Are there any factors affecting the causal relationship between military spending and GDP growth?

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Abstract

The analysis of causal relationship between GDP growth and military spending received considerable attention. Using cross-sectional, time-series and panel type analysis, consensus is yet to be reached about the existence of the relationship as well as the type of effect. Causality studies fall short of establishing general results as well. These mixed findings are due primarily to differences in data, countries, time periods and econometric methods. This study employs a Granger type causality analysis for 65 countries for the period between 1975 and 2004. Vector autoregressive estimation with the panel data provides general results for the overall sample. Each country is evaluated individually for stationarity and special emphasis is on the structural breaks and the time trends. Omitting structural changes in the variables can result in a bias which would lead to rejecting stationarity for stationary variables. Omitting time trend can also result in a bias which would lead to concluding difference stationarity for trend stationary variables. We use four variables namely GDP, military spending, government size and openness. Estimation, based on the whole sample, provides evidence of bi-directional positive causal relationship. For further analysis of possible factors influencing the causality, we initially control for any military disputes during 1975-2004. The results are unchanged. Then, the VAR model with military dispute dummy variable is estimated for countries; 1) where there is mandatory military service, 2) that are members of NATO and 3) where terrorist attacks with fatality are frequent. In each case we compare the results to the rest of the sample. We find that, military spending does not cause GDP growth, for countries in which there is mandatory military service, for NATO member countries and for countries where terrorism is an above average concern. We also find that, GDP growth does not cause military spending, for countries in which there is no mandatory military service and for countries where terrorism is an above average concern. Therefore, mandatory military service, NATO membership and high level of terrorism are factors that influence the causal relationship between military spending and GDP growth.

Keywords: Military spending, defense burden, economic growth, military disputes, mandatory military service, NATO, terrorism

INTRODUCTION

The effect of military spending on GDP growth is argued to be positive as well as negative. Since there is evidence to support both effects, the main argument becomes the prevailing effect. The discussion about positive effect is based on the mobilization of the idle production capacity and stimulating aggregate demand and additional investment. Spin-off effects such as improved infrastructure, higher research and development, more disciplined labor force and modernization also find supporting evidence. The negative effect discussion is based on the diversion of resources away from civilian production and reducing the public investment. Both sides of the argument assume that the military spending is prior to economic growth. Joerding (1986) argues that while military spending effect can affect the economic growth, it can also be that economic growth affects the military spending. The evidence for the relationship between GDP growth and military spending is mixed.

Earlier studies, starting with Benoit (1973, 1978), use cross-sectional methods while later studies, starting with Chowdhury (1991), use time-series analysis. Panel type estimations using vector autoregressive (VAR) and vector error correction models (VECM) are used to analyze Granger type causality and long-term relationships. Existence, type and direction of relationship are yet to be generalized. It is imperative to point out that it is a priori to have stationary variables in any estimation. This is also the first step in all related literature employing VAR and VEC models. In fact omitting structural breaks and time trends in the variables can potentially render stationarity analysis biased which may result in spurious estimation results. Among others, Chowdhury (1991), Kusi (1994), Mintz and Stevenson (1995), Heo (1998), Dakurah, Davies and Sampath (2001) and Al-Yousif (2002) provide evidence of causality between military spending to GDP growth for some of the countries they evaluate. However, they fall short of general results.

This study aims to provide a general evidence of Granger type causality between military spending and GDP growth using VAR model for a panel of 65 countries for the period between 1975 and 2004. Government size and openness are used as the control variables in this analysis. Augmented Dickey-Fuller (ADF) (using GLS) test with time trend is employed for the initial tests of stationarity for each of the 65 countries. According to Enders (1995), if the variables have structural change, the results of stationarity tests may be biased towards rejecting stationarity. Thus, for the countries where stationarity is rejected, we employ Zivot and Andrews (1992) method that allows for structural change. This initial analysis provides us with two additional variables for the VAR analysis namely time trend and structural break dummy variable. Time trend is included, if the first differenced variable is trend stationary. Structural break dummy variable is included, if the first differenced variable is stationary with a structural break.

The initial VAR estimation includes the whole sample and provides an evidence of Granger type bi-directional positive causality between military spending and GDP growth. The magnitude of causal effect from GDP growth to military spending is much higher than vice versa. In further analysis of this evidence, we estimate the same VAR type Granger causality model controlling for any military disputes during

1975-2004. The results are unchanged. The evaluation of factors that influence the existing causal relationships is through estimating the causality for subsamples. These subsamples include countries that have mandatory military service, are NATO members and have above average terrorist attacks with fatality. We estimate the causality for each of these subsamples separately. Each time, we also estimate the causality for the rest of the sample for comparison purposes.

Our contribution to current literature is the evaluation of causality relationship between GDP growth and military spending with more exhaustive and robust analysis of stationarity for different groups of countries. Analysis of mandatory military service, NATO membership and number of terrorist attacks with fatality contributes to the understanding of the channels in which military spending causes GDP growth and vice versa.

For countries with mandatory military service, it would be expected that maintaining and educating military personnel would be an ongoing cost and constitute a larger portion of overall military spending compared to countries with no mandatory service. The spin-off effect of providing literacy and other craft to otherwise unskilled labor is also expected to be higher and ongoing for countries with mandatory military service. Thus, if the military service is mandatory then the any increase in the military spending would not necessarily have an economic impact above and beyond the ongoing impact that it already has. In support of our argument, we find that the military spending does not cause GDP growth in countries with mandatory service. However, it has an overall positive effect in other countries. In case of economic development, the mandatory military service could be used as a channel in which further spin-off effects are stimulated through military service. In support of our argument, we find that there is positive causation from GDP growth to military spending for countries with mandatory service which is also quite high (0.54). We also have a significant effect at the first year for other countries but the magnitude is less than half (0.25).

For NATO member countries, the increased military cooperation would help countries to take advantage of increased security, research and development and lowered cost of military capability. The impact of peace dividend can be achieved with membership to NATO. The effects of such cooperation would be continuous. In support of our argument, we find that there is no causal effect from military spending to GDP growth for NATO member countries while there is overall positive causation for non members. For the effect of GDP growth on military spending, we argue that membership to NATO should promote higher cooperation in technology and training. Economic growth would allow countries to take advantage of such cooperation to fuller extent. This effect would also be continuous. Accordingly, we find no causality from GDP growth to military spending. In fact, we find that the only statistically significant coefficient is negative. While there is no overall causation for non member countries, the only significant coefficient is positive.

Finally, for countries where terrorist attacks are more often and more severe, military spending would primarily be directed to maintaining domestic security. Thus, it would be hard to talk about economic impact of military spending other than economic benefit of improved security. We find evidence in line with our expectation that there is no causal relationship for countries where terrorist attacks are above average in number and in number of fatalities. For other countries, there is positive causality from military spending to GDP growth. However, in case of economic growth, it would be expected that countries with above average terrorist attacks to spend more to improve security. Contrary to our expectations, we do not find any statistically significant causality from GDP growth to military spending.

In the following section we summarize the theories, empirical models and evidence provided in the previous literature. Descriptions of the variables along with summary statistics are provided in the third section. Econometric model employed for each analysis, their results and implications are included in the fourth section. Final part provides summary and concluding remarks.

LITERATURE REVIEW[1]

Keynesian theory supports the positive effect of military spending on the economic output. One of the earliest studies in support of positive effect is the Benoit (1973) and later Benoit (1978). For the period between 1950 and 165, Benoit (1973) evaluates 44 less developed countries (LDC) and find evidence of positive effect. The main argument is the higher utilization of available capacity, aggregate demand and in turn additional investment. In later studies such as Frederiksen and Looney (1982, 1983) (61 developing countries for 1960-1978), this argument is extended to differentiate between less developed and developed countries. While for developed countries there could be room for higher capacity utilization, this is debatable for less developed countries where military spending could divert production resources away from civilian production. However, it is also argued that for less developed countries, military spending improves productivity (more disciplined and crafted labor, higher literacy) and available infrastructure. These are referred to as spin-off effects. Several authors provide evidence for the positive effect including but not limited to; Kennedy (1974, 1983), Whynes (1979), Deger and Smith (1983), Weede (1983), Cappelen, Gleditsch and Bjerkholt (1984), Alexander (1995), Atesoglu and Mueller (1990), Biswas (1993) and Mueller and Atesoglu (1993).

