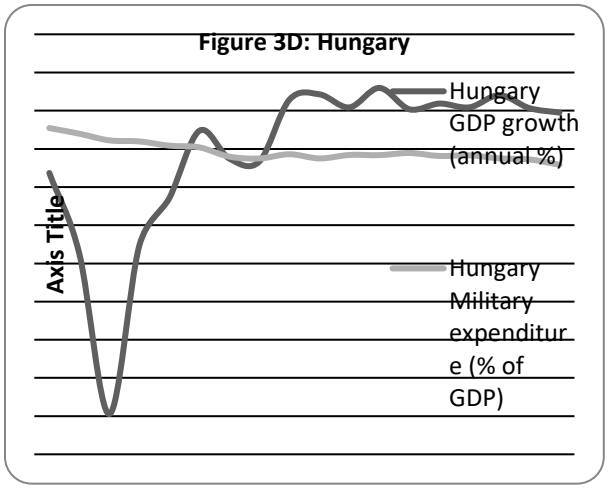


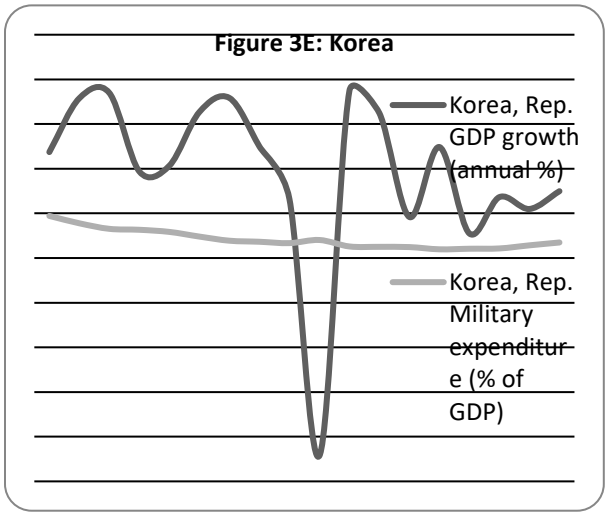
A sample of single countries' military expenditure as a percentage of GDP and the respective country's GDP growth rate are plotted on the same graphs in Figure 3, to exhibit that no strong visual relationship or correlation exists.

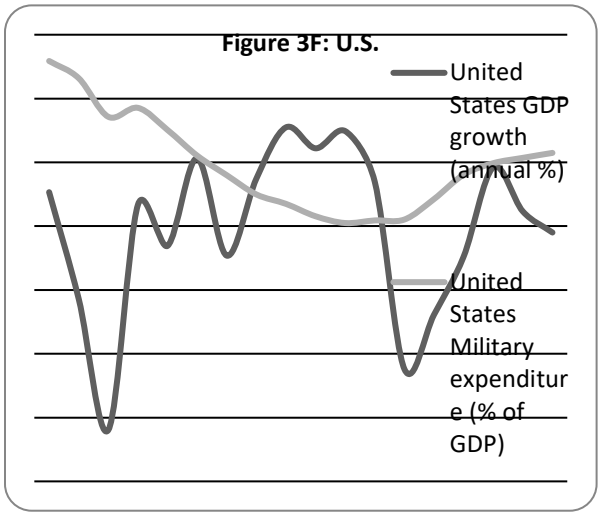












3.0 LITERATURE REVIEW

In 1973, Benoit became the first economist to address through causal analysis, the relationship between defense spending and economic growth. These early studies, and most popularly by Benoit (1973, 1978), suggested a causal relationship between defense spending and economic growth. This started when Benoit (1973) suggested that higher defense spending was more likely to not be the effect of economic growth, but actually the cause. Benoit (1973, 1978) also exhibits how defense spending stimulates growth by increasing aggregate demand, which ostensibly leads to a higher utility of the capital stock, reduced resource costs, and a higher level of employment.

