

Military Expenditure and Economic Growth in Developing Countries: Evidence from System GMM Estimates

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Abstract

Evaluating the effects of defense expenditure on economic growth in developing countries has been examined by many empirical studies. On the other hand, there is little consensus on that impact and the variety seems to come from imply of different models and different estimators. The paper aims at contributing to the literature by utilizing a recently constructed economic growth data set and controlling for defense expenditure, covering a large set of countries and an extended time period, the study reveals further evidence on the relationship between economic growth and military spending. This study integrates the system Generalized Method of Moments (GMM) estimators to analysis the impact of defense expenditure on economic growth between 2002 and 2010 for 67 developing countries. The findings indicate that military spending has a positive and significant effect on economic growth in the sample countries. Our empirical results strongly support the Bionit's who found that government military spending is helpful to economic growth regardless of how we measure the government size and economic growth. When the countries are disaggregated by income levels and the degree of corruption.

Keywords: *military expenditure; economic growth; developing countries; system GMM estimates*

INTRODUCTION

The effect of military expenditure on the economy is a controversial area of research among economists. Particularly, in the last four decades, there has been a growing interest in the role of military spending in developing countries.⁷