Military spending can impede GDP growth, as well. Peace dividend argument suggests that countries could achieve GDP growth by lowering military spending. Since, military spending diverts resources (labor, research and development and production capacity) away from civilian production, it has a crowding effect. Taylor, Faini and Annez (1980), Deger and Sen (1983), Cappelen et al. (1984), Faini, Arnez and Taylor (1984) and Chan (1985) are among those that support the crowding-out effect of military spending. It is also argued that military spending decreases savings and impedes the GDP growth (Deger and Smith, 1983), decreases exports (Rothschild, 1973) and diverts research from civilian to military (Chan, 1985). Among the studies that provide evidence for negative effect are; Smith and Smith (1980), Leontief and Duchin (1983), Lim (1983), Nabe (1983), Linden (1992), Lebovic

[1] Please refer to Grobar and Porter (1989) and Dunne (1996) for detailed surveys of earlier studies.

and Ishaq (1987), Gyimah-Brempong (1989), Deger (1986), Mintz and Huang (1990, 1991), Ward and Davis (1992), Mintz and Stevenson (1995), Cohen, Stevenson, Mintz and Ward (1996), Antonakis (1997, 1999), Dunne and Vougas (1999) and DeRouen (2000).

While positive and negative effects find considerable support in literature, there are also studies that provide evidence for no (or not statistically significant) relationship including Biswas and Ram (1986), Alexander (1990), Payne and Ross (1992) and DeRouen (1993). Causality studies that provide no relationship include Kinsella (1990), Chen (1993), Madden and Haslehurst (1995) and Kollias and Makrydakis (1999). There are also several causal studies[2] that find relationship for some of the countries but report no generalizable results including, Chowdhury (1991), Kusi (1994), Mintz and Stevenson (1995), Heo (1998), Dakurah, Davies and Sampath (2001) and Al-Yousif (2002).

The econometric methodology employed in the recent literature to evaluate causal relationship is through VAR or VECM. Stationarity is evaluated in almost all previous studies. However, there is no consensus for the treatment of trend and difference stationarity. In most cases, it is omitted and difference stationarity is assumed. Green (2003) (pg.644) shows that augmented Dickey-Fuller (ADF) test with time trend has a combined null hypothesis of time trend and lag of variable's level to be equal to zero. If we fail to reject the null hypothesis, lag of variable's level is equal to zero and the variable has a unit root (non-stationary). However, if we reject the null then either the trend or the lag of variable's level is not equal to zero and further test is need to separate trend stationarity from difference stationarity.

There is also no consensus for allowing structural break in stationarity tests and in most cases is it is not allowed. According to Enders (1995), stationarity may be rejected for stationary variables if they have structural changes. Thus, existence of such changes should be evaluated. A test of stationarity in the presence of structural change is provided by Zivot and Andrews (1992). There are limited number of studies in the related literature that evaluates structural breaks (i.e. Kollias, Naxakis and Zarangas, 2004; Lee and Chang, 2006).

DATA

The economic data is provided by Heston, Summers and Aten (2006) for 188 countries for 1950-2004 through Penn World Table (PWT), Center for International Comparisons of Production, Income and Prices[3] (CIC) at University of Pennsylvania. While economic data is widely available, there are limited resources for military spending. To our knowledge, there are two main data sources that are used in the related literature; SIPRI (e.g. Faini, Arnez and Taylor, 1984; Cappelen, Gleditsch and Bjerkholt, 1984; Biswas and Ram, 1986; Deger, 1986; Linden, 1992; Kusi, 1994; Mintz and Stevenson, 1995; Heo, 1998; DeRouen, 2000; Al-Yousif, 2002; Kollias,

[2] Lee and Chang (2006) summarize the results of causality tests in the recent literature.
[3] Available through http://pwt.econ.upenn.edu/php_site/pwt_index.php

Naxakis and Zarangas, 2004) and Arms Control and Disarmament Agency[4] (ACDA) (e.g. Looney and Frederiksen, 1986; Lebovic and Ishaq, 1987; Gyimah-Brempong, 1989; Chowdhury, 1991; Dakurah, Davies and Sampath, 2001). Military spending data, for this study, is provided by Stockholm International Peace Research Institute[5] (SIPRI). Military spending as a percentage of GDP is provided by SIPRI[6] for 1988-2004. For prior years, SIPRI[7] annual publications are used similar to previous studies.

"Militarized Interstate Dispute (MID)[8] at participant level" data is provided by Ghosn, Palmer and Bremer (2004). Version 3.02 is provided as an extension of version 2.1 by Jones, Bremer and Singer (1996). In terms of the terrorism data, it is provided by Inter-university Consortium for Political and Social Research (ICPSR)[9] in two separate studies. The first study[10] (ICPSR Study No.: 22541) provides the data for the period between 1970 and 1997 (LaFree and Dugan, 2006). The second study[11] (ICPSR Study No.: 22600) provides the data for the period between 1998 and 2004 (LaFree and Dugan, 2007). Countries are separated into two groups based on the number of terrorist attacks with fatalities. Level of terrorism dummy variable gets the value of one if the country was a victim of terrorist attack with fatality more frequently than the average and zero otherwise. We also construct an alternative dummy variable based on the number of fatalities in terrorist attacks, as a robustness check.

Our method of evaluation is similar to the previous literature for comparability purposes (i.e. Chowdhury, 1991; Dakurah, Davies and Sampath, 2001; Al-Yousif, 2002). In our analysis we control for government size (government share of real GDP) and openness (ratio of imports and exports to real GDP). Government size is the nonmilitary share of GDP to control for the crowding-out effect (i.e. Looney and Frederiksen, 1986; Lebovic and Ishaq, 1987; Linden, 1992; Heo, 1998; DeRouen, 2000; Al-Yousif, 2002; Halicioglu, 2004). Openness controls for the international integration (i.e. Looney and Frederiksen, 1986; Al-Yousif, 2002). The variables used in the analysis include; real GDP (G), share of military spending in GDP (M), government share in GDP (GE) and ratio of total imports and exports to GDP (X).

We employ two main filters for the data. First, we require that there are at least 20 observations for all of the variables for any country to be included. Second, each country must have economic and military spending data for corresponding time periods. There are 75 countries that meet the requirements of both filters. Descriptive statistics for first differenced natural logs of real GDP (G), share of military spending in GDP (M), government share in GDP (GE) and ratio of total

[4] Available through http://dosfan.lib.uic.edu/acda/
[5] Available through http://www.sipri.org/
[6] http://www.sipri.org/contents/milap/milex/mex_database1.html
[7] World Armaments and Disarmament: SIPRI Yearbooks
[8] Data from the Correlates of War Project, http://www.correlatesofwar.org/, version 3.02.
[9] Available through www.icpsr.umich.edu
[10] Global Terrorism Database 1.1, 1970-1997
[11] Global Terrorism Database II, 1998-2004

imports and exports to GDP (X) are provided in Table 1. We note that, while the GDP grows by about 3.33%, military spending is reduced by 1.18% per year.