Other studies followed Benoit's (1973, 1978) work but found different results. Deger and Sen (1983), Faini, Annez, and Taylor (1984), and Leontief and Dutchin (1983) found evidence to reject Benoit's (1973, 1978) suggestion that defense spending stimulates economic growth. Smith and Smith (1980) found no strong and systematic relationship between defense spending and economic growth, and Biswas and Ram (1986) found no statistically significant relationship between military expenditure and economic growth in middle-income and low-income countries.

Some studies have even suggested a negative relationship between economic growth and defense spending. Deger and Smith (1983) and Fredericksen and Looney (1983) each exhibit this type of relationship in a majority of all of their tests of developed countries. Deger and Smith (1983) claim that military expenditures impede economic growth.

Finally, Chowdhury (1991) concluded that we cannot generalize the relationship between defense spending and growth across countries. The results of the study implied that the conclusion about whether defense spending helps or impedes economic growth does not solely depend on the development stage in which a particular country is. Chowdhury's study inspired this paper, because at a time in the United States when defense spending has been on the rise and is at a very high level relative to other historical amounts.

Deger (1986) has suggested that defense spending helps economic growth through a "spin-off effect." However, Deger (1966) also suggests, along with Chowdhury (1991), that defense spending can hinder economic growth in a number of ways, such as diverting available resources from domestic capital accumulation (reducing national savings available for investment leading to reduced growth) and diverting funds from other national expenditures such as healthcare and

education. This also takes available funds and labor (as the size of the military increases) away from potentially productive capitalist ventures.

Smith and Georgian (1983) summarize the ultimate conclusion about the relationship between defense spending and economic growth: "… it depends on the nature of the expenditure, the prevailing circumstances, and the concurrent government policies" (15).

4.0 DATA AND EMPIRICAL METHODOLOGY

4.1 Empirical methodology and results

GC testing, developed in Granger (1969, 1980), is a technique for determining the causal relationship between time series data, to see whether one time series can be useful in forecasting another. The GC method regresses the variable X on lagged values of X (X_{t-i}). When the appropriate lag interval for X is significant, regressions for the variable Y are performed. In turn, serial correlation is eliminated to leave only correlation between the pair of variables. Y Granger-causes X when the coefficients of the lagged values of Y are significant. The same goes for X Granger-causing Y when the coefficients of the lagged values of X are significant after one regresses Y on lagged values of Y. The four possible results of a GC test are: no causality, X Granger-causes Y, Y Granger-causes X, and X and Y Granger-cause each other.

Sims' (1972, 1980) work promoted GC testing and helped to operationalize the test. Many econometricians discredit the GC test, because it does not imply true causality, however, it gives important insight into whether the current value of one variable influences the future value of another variable, when that other variable's past is considered.

The following steps are the order in which to conduct a GC test:

1. Test for the presence of a unit root using the Augmented Dickey-Fuller Test (ADF).
2. Difference the data in the presence of unit root and conduct the ADF test again on the differenced data.
3. Exclude if one series is non-stationary and the other is stationary.
4. Estimate co-integration using the same order of integrated variables using the Johansen test.
5. Based on the co-integration results, use VAR or VEC to test causality.

The first step in the process, testing for unit roots indication non-stationary data, uses the ADF test. The ADF test uses the following regression equations:

$$(1)\ \Delta X_t = \beta X_{t-1} + \Sigma(^{p}_{i=2})\eta_i\, \Delta X_{t-1+i} + \varepsilon_t$$

(2) $\Delta X_t = \alpha_0 + \beta X_{t-1} + \Sigma(^{p}_{i=2})\eta_i \Delta X_{t-1+i} + \varepsilon_t$

(3) $\Delta X_t = \alpha_0 + \beta X_{t-1} + \delta t + \Sigma(^{p}_{i=2})\eta_i \Delta X_{t-1+i} + \varepsilon_t$

where Δ is the first difference operator, X is logGDP (or logDS), p is the maximum lag error, ε is the stationary random error, and t is the time. Equation 1 tests for random walk, however one would use equation 3 which includes both the drift term (intercept, α_0) and linear time trend (δt), and use the other equations when the test fails to reject the null hypothesis that $\beta=0$ (unit root is present). If β is negative and statistically significant, then the time series has no unit root or is stationary.