STATIONARITY

We follow the previous literature in our Granger causality estimations for comparability purposes. Thus, we use the first differenced logs of the variables as a measure of change in each variable regardless of the stationarity at their levels. As the initial step in empirical analysis, we test the first differenced variables for stationarity using augmented Dickey-Fuller test (ADF) following Enders (2003) (pg. 193);

$$\Delta y_t = a_0 + \gamma y_{t-1} + a_2 t + \sum_{i=2}^{p} \beta_i \Delta y_{t-i+1} + \varepsilon_t \qquad (1)$$

where y is one of the four variables used in the VAR estimation (G, M, GE and X), a_0 is the constant, t is the time trend, p is the lag length. Δ denotes the first difference. ADF test statistic is the coefficient γ. Critical values are provided by Dickey and Fuller (1981), Fuller (1976) and MacKinnon (1994). Following Elliot, Rothenberg and Stock (1996), we transform (detrend) the variable using generalized least squares for the ADF. The null hypothesis is $\gamma = 0$ which means there is unit root (non-stationary). If we reject this null hypothesis, it is in favor of stationarity around time trend in which case we estimate equation 1 without the time trend. The alternative hypothesis, without the time trend, is the stationarity.

One of the main issues in testing for stationarity is the usage of lag length. The stationarity test is very sensitive to different lag lengths. Ng and Perron (1995) and Enders (2003) (pg. 192) suggest testing significance of different lag lengths (highest lag length is chosen according to Schwert, 1989). We first estimate the model using the highest lag length. If the coefficient of the highest lag length is not statistically significant, we reduce the lag length until we have statistically significant lag length. In line with Enders (2003) (pg. 192), we also make sure that for the selected lag length ε_t is white noise. Based on Enders' (1995) argument for a bias towards non-stationarity in case of structural changes, we further employ Zivot and Andrews (1992) method which allows for such structural change.

For military spending and GDP growth[12], Table 2 reports the results for ADF with time trend, without time trend (as needed) and Zivot-Andrews (as needed). We use this table to decide for which country, we need to include time trend and structural change variables. We first test the first differenced variable for stationarity with the time trend included. If the variable is stationary then we test for trend stationarity without time trend in the ADF. If the variable is non-stationary then we test for structural break. If the variable is still non-stationary then we deem the variable as non-stationary. For instance, ADF for first differenced

[12] Results for government share in GDP and openness are available upon request.

log of real GDP (DG), for Algeria, fails to reject unit-root (non-stationary). Thus, we test for unit root by allowing structural break (Zivot-Andrews) and we reject unit root. Thus, DG for Algeria is stationary with structural change. In terms of the time trend evaluation, for instance, for Denmark, we reject the unit root for DG. However, the variable could be stationary or trend stationary. Thus, we exclude the time trend in ADF and retest the variable for unit root. For Denmark, we fail to reject the unit root in the absence of time trend. Thus, we can conclude that the variable becomes stationary with the time trend. There are 22 countries[13] that require inclusion of time trend variable, 27 countries[14] that require one structural change variable (structural change is found in only one of the four variables) and 3 countries[15] that require two structural change variables in further analysis. Based on the results of stationarity tests for DG and DM (and results for government share and openness), we exclude Cameroon, Canada, Ireland, Japan, Philippines, Senegal, Spain, Sweden, Switzerland and Thailand because one of the four variables is not stationary at first difference and second differencing is needed (I(2)). After this exclusion, we have our final sample of 65 countries.

GRANGER CAUSALITY

We follow Chowdhury (1991) in our Granger causality analysis. Similar methodology became common in the literature. Our main difference is the use of panel data for the estimation using the whole sample rather than evaluating each individual country. With panel data estimation, we take advantage of serial correlations in residuals between countries and the results are general to whole sample. The VAR estimation for such Granger causality test is as follows;

$$DG_{c,t} = \alpha_0 + \sum_{i=1}^{m} \alpha_{1,c,i} DG_{c,t-i} + \sum_{i=1}^{m} \alpha_{2,c,i} DM_{c,t-i} + \sum_{i=1}^{m} \alpha_{3,c,i} DGE_{c,t-i} + \sum_{i=1}^{m} \alpha_{4,c,i} DX_{c,t-i} + \varphi_c + \varepsilon_{c,t} \quad (2)$$

$$DM_{c,t} = \beta_0 + \sum_{i=1}^{n} \beta_{1,c,i} DM_{c,t-i} + \sum_{i=1}^{n} \beta_{2,c,i} DG_{c,t-i} + \sum_{i=1}^{n} \beta_{3,c,i} DGE_{c,t-i} + \sum_{i=1}^{n} \beta_{4,c,i} DX_{c,t-i} + \phi_c + \mu_{c,t} \quad (3)$$

where G is the log of real GDP, M is the log of share of military spending in GDP, GE is the government share in GDP, X is the ratio of total imports and exports to GDP. D refers to the first difference, n and m are the selected lag lengths for equations (2) and (3) respectively. We follow the previous literature (e.g. Chowdhury, 1991; Al-Yousif, 2002) and select the lag length which minimizes the AIC criterion with white noise residuals. With respect to the evidence presented in Table 2 for the stationarity of the variables, time trend and/or structural break

[13] Botswana, Burkina Faso, Cyprus, Denmark, Dominican R., Ecuador, El Salvador, Guatemala, India, Jordan, Madagascar, Nepal, Netherlands, Norway, Oman, Paraguay, Portugal, Romania, Saudi Arabia, Syria, Zambia and Zimbabwe.

[14] Algeria, Australia, Austria, Bahrain, Belgium, Cyprus, El Salvador, Ethiopia, Finland, Germany, Ghana, Hungary, Israel, Jordan, Madagascar, Malaysia, Mauritius, Netherlands, Oman, Pakistan, Portugal, Romania, South Africa, Tunisia, Turkey, U.A.E. and U.K.

[15] Bangladesh, Greece and Italy

dummy variables are included in equations 2 and 3. Structural change dummy variable is constructed according to Enders (2003) (pg. 204) and gets a value of one if the observation is after the structural break date (provided in Table 2 for each country where Zivot-Andrews test is employed) and zero otherwise. For countries that do not require time trend and/or structural break, these variables get the value of zero.

Equation 2 (3) tests whether any of the variables, with all of its lags, Granger cause GDP growth (change in military spending). For instance, for the equation 2, we are testing whether DM Granger causes DG. Thus, we are testing the null hypothesis of $\alpha_{2,1} = \alpha_{2,2} = ... = \alpha_{2,m} = 0$ with a Wald test. The alternate hypothesis is that DM Granger causes DG with all of its lags. For the panel data estimation, we can employ either fixed effects or random effects model. With the Hausman test, efficiency and consistency of coefficients of random effects model is compared to fixed effects model. We use fixed effects model if we reject the null with Hausman test and use random effects otherwise.

First column of the Table 3 provides the results for the equation 2 and the first column of the Table 4 provides the results for the equation 3. Accordingly, using fixed effects model (Hausman statistic of 139.80 is rejected at 1% level), military spending Granger causes GDP growth with 1% statistical significance. While the effect is negative for the first year, it is positive for the second year. These are the only two years with statistical significance. Summed effect is positive. Using random effects model (Hausman statistic of 22.68), GDP growth Granger causes military spending. The only statistically significant coefficient is the positive first year.

As a robustness check we control for military dispute during 1975-2004 using MID data to construct a military conflict dummy variable which gets a value of one for the years with military disputes and zero otherwise. The analysis between military spending and economic variables could be affected by the existence of military disputes in which countries need to increase military spending. Second columns of the Table 3 and Table 4 provide the results for the equation 2 and 3 respectively, with MID dummy variable. The results without the MID dummy variable, presented in the first columns of the same tables do not change.

FACTORS INFLUENCING CAUSALITY

In the previous section, we provide evidence for the general causal relationship between military spending and GDP growth for the while sample of 65 countries. In further analysis of these results, we evaluate such causality for three different groups of countries. Factors evaluated include mandatory military service, NATO membership and level of terrorism. Thus, we estimate equations 2 and 3 for countries where military service is mandatory and also for countries where military service is not mandatory. Similarly, we estimate both equations for NATO member countries and non-member countries. Finally, we estimate these equations for countries where terrorist attacks with fatality are more frequent than the average for the overall sample and for countries where these attacks are less frequent. Thus, we estimate six estimations for a total of three factors influencing the causal relationship between military spending and GDP growth.

The results are provided in Table 3 for the equation 2 and in the Table 4 for the equation 3. In order to capture the differences between groups of countries, we discuss the differences to results obtained from the whole sample, especially in coefficients of individual lags. For the causality from military spending to GDP growth for the whole sample, we have a negative coefficient for the first year and positive coefficient for the second year for a combined positive effect. This is the same for countries where there is no mandatory military service, for countries that are not members to NATO and for countries where terrorist attacks are less frequent than the average. There is no causality for countries where there is mandatory military service, for countries that are NATO members and for countries where terrorist attacks are more frequent than the average.

For the causality from GDP growth to military spending for the whole sample, we have a positive coefficient for the first year. This is the same for countries where there is no mandatory military service, for countries that are not members to NATO and for countries where terrorist attacks are less frequent than the average. For countries where there is mandatory military service, positive coefficient is for the second year and this coefficient is the highest for all groups in either direction. However, there is no causality for countries where terrorist attacks are more frequent than the average. More interestingly, the sign changes to negative for NATO member countries.

Our main argument is the continuous effect of mandatory military service and NATO membership on military spending and GDP growth relationship. Countries where there is mandatory military service, we argue that expected spin-off effects would be continuous through training, increased security and infrastructure. Thus, temporary changes in the military spending are not expected to have any significant effects on the GDP growth beyond what is accomplished with the ongoing process. Some major events may lead countries to change their military capability, extend (or shorten) the mandatory service time and/or redefine the social contribution of military service. However, since we control for structural changes in all four variables, our results are robust to such events. Similar argument is made for NATO membership. The advantages of membership to NATO are continuous and temporary changes should not impact the relation between military spending and GDP growth. In terms of the terrorist attacks with fatality, countries that are victims of such events prioritize domestic security. Through international cooperation, intelligence and military capabilities are improved. Thus, it is expected that victim countries to have higher military spending. However, we argue that terrorist attacks would interfere with the relationship between military spending and GDP growth. In other words, military spending in response to terrorist activity is not expected to have the same economic impact as the military spending under normal circumstances.

SUMMARY AND CONCLUSION

This study evaluated the causal relationship between military spending and GDP growth using panel data from 65 countries for the period between 1975 and 2004. Following the previous literature, VAR model for Granger type causality is employed using government size and openness as control variables. Augmented

Dickey-Fuller (GLS) stationarity test is employed and special emphasis is paid to trend or difference stationarity. Considering the bias in rejecting stationarity in the presence of structural breaks, we also employ Zivot and Andrews (1992) stationarity test and allow for structural breaks. Based on the results of stationarity tests, we include trend variable and/or structural break dummy variable as needed to our VAR estimation. Initial estimations provide evidence for bi-directional positive causal relationship. As a robustness check, military dispute dummy variable is included to the initial estimation and the results do not change.

In evaluation of the factors that influence the relationship between military spending and GDP growth, we divide the sample into groups of countries based on mandatory military service, NATO membership and level of terrorist attacks with fatality. We re-estimate the initial VAR estimation with military dispute dummy variable for each group and for the rest of the countries (for comparison purposes). We argue that mandatory military service and NATO membership have continuous effects on the relationship between military spending and GDP growth. Temporary changes in either variable are not expected to have an impact on this relationship. In terms of the terrorist attacks, we argue that countries with more frequent terrorist attacks would have higher military spending for higher domestic security. The expected economic impact of such military spending would be different than usual.

In line with our expectations, we find that, military spending does not cause GDP growth, for countries in which there is mandatory military service, for NATO member countries and for countries where terrorism is an above average concern. We also find that, GDP growth does not cause military spending, for countries in which there is no mandatory military service and for countries where terrorism is an above average concern. In sum, we conclude that mandatory military service, NATO membership and high level of terrorism are factors that influence the causal relationship between military spending and GDP growth.

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Table 1: Descriptive statistics for first differenced natural logs of real GDP (G), share of military spending in GDP (M), government share in GDP (GE) and ratio of total imports and exports to GDP (X). G, GE and X are obtained from Penn World Table provided by Heston, Summers and Aten (2006). M is obtained from SIPRI. Data period includes 1975-2004. n refers to number of observations for each country for each variable, SD to standard deviation, Skew to skewness and Kurt to kurtosis. D in front of each variable refers to first differences.