In this regression, an optimal number of 4 lags were included on the first level based on Schwartz Bayesian Criterion (BSC). Table 1 shows the ADF test results on the level and on first differenced data. The results indicate that they are all non-stationary, and that the null hypothesis can be rejected at the 1% level for all but LogDS, implying that all of the variables are stationary after converting the series through first differencing.

The second step estimates co-integration using the same order of integrated variables.[1] Each of the two variables that is I(1) needs to be tested for co-integration.[2] In order to test for co-integration, the Johansen method was used. The Johansen method uses the following regressions:

(3) $\lambda_{trace}\ (r) = -T\ \Sigma(^{n}_{i=r+1})\ \ln(1-\lambda i)$

(4) $\lambda_{max}\ (r, r+1) = -T\ \ln(1-\lambda_{r+1})$

where λ is the estimated values of characteristic root or the eigenvalues and T is the number of usable observations.

For λ_{trace} statistics, the null hypothesis is that against the general alternative, the number of co-integration vectors is less than or equal to r. For the λ_{max} statistics, the null hypothesis is the number of co-integration vectors, r, against the alternative co-integration vectors, r+1, where if r=0, the alternative is r=1. The distribution of the statistics depends on both the number of non-stationary components under the null hypothesis and whether a constant or drift term is included in the co-integrating vector.

[1] A series is integrated of order (d) or I(d) if after being differenced d times it becomes stationary. Such is the case in this test.

[2] In the case where Xt and Yt are both I(d) and linear combination exists, Zt = aXt + bYt, and characteristic roots (c<0), Xt and Yt are co-integrated.

The results of the Johansen test are included under Table 2. If the rank of r is 0, the variables are not co-integrated. The null hypothesis of no co-integration was rejected at a 1% critical value level.

Tthe GC test was then used to test causality. The VEC model. In this study the lag length of 3 was automatically chosen by Eviews as the optimal lag length for the annual data. The following criteria was used to determine the lag length of 3:

$SBC = T \log | \Sigma | + N \log(T)$

where $| \Sigma |$ = determination of the variance/covariance matrix of the residuals and N = total number of parameters estimated in all equations.

The GC test (Table 3) concluded that neither variable Granger-causes the other in any of the 24 of 31 countries for which data was available and which unit root did not exist (i.e. non-stationary countries).

4.2 Data

The variables tested were log(GDP growth rate) and log(Military expenditure as a percentage of GDP). The data was obtained from the World Bank's World Development Indicators Online and includes the years from 1989-2006.

Table 1: Results of ADF test

Ho: Unit root vs. H1: No unit root

	Variable	ADF Prob.	Lag
Afghanistan	D(GDP Growth Rate)	I	I
	D(Military Expenditure (as a % of GDP))	I	I
Albania	D(GDP Growth Rate)	.0002***	5
	D(Military Expenditure (as a % of GDP))	.0573***	12
Australia	D(GDP Growth Rate)	.0000***	0
	D(Military Expenditure (as a % of GDP))	.0572***	0
Azerbaijan	D(GDP Growth Rate)	.0148***	
	D(Military Expenditure (as a % of GDP))	.0691***	
Bulgaria	D(GDP Growth Rate)	.0010**	0
	D(Military Expenditure (as a % of GDP))	.0275**	2
Columbia	D(GDP Growth Rate)	.0000***	0