	DG					DM					DGE					DX				
Country	n	Mean	SD	Skew.	Kurt	n	Mean	SD	Skew.	Kurt	n	Mean	SD	Skew.	Kurt	n	Mean	SD	Skew.	Kurt
Algeria	28	3.99%	0.047	1.522	6.835	29	1.35%	0.159	1.262	5.984	28	0.10%	0.059	-0.615	3.466	28	-2.22%	0.090	-0.918	3.451
Argentina	29	1.59%	0.058	-0.159	2.063	29	-2.06%	0.254	0.451	9.663	29	0.14%	0.030	-0.170	2.584	29	4.20%	0.089	-0.808	3.824
Australia	29	3.28%	0.015	-1.426	4.555	29	-1.34%	0.051	-0.829	4.249	29	-0.11%	0.017	0.734	3.176	29	2.55%	0.036	-0.003	2.783
Austria	29	2.39%	0.018	0.407	3.967	29	-1.40%	0.052	-0.299	2.883	29	-0.42%	0.016	-0.016	2.515	29	2.71%	0.033	-0.709	3.334
Bahrain	28	3.55%	0.067	-0.917	6.366	29	3.49%	0.227	1.412	9.808	28	-2.08%	0.154	-4.162	20.583	28	-0.54%	0.096	-0.225	3.276
Bangladesh	28	3.85%	0.025	-0.059	2.455	29	0.99%	0.138	1.339	7.315	28	0.92%	0.074	-0.004	4.286	28	3.64%	0.141	-0.307	3.553
Belgium	29	2.17%	0.016	0.013	2.781	29	-3.00%	0.054	-2.304	10.090	29	-0.33%	0.021	-0.357	2.962	29	2.06%	0.023	-0.803	4.508
Botswana	29	7.67%	0.059	0.203	2.474	27	2.38%	0.175	1.059	4.373	29	2.31%	0.092	0.521	2.864	29	-1.22%	0.066	0.145	2.544
Brazil	28	2.81%	0.038	-0.072	2.614	29	0.49%	0.261	0.676	5.014	28	-0.80%	0.074	0.019	3.404	28	2.97%	0.091	1.278	6.034
Burkina Faso	29	4.24%	0.037	-0.063	2.192	29	-2.52%	0.148	-0.262	3.658	29	0.10%	0.104	-0.268	8.072	29	-0.87%	0.152	0.142	3.174
Burundi	28	1.65%	0.072	-0.815	3.455	29	3.79%	0.123	0.251	3.116	28	2.30%	0.075	-0.272	2.384	28	4.12%	0.151	1.826	9.167
Cameroon	28	3.75%	0.061	0.124	3.421	29	-0.46%	0.154	-0.154	6.402	28	-0.30%	0.041	0.137	4.539	28	-1.92%	0.065	-1.549	6.834
Canada	29	2.97%	0.022	-1.273	4.614	29	-1.88%	0.069	0.128	2.349	29	-1.01%	0.029	0.442	3.141	29	2.09%	0.036	-0.327	3.380
Chile	29	4.56%	0.048	-2.216	9.807	29	-1.87%	0.124	-0.163	3.008	29	-2.39%	0.042	0.536	6.583	29	3.78%	0.046	-0.529	3.317
Cyprus	29	6.28%	0.039	1.135	4.473	29	-2.27%	0.393	1.495	8.118	29	-0.99%	0.076	-0.521	3.514	29	1.66%	0.073	0.746	4.728
Denmark	29	1.97%	0.019	0.150	3.103	29	-1.76%	0.042	-0.089	2.217	29	0.08%	0.024	0.426	2.365	29	2.59%	0.026	0.406	2.795
Dominican R.	28	4.53%	0.034	-0.396	3.314	29	-4.01%	0.202	-1.039	4.033	28	1.29%	0.115	-1.477	5.496	28	-1.23%	0.075	-0.538	4.264
Ecuador	29	2.82%	0.035	-0.213	4.378	29	0.00%	0.169	-0.751	4.316	29	-1.73%	0.044	0.859	3.708	29	0.39%	0.063	-0.677	2.910
El Salvador	28	2.14%	0.034	-1.118	3.801	29	-2.85%	0.228	-1.383	7.683	28	0.90%	0.038	0.866	3.869	28	2.05%	0.086	-0.388	2.812
Ethiopia	28	3.69%	0.091	0.430	5.695	28	-0.08%	0.309	0.404	3.409	28	1.72%	0.153	-0.657	3.530	28	1.61%	0.187	0.729	5.654
Fiji	28	2.28%	0.064	1.492	6.550	29	6.18%	0.340	1.991	7.342	28	0.81%	0.076	-0.408	2.722	28	1.11%	0.086	0.930	4.003
Finland	29	2.31%	0.034	-1.228	4.647	29	-0.53%	0.104	0.033	3.144	29	0.13%	0.036	0.943	3.924	29	2.78%	0.037	0.828	3.210
France	29	2.34%	0.013	-0.567	3.841	29	-1.31%	0.035	-1.158	3.810	29	0.18%	0.019	0.161	3.666	29	2.61%	0.027	0.507	2.496
Germany	29	2.04%	0.017	-0.144	2.495	29	-3.35%	0.052	-2.306	9.647	29	-0.43%	0.018	-0.153	3.034	29	3.26%	0.029	-0.505	2.897
Ghana	28	3.55%	0.065	0.698	4.335	29	-2.60%	0.314	-0.522	3.231	28	1.85%	0.127	0.325	3.727	28	-1.44%	0.144	-0.568	3.057
Greece	29	2.36%	0.024	-0.229	2.427	29	-1.66%	0.078	0.097	5.102	29	-0.10%	0.043	0.070	3.302	29	3.27%	0.057	-0.375	3.000
Guatemala	28	3.14%	0.022	0.048	2.328	29	-3.79%	0.206	-1.133	3.654	28	2.13%	0.049	2.660	12.480	28	-0.05%	0.096	0.377	3.225
Hungary	29	2.05%	0.036	-1.718	7.923	29	-1.62%	0.128	1.362	7.339	29	0.16%	0.057	1.216	6.952	29	4.43%	0.065	0.881	2.887
India	28	5.20%	0.022	-0.375	4.765	29	-0.33%	0.063	0.005	2.858	28	0.94%	0.030	0.375	1.854	28	2.27%	0.066	0.206	3.039
Indonesia	29	4.84%	0.040	-1.272	4.631	29	-5.29%	0.102	-0.009	2.167	29	0.23%	0.059	0.122	2.047	29	0.27%	0.113	-2.241	9.751
Ireland	29	4.90%	0.033	0.151	2.146	29	-3.26%	0.093	-1.388	8.016	29	-1.86%	0.035	0.057	2.542	29	4.26%	0.043	-0.093	3.156
Israel	29	3.46%	0.032	-0.115	1.860	29	-3.78%	0.133	-0.596	4.339	29	-2.23%	0.053	0.161	2.141	29	1.97%	0.042	0.030	2.694
Italy	29	2.17%	0.016	0.539	3.898	29	-0.77%	0.055	-0.294	2.645	29	-0.25%	0.020	-0.509	2.680	29	2.39%	0.033	-0.306	2.449
Japan	29	2.64%	0.020	-0.002	2.290	29	0.36%	0.044	0.236	5.760	29	0.70%	0.021	-0.318	2.734	29	2.40%	0.040	-0.314	2.176
Jordan	28	4.44%	0.067	-0.720	5.310	29	-2.63%	0.157	0.434	4.434	28	-0.94%	0.047	-0.804	2.864	28	0.95%	0.128	-0.315	2.951
Kenya	28	3.12%	0.030	0.673	3.206	29	-0.21%	0.199	2.490	11.410	28	2.13%	0.062	1.190	5.781	28	0.02%	0.092	0.370	4.725
Kuwait	28	1.36%	0.180	-0.166	6.470	29	1.25%	0.502	0.753	7.808	28	3.21%	0.235	0.740	6.654	28	-0.33%	0.215	0.491	12.694
Luxembourg	29	4.34%	0.030	0.422	1.927	29	0.41%	0.088	-0.054	3.129	29	-0.38%	0.030	-0.147	2.188	29	1.47%	0.034	-0.132	3.132
Madagascar	29	1.06%	0.041	-1.038	4.178	26	-0.51%	0.186	-0.420	3.291	29	0.87%	0.092	-0.977	7.922	29	2.10%	0.140	-0.838	7.267
Malawi	29	3.75%	0.050	-0.154	5.573	28	-2.48%	0.221	0.165	3.526	29	0.99%	0.149	1.935	11.701	29	-0.13%	0.137	-0.106	2.985
Malaysia	28	6.44%	0.027	-0.975	3.581	29	-3.79%	0.227	-1.998	9.480	28	-0.16%	0.064	0.631	3.432	28	3.28%	0.062	-0.289	2.464
Mauritius	29	4.80%	0.032	-0.964	4.495	29	0.00%	0.241	1.727	8.821	29	-0.37%	0.040	0.975	4.675	29	0.18%	0.062	0.649	3.415
Mexico	29	3.04%	0.036	-0.759	3.370	29	-0.77%	0.137	0.015	2.028	29	-0.31%	0.030	0.467	2.790	29	5.21%	0.072	-1.379	5.700
Nepal	28	4.14%	0.032	-1.316	5.227	29	3.06%	0.170	-2.545	12.500	28	1.07%	0.086	-0.372	3.166	28	2.33%	0.089	0.057	3.126
Netherlands	29	2.23%	0.017	-0.840	3.206	29	-2.39%	0.047	-0.192	2.292	29	0.40%	0.022	0.243	2.298	29	2.52%	0.023	0.188	2.331
New Zealand	29	2.09%	0.023	-0.347	2.795	29	-1.83%	0.055	0.507	3.149	29	-0.05%	0.029	0.795	3.477	29	2.62%	0.027	0.009	2.370
Niger	29	2.10%	0.056	-0.839	4.150	21	0.22%	0.147	-0.529	2.964	29	-1.63%	0.084	0.012	3.160	29	1.27%	0.088	0.648	4.197
Norway	29	3.11%	0.017	0.082	1.830	29	-1.62%	0.079	0.490	3.794	29	0.09%	0.023	-0.348	2.287	29	0.77%	0.025	-0.261	3.628
Oman	28	6.03%	0.055	1.123	5.020	29	-3.52%	0.107	-0.843	3.565	28	-0.70%	0.151	-1.930	13.578	28	-1.30%	0.056	-1.171	4.530
Pakistan	29	4.89%	0.022	-0.052	2.254	29	-2.07%	0.076	-0.502	3.608	29	-0.15%	0.071	-0.088	2.475	29	-0.01%	0.073	0.434	2.530
Panama	28	4.26%	0.044	0.897	6.639	24	0.93%	0.213	1.377	8.338	28	-1.73%	0.059	-0.418	2.723	28	-1.38%	0.120	-0.294	3.830
Paraguay	28	3.76%	0.033	0.533	2.515	29	-3.06%	0.146	0.852	3.968	28	0.81%	0.074	-0.613	3.550	28	2.47%	0.160	0.002	2.505
Philippines	29	3.39%	0.042	-0.129	3.111	29	-4.48%	0.104	-1.048	5.108	29	-1.04%	0.046	-0.172	2.160	29	2.81%	0.076	-0.354	2.894
Poland	29	2.20%	0.045	-1.228	3.735	29	-1.16%	0.131	0.378	5.197	29	0.19%	0.044	1.109	3.372	29	5.94%	0.114	2.674	12.950
Portugal	29	3.01%	0.025	-0.279	2.432	29	-2.88%	0.067	-1.937	8.315	29	1.26%	0.020	0.473	3.165	29	3.26%	0.038	0.431	4.251
Romania	29	2.30%	0.067	-0.108	3.775	29	-0.16%	0.269	3.705	19.174	29	-0.92%	0.133	-1.762	9.779	29	1.40%	0.110	-0.900	3.810
Saudi Arabia	28	2.04%	0.067	-0.960	4.728	29	-1.38%	0.166	0.604	2.561	28	1.40%	0.167	-0.128	3.322	28	-1.12%	0.078	-0.030	4.865
Senegal	28	2.58%	0.051	-0.100	3.214	29	-1.56%	0.095	0.815	4.176	28	0.70%	0.065	-0.079	3.569	28	1.33%	0.125	1.542	7.852
Singapore	29	6.45%	0.044	-1.319	3.896	29	-0.54%	0.093	0.216	2.667	29	0.26%	0.081	0.783	4.917	29	3.74%	0.047	0.519	2.385
South Africa	29	2.77%	0.019	-0.431	3.229	29	-3.06%	0.095	0.204	2.833	29	0.08%	0.026	-0.768	4.156	29	-0.18%	0.067	-0.448	2.916
Spain	29	2.68%	0.016	-0.310	2.781	29	-1.50%	0.120	1.661	8.783	29	1.53%	0.019	-0.306	1.813	29	4.38%	0.027	0.335	2.719
Sri Lanka	28	5.04%	0.030	0.444	2.823	29	2.15%	0.291	-0.222	6.066	28	-0.38%	0.058	0.645	2.961	28	0.41%	0.068	-0.198	2.498
Sweden	29	1.85%	0.020	-0.594	2.420	29	-2.39%	0.108	-0.546	11.949	29	-0.30%	0.027	0.034	2.459	29	2.64%	0.031	0.408	2.719
Switzerland	29	1.58%	0.017	0.074	2.099	29	-2.39%	0.082	-0.785	3.873	29	0.46%	0.022	-0.232	2.996	29	2.75%	0.028	0.968	3.721
Syria	28	3.78%	0.067	-0.743	3.753	29	-3.10%	0.144	0.505	4.888	28	-1.19%	0.118	0.503	4.027	28	-0.59%	0.145	0.505	3.193
Tanzania	28	4.44%	0.088	4.421	22.353	22	-1.75%	0.762	0.138	9.085	28	3.10%	0.124	4.583	23.343	28	0.82%	0.161	-3.805	19.091
Tunisia	29	4.74%	0.021	0.050	3.068	29	-0.63%	0.246	-0.423	9.830	29	-0.02%	0.028	0.630	3.346	29	0.07%	0.065	-0.297	3.037
Turkey	29	3.77%	0.043	-0.937	3.124	29	-2.16%	0.121	-0.796	3.800	29	0.39%	0.088	1.713	9.460	29	5.27%	0.115	-0.095	3.392
Uganda	28	3.32%	0.069	-1.082	5.914	29	-0.80%	0.269	0.221	2.819	28	-0.19%	0.055	-0.639	4.300	28	2.51%	0.327	2.379	12.680
U.A.E.	28	4.88%	0.096	-0.306	3.468	29	7.17%	0.358	3.004	13.052	28	1.49%	0.131	1.479	8.204	28	0.46%	0.054	0.471	2.650
U.K.	29	2.41%	0.017	-0.894	3.383	29	-1.93%	0.052	0.362	2.374	29	-0.99%	0.023	0.418	2.804	29	2.22%	0.021	0.124	1.961
U.S.A.	29	3.22%	0.019	-0.705	3.386	29	-1.34%	0.076	-0.003	2.311	29	-1.16%	0.026	0.583	2.331	29	3.12%	0.029	-0.639	3.385
Uruguay	29	1.97%	0.063	-0.825	3.564	29	-2.80%	0.190	0.052	3.010	29	-0.40%	0.048	-0.297	2.442	29	2.43%	0.049	-0.575	2.152
Zambia	28	1.65%	0.061	-0.124	2.785	25	-6.30%	0.338	0.034	2.401	28	-1.25%	0.196	0.464	3.066	28	-4.25%	0.138	-0.067	2.137
Zimbabwe	28	1.27%	0.091	-0.298	2.533	28	-1.80%	0.205	-0.033	6.378	28	1.11%	0.229	0.214	2.922	28	2.91%	0.121	0.016	3.856