	D(Military Expenditure (as a % of GDP))	.0011***	0
Czech Republic	D(GDP Growth Rate)	.1123****	1
	D(Military Expenditure (as a % of GDP))	.1548****	0
Denmark	D(GDP Growth Rate)	.0000**	1
	D(Military Expenditure (as a % of GDP))	.0002**	0
El Salvator	D(GDP Growth Rate)	.0000**	0
	D(Military Expenditure (as a % of GDP))	.5059***	1
Eritrea	D(GDP Growth Rate)	.0001**	0
	D(Military Expenditure (as a % of GDP))	.0484***	0
Estonia	D(GDP Growth Rate)	.0001**	0
	D(Military Expenditure (as a % of GDP))	.0988***	0
Ethiopia	D(GDP Growth Rate)	.0000**	1
	D(Military Expenditure (as a % of GDP))	.0194***	1
Georgia	D(GDP Growth Rate)	.0001***	0
	D(Military Expenditure (as a % of GDP))	.0640***	0
Hungary	D(GDP Growth Rate)	.0000***	0
	D(Military Expenditure (as a % of GDP))	.0031***	0
Italy	D(GDP Growth Rate)	.0000***	1
	D(Military Expenditure (as a % of GDP))	.0480***	0
Japan	D(GDP Growth Rate)	.0000*	1
	D(Military Expenditure (as a % of GDP))	.1832*	0
Latvia	D(GDP Growth Rate)	.0000*	0
	D(Military Expenditure (as a % of GDP))	.2618*	0
Lithuania	D(GDP Growth Rate)	.0021***	0
	D(Military Expenditure (as a % of GDP))	.0140***	0
Macedonia	D(GDP Growth Rate)	.0039**	0
	D(Military Expenditure (as a % of GDP))	.0132**	0
Netherlands	D(GDP Growth Rate)	.0000*	0
	D(Military Expenditure (as a % of GDP))	.4357*	1
Nicaragua	D(GDP Growth Rate)	.0000**	1

	D(Military Expenditure (as a % of GDP))	.0001**	0
Philippines	D(GDP Growth Rate)	.0000**	1
	D(Military Expenditure (as a % of GDP))	.0098**	0
Poland	D(GDP Growth Rate)	.0005***	0
	D(Military Expenditure (as a % of GDP))	.0453***	3
Romania	D(GDP Growth Rate)	.0032***	0
	D(Military Expenditure (as a % of GDP))	.0731***	3
Slovak Republic	D(GDP Growth Rate)	.0060**	0
	D(Military Expenditure (as a % of GDP))	.0014**	1
South Korea	D(GDP Growth Rate)	.0000***	3
	D(Military Expenditure (as a % of GDP))	.0960***	0
Spain	D(GDP Growth Rate)	.0000*	0
	D(Military Expenditure (as a % of GDP))	.1035*	1
Turkey	D(GDP Growth Rate)	.0000**	1
	D(Military Expenditure (as a % of GDP))	.0972***	0
U.K.	D(GDP Growth Rate)	.0000*	1
	D(Military Expenditure (as a % of GDP))	.1790*	0
United States	D(GDP Growth Rate)	.0000**	3
	D(Military Expenditure (as a % of GDP))	.0229**	0
Uzbekistan	D(GDP Growth Rate)	D	D
	D(Military Expenditure (as a % of GDP))	I	I

ADF regression equation: $\Delta X_t = \alpha_0 + \beta X_{t-1} + \delta t + \Sigma(^{p}_{i=2})\eta_i \Delta X_{t-1+i} + \varepsilon_t$

*** denotes significant at 5% critical value

** denotes significant at 1% critical value

* has unit root

LogGDP and LogDS are series in level

D(LogGDP) and D(LogDS) are first differenced series

Table 2: Results of the co-integration test using the Johansen method		
	λ_{trace}	λ_{max}