Table 2: Stationarity tests using augmented Dickey-Fuller (GLS) (ADF) test on first difference of log of real GDP (DG) and first difference of log of share of military spending in GDP (DM). G is obtained from Penn World Table provided by Heston, Summers and Aten (2006). M is obtained from SIPRI. Data period includes 1975-2004. Lag legth (k) is chosen according to Ng and Perron (1995) method. n refers to number of observations for each country and τ to ADF statistics. Zivot-Adrews refers to Zivot and Andrews (1992) type unit root test that allow for structural break. Break refers to the year in which structural break is found, DF-min is the Dickey-Fuller type minimum t-statistic at the structural break. There are two major columns in the table for each variable (DG and DM); time trend included and no time trend. We first test the variable for stationarity with the time trend included. If the variable is stationary, we test for trend stationarity without time trend in the ADF. If the variable is non-stationary, then we test for structural break. If the variable is still non-stationary then we deem the variable as non-stationary. "*" refers to statistical significance at 1%, "**" at 5% and "***" at 10%.

	Time trend included						No time trend			Time trend included						No time trend		
	DG			Zivot-Andrews			DG			DM			Zivot-Andrews			DM		
	Ng-Perron			Structural Change			Ng-Perron			Ng-Perron			Structural Change			Ng-Perron		
Country	n	k	τ	k	Break	DF-min	n	k	τ	n	k	τ	k	Break	DF-min	n	k	τ
Algeria	21	6	-0.704	1	1987	-8.0727 *				22	2	-3.421 **				22	0	-4.904 *
Argentina	22	0	-4.155 *				22	0	-4.166 *	22	0	-4.973 *				22	0	-4.649 *
Australia	22	0	-5.193 *				22	0	-5.279 *	22	1	-3.786 *				22	1	-3.729 *
Austria	22	5	-1.663	0	1987	-7.2803 *				22	0	-6.205 *				22	0	-6.012 *
Bahrain	21	0	-6.611 *				21	0	-5.874 *	22	4	-3.771 *				22	4	-4.302 *
Bangladesh	21	0	-5.094 *				21	0	-4.279 *	22	5	-1.013	0	1991	-8.7084 *			
Belgium	22	0	-4.929 *				22	0	-3.804 *	22	0	-4.600 *				22	0	-4.292 *
Botswana	22	0	-6.092 *				22	0	-5.294 *	20	1	-4.591 *				20	2	-1.583
Brazil	21	3	-3.936 *				21	0	-3.603 *	22	2	-4.740 *				22	2	-4.694 *
Burkina Faso	22	0	-5.255 *				22	0	-4.956 *	22	0	-6.848 *				22	0	-6.427 *
Burundi	21	0	-4.733 *				21	0	-4.173 *	22	0	-6.032 *				22	0	-5.853 *
Chile	22	5	-3.693 **				22	2	-3.074 *	22	1	-3.209 ***				22	1	-3.080 *
Cyprus	22	0	-4.019 *				22	1	-0.706	22	0	-5.880 *				22	0	-5.759 *
Denmark	22	0	-4.438 *				22	5	-1.117	22	0	-4.978 *				22	0	-4.420 *
Dominican R.	21	0	-3.253 ***				21	0	-3.243 *	22	0	-4.803 *				22	0	-4.863 *
Ecuador	22	0	-5.458 *				22	1	-1.625	22	0	-6.724 *				22	0	-6.447 *
El Salvador	21	4	-1.771	2	1995	-9.9233 *				22	0	-4.198 *				22	0	-3.942 *
Ethiopia	21	0	-7.567 *				21	0	-7.461 *	21	4	-2.707	0	1996	-5.4032 **			
Fiji	21	3	-4.971 *				21	3	-4.667 *	22	0	-3.630 **				22	0	-3.391 *
Finland	22	0	-2.949	0	1993	-4.1178				22	2	-4.051 *				22	0	-5.417 *
France	22	0	-3.840 *				22	0	-3.250 *	22	0	-5.600 *				22	0	-5.206 *
Germany	22	0	-3.201 ***				22	0	-2.759 *	22	2	-1.646	2	1990	-5.0175			
Ghana	21	0	-8.280 *				21	0	-7.845 *	22	6	-3.832 *				22	6	-3.185 *
Greece	22	2	-1.785	0	1979	-5.6395 *				22	3	-2.581	0	1985	-5.9096 *			
Guatemala	21	5	-2.726 ***				21	5	-2.713 *	22	3	-3.118 ***				22	5	-1.051
Hungary	22	0	-4.147 *				22	0	-4.000 *	22	0	-5.580 *				22	0	-5.162 *
India	21	0	-5.396 *				21	0	-5.231 *	22	0	-4.699 *				22	0	-4.753 *
Indonesia	22	0	-3.949 *				22	0	-3.644 *	22	0	-4.679 *				22	0	-3.787 *
Israel	22	3	-0.450	0	1989	-5.5086 **				22	0	-5.651 *				22	0	-5.515 *
Italy	22	0	-3.866 *				22	0	-2.567 **	22	0	-6.605 *				22	1	-2.593 **
Jordan	21	0	-4.086 *				21	0	-3.653 *	22	0	-6.785 *				22	3	-1.132
Kenya	21	0	-4.478 *				21	0	-3.411 *	22	0	-4.887 *				22	0	-4.459 *
Kuwait	21	1	-5.212 *				21	1	-4.979 *	22	1	-5.084 *				22	1	-4.901 *
Luxembourg	22	3	-3.409 **				22	3	-2.859 *	22	0	-5.402 *				22	0	-5.382 *
Madagascar	22	0	-6.840 *				22	2	-1.454	19	0	-5.207 *				19	0	-4.723 *
Malawi	22	1	-5.440 *				22	0	-4.953 *	21	0	-4.153 *				21	0	-4.000 *
Malaysia	21	2	-1.551	2	1987	-3.5594				22	2	-4.323 *				22	0	-5.731 *
Mauritius	22	6	-3.249 **				22	0	-4.146 *	22	0	-5.736 *				22	0	-5.664 *
Mexico	22	0	-4.096 *				22	0	-3.984 *	22	0	-5.484 *				22	0	-5.247 *
Nepal	21	0	-6.521 *				21	6	-0.564	22	0	-5.526 *				22	0	-5.334 *
Netherlands	22	6	-3.356 **				22	1	-4.278 *	22	2	-1.512	2	1994	-3.0916			
New Zealand	22	3	-3.021 ***				22	0	-3.279 *	22	0	-5.324 *				22	0	-3.919 *
Nigeria	22	0	-5.066 *				22	0	-4.786 *	22	1	-5.455 *				22	0	-6.625 *
Norway	22	1	-3.592 **				22	1	-3.075 *	22	0	-6.716 *				22	0	-6.678 *
Oman	21	0	-4.471 *				21	6	0.640	22	6	-3.801 *				22	6	-3.809 *
Pakistan	22	0	-4.211 *				22	0	-3.341 *	22	4	-2.612	0	1979	-5.9220 *			
Panama	21	2	-4.639 *				21	2	-4.625 *	17	0	-5.030 *				17	0	-3.188 *
Paraguay	21	4	-3.649 **				21	4	-1.716	22	0	-6.968 *				22	0	-7.080 *
Poland	22	1	-5.191 *				22	0	-2.167 ***	22	1	-5.146 *				22	0	-6.208 *
Portugal	22	6	-2.893 **				22	0	-2.469 **	22	0	-3.646 **				22	2	-0.111
Romania	22	0	-2.452	0	1992	-5.0290				22	0	-5.180 *				22	0	-5.170 *
Saudi Arabia	21	0	-3.457 **				21	0	-3.119 *	22	0	-5.475 *				22	2	-1.182
Singapore	22	0	-4.815 *				22	0	-4.734 *	22	0	-4.331 *				22	0	-4.226 *
South Africa	22	0	-3.601 **				22	0	-3.262 *	22	0	-3.303 ***				22	0	-2.511 **
Sri Lanka	21	1	-5.379 *				21	0	-4.970 *	22	2	-4.324 *				22	2	-4.127 *
Syria	21	0	-5.832 *				21	0	-5.689 *	22	0	-5.617 *				22	0	-5.548 *
Tunisia	22	6	-1.749	2	1988	-5.4269 **				22	5	-3.161 **				22	5	-3.173 *
Turkey	22	0	-5.794 *				22	0	-4.710 *	22	0	-3.801 *				22	0	-3.831 *
Uganda	21	0	-4.562 *				21	0	-3.637 *	22	6	-2.860 ***				22	6	-2.590 **
U.A.E.	21	0	-4.249 *				21	0	-3.952 *	22	2	-1.632	0	1979	-12.7995 *			
U.K.	22	4	-3.178 **				22	4	-3.123 *	22	0	-3.311 ***				22	0	-3.310 *
U.S.A.	22	6	-4.628 *				22	0	-3.516 *	22	0	-4.103 *				22	0	-3.996 *
Uruguay	22	0	-3.151 ***				22	0	-3.083 *	22	2	-4.441 *				22	0	-5.570 *
Zambia	21	0	-5.155 *				21	3	-0.943	18	1	-4.981 *				18	1	-4.863 *
Zimbabwe	21	3	-3.455 **				21	3	-2.888 *	21	1	-5.202 *				21	4	-0.476

Table 3: Results for panel Granger causality tests using equation (2) where dependent variable is the first difference of log of real GDP (DG). Logs of real GDP (G), government share in GDP (GE) and ratio of total imports and exports to GDP (X) are obtained from Penn World Table provided by Heston, Summers and Aten (2006). Share of military spending in GDP (M) is obtained from SIPRI. MID is the dummy variable for military dispute and constructed using "Militarized Interstate Dispute (MID) at participant level" data is provided by Ghosn, Palmer and Bremer (2004). Version 3.02 is provided as an extension of version 2.1 by Jones, Bremer and Singer (1996). Terrorism data is provided by Inter-university Consortium for Political and Social Research (ICPSR) in two separate studies. The first study (ICPSR Study No.: 22541) provides the data for the period between 1970 and 1997 (LaFree and Dugan, 2006). The second study (ICPSR Study No.: 22600) provides the data for the period between 1998 and 2004 (LaFree and Dugan, 2007). Data period for all of the variables includes 1975-2004. D refers to first difference of variables. Lag lengths for both equations are chosen according to AIC criterion based on Granger causality estimations for individual countries. There are four major columns in the table with two sub-columns each. "Whole Sample" provides the results for equation (2) for the whole sample. "Military service" provides the results for sub samples of countries with and without mandatory military service. "NATO" provides the results for sub samples of countries that are and are not members of NATO. "Level of terrorism" provides the results for sub samples of countries with below and above average terrorist attacks with fatality. Hausman is the statistic to test efficiency and consistency of coefficients of random effects model compared to fixed effects model. We use fixed effects model if we reject the null with Hausman test and use random effects otherwise. "F or Chi2" is the Granger causality (Wald test) test for the combined significance of coefficients of all lags of first difference of log of Military spending (DM). The statistic provided is an F test if fixed effects model is used and Chi2 if random effects model is used. "*" refers to statistical significance at 1%, "**" at 5% and "***" at 10%.