Afghanistan	NA	NA
Albania	32.37***	21.38***
Australia	19.97***	18.45***
Azerbaijan	43.21***	42.49**
Bulgaria	26.28**	17.36***
Columbia	12.00**	9.40***
Czech Republic	UR	UR
Denmark	8.43***	8.27**
El Salvator	29.59***	18.27**
Eritrea	23.02***	18.59**
Estonia	14.86***	11.82**
Ethiopia	22.32**	13.10***
Georgia	16.63**	10.79***
Hungary	23.35***	16.82***
Italy	17.75***	9.13***
Japan	UR	UR
Latvia	UR	UR
Lithuania	21.67***	15.39***
Macedonia	19.63***	15.48***
Netherlands	UR	UR
Nicaragua	34.42***	23.87**
Philippines	15.02***	14.67**
Poland	23.17**	17.71**
Romania	14.58***	10.21***
Slovak Republic	19.44**	18.25**
South Korea	18.81**	13.69***
Spain	UR	UR
Turkey	20.95***	16.69**
U.K.	20.66***	16.94***
United States	19.73***	15.84***

Uzbekistan	NA	NA

** denotes not significant at 5% critical value
*** denotes significant at 5% critical value

Table 3: Results of the Granger-causality test

Country	Military expenditure→GDP Growth	GDP Growth→Military expenditure
Afghanistan	NA	NA
Albania	No	No
Australia	No	No
Azerbaijan	No	No
Bulgaria	No	No
Columbia	No	No
Czech Republic	UR	UR
Denmark	No	No
El Salvator	No	No
Eritrea	No	No
Estonia	No	No
Ethiopia	No	No
Italy	No	No
Japan	UR	UR
Georgia	No	No
Hungary	No	No
Latvia	UR	UR
Lithuania	No	No
Macedonia	No	No
Netherlands	UR	UR
Nicaragua	No	No
Philippines	No	No
Poland	No	No

Romania	No	No
Slovak Republic	No	No
South Korea	No	No
Spain	UR	UR
Turkey	No	No
U.K.	No	No
United States	No	No
Uzbekistan	NA	NA

NA denotes not enough data available
UR denotes unit root exists and cannot be tested

5.0 EMPIRICAL ANALYSIS

The hypothesis in the introduction of this study tested the direction of causality between economic growth and military expenditure as a percentage of GDP in the member-nations of the Coalition of the Willing. Most previous studies were performed in the 1970s and 80s with older data, and used OLS estimation and cross-sectional data, under the assumption that defense spending causes economic growth, without consideration of the reverse. Most studies have used defense spending as one of the variables, and not the log of military expenditure as a percentage of GDP as this study has done.

The ADF test indicates that both logGDP and logDS have unit roots in the level data. In the presence of unit roots, the variables needed to be first differenced in order to make the series stationary because without differencing the data, the causality test would lead to misspecification. The Johansen test (in Table 2) co-integrated using the VEC model. The resulting GC test showed no Granger-causality in either direction between the two variables in any of the 24 (out of 31) countries with GC-testable data.

6.0 CONCLUSION

Previous studies have used different testing techniques (OLS, GC, some cross-sectional, etc.) to analyze the relationship between defense spending and economic growth. This paper aimed to employ GC testing between the log of military expenditure as a percentage of GDP and the GDP growth rate of the 31 member nations of the Coalition of the Willing to test for a causal

relationship, amidst growth in defense spending, an economy on the brink of recession, and claims that the war in Iraq will help the economy.

In summary, this study does not support Benoit's (1973) early claim that defense spending causes economic growth. Furthermore, it does not help to support later studies suggestions that defense spending hinders economic growth.

Based on the empirical results using GC testing, the findings of the study agree with the findings of Biswas and Ram (1986) and Chowdhury (1991) that there is no statistically significant evidence to support the idea that defense spending causes economic growth. That is to say, there is no statistically significant evidence to support the claim that defense spending causes economic growth in any of the countries involved in the Iraq war. For this time period, even though there were no large-scale significant wars, there have been many minor conflicts and large investments in military technology. Governments spending money abroad in foreign conflicts and wars would not necessarily typically benefit domestic GDP, however investments in technology and research typically should. There appears to be other exogenous factors that have a larger effect on GDP than military expenditure, or it may be that the results take longer to materialize and that countries may see benefits further down the road. Either way, countries should be weary of where they spend their money by maintaining sound fiscal policy and not relying on one area such as military expenditure to help stimulate an economy.

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