		Whole sample		Military service		NATO		Level of terrorism	
				Not Mandatory	Mandatory	Not member	Member	Below average	Above average
Hausman:		139.80 *	140.80 *	96.94 *	45.17 *	106.52 *	36.06 **	121.63 *	20.06
DG	L1.	0.073 *	0.072 **	0.062 ***	0.171 *	0.068 **	0.213 *	0.067 **	0.186 *
	L2.	-0.039	-0.038	-0.035	-0.019	-0.045	0.033	-0.041	0.012
	L3.	0.023	0.023	0.023	-0.051	0.020	-0.056	0.013	0.169 *
	L4.	-0.067 **	-0.066 **	-0.057 ***	-0.119 **	-0.061 **	-0.229 *	-0.072 **	0.012
DM	L1.	-0.014 **	-0.014 **	-0.016 ***	-0.005	-0.016 **	0.034 ***	-0.014 ***	0.006
	L2.	0.023 *	0.023 *	0.030 *	-0.007	0.024 *	-0.036 ***	0.028 *	-0.006
	L3.	-0.007	-0.007	-0.007	-0.004	-0.007	-0.006	-0.007	0.017
	L4.	-0.008	-0.008	-0.010	0.007	-0.008	-0.016	-0.007	-0.007
DGE	L1.	-0.054 *	-0.053 *	-0.051 *	-0.061 ***	-0.052 *	-0.074 ***	-0.056 *	-0.064 ***
	L2.	0.043 *	0.044 *	0.047 **	-0.030	0.045 **	-0.007	0.043 **	-0.019
	L3.	0.023	0.023	0.026	-0.019	0.022	0.055	0.019	0.022
	L4.	0.014	0.015	0.020	-0.003	0.016	0.044	0.014	-0.008
DX	L1.	0.066 *	0.066 *	0.067 *	0.009	0.067 *	-0.027	0.065 *	0.052 **
	L2.	0.014	0.015	0.017	-0.017	0.013	-0.011	0.011	0.056 **
	L3.	0.032 *	0.032 *	0.031 **	0.048 ***	0.031 **	0.053 ***	0.030 **	0.020
	L4.	-0.005	-0.005	-0.004	-0.011	-0.005	-0.016	-0.006	-0.008
	td	-0.001	-0.001 ***	-0.001	-0.001	-0.001 ***	0.000	-0.001 **	0.000
	sc1	0.007	0.006	0.006	0.008 ***	0.006	0.003	0.008	-0.001
	MID		-0.003	-0.005	0.001	-0.005	0.000	-0.005	0.004
	c	0.031 *	0.032 *	0.034 *	0.028 *	0.035 *	0.026 *	0.033 *	0.020 *
F or Chi2		4.65 *	4.68 *	4.98 *	0.34	4.18 *	1.90	4.84 *	2.59

Table 4: Results for panel Granger causality tests using equation (3) where dependent variable is the first difference of log of share of military spending in GDP (DM). Logs of real GDP (G), government share in GDP (GE) and ratio of total imports and exports to GDP (X) are obtained from Penn World Table provided by Heston, Summers and Aten (2006). Share of military spending in GDP (M) is obtained from SIPRI. MID is the dummy variable for military dispute and constructed using "Militarized Interstate Dispute (MID) at participant level" data is provided by Ghosn, Palmer and Bremer (2004). Version 3.02 is provided as an extension of version 2.1 by Jones, Bremer and Singer (1996). Terrorism data is provided by Inter-university Consortium for Political and Social Research (ICPSR) in two separate studies. The first study (ICPSR Study No.: 22541) provides the data for the period between 1970 and 1997 (LaFree and Dugan, 2006). The second study (ICPSR Study No.: 22600) provides the data for the period between 1998 and 2004 (LaFree and Dugan, 2007). Data period for all of the variables includes 1975-2004. D refers to first difference of variables. Lag lengths for both equations are chosen according to AIC criterion based on Granger causality estimations for individual countries. There are four major columns in the table with two sub-columns each. "Whole Sample" provides the results for equation (2) for the whole sample. "Military service" provides the results for sub samples of countries with and without mandatory military service. "NATO" provides the results for sub samples of countries that are and are not members of NATO. "Level of terrorism" provides the results for sub samples of countries with below and above average terrorist attacks with fatality. Hausman is the statistic to test efficiency and consistency of coefficients of random effects model compared to fixed effects model. We use fixed effects model if we reject the null with Hausman test and use random effects otherwise. "F or Chi2" is the Granger causality (Wald test) test for the combined significance of coefficients of all lags of first difference of log of real GDP (DG). The statistic provided is an F test if fixed effects model is used and Chi2 if random effects model is used. "*" refers to statistical significance at 1%, "**" at 5% and "***" at 10%.

		Whole sample		Military service		NATO		Level of terrorism	
				Not Mandatory	Mandatory	Not member	Member	Below average	Above average
Hausman:		22.68	23.93	18.63	9.15	19.66	3.85	20.71	13.88
DG	L1.	0.272 *	0.275 *	0.258 **	0.324	0.296 **	-0.050	0.290 *	0.082
	L2.	-0.014	-0.017	-0.076	0.543 ***	-0.014	-0.351 ***	0.020	-0.363
	L3.	0.089	0.091	0.112	0.177	0.086	0.191	0.089	0.068
	L4.	0.027	0.023	0.025	-0.137	0.018	0.313	0.027	0.221
DM	L1.	-0.001	0.000	0.019	-0.117 **	-0.002	0.036	-0.020	0.131 ***
	L2.	-0.088 *	-0.088 *	-0.098 *	-0.107 **	-0.088 *	0.000	-0.098 *	-0.015
	L3.	-0.089 *	-0.087 *	-0.056 ***	-0.260 *	-0.091 *	0.083	-0.077 *	-0.209 *
	L4.	-0.019	-0.017	-0.028	0.012	-0.018	0.032	-0.020	0.007
DGE	L1.	0.248 *	0.246 *	0.223 *	0.471 *	0.250 *	0.159	0.263 *	0.150
	L2.	-0.098	-0.101 ***	-0.124 ***	0.278	-0.107	-0.138	-0.082	-0.217
	L3.	0.016	0.016	-0.008	0.259	0.023	-0.209	0.013	0.068
	L4.	0.108 ***	0.105 ***	0.110	0.105	0.101	0.048	0.101	0.277
DX	L1.	0.023	0.023	0.029	-0.045	0.028	0.021	0.060	-0.311 **
	L2.	0.004	0.003	0.000	0.009	0.003	0.113	0.018	0.014
	L3.	0.002	0.001	0.021	-0.159	0.000	0.070	-0.009	0.230
	L4.	0.080 ***	0.079 ***	0.094 ***	-0.080	0.089 ***	-0.129	0.099 **	-0.180
	td	-0.001	0.000	0.000	-0.001	-0.001	0.000	0.000	-0.002
	sc1	-0.001	-0.001	0.003	-0.009	0.004	-0.008	-0.006	0.016
	MID		0.014	0.017	0.003	0.020	0.003	0.016	0.018
	c	-0.031 *	-0.035 *	-0.035 *	-0.034 ***	-0.037 *	-0.018 ***	-0.038 *	-0.023
F or Chi2		8.42 ***	8.57 ***	6.20	9.22 ***	7.27	5.89	8.85 ***	1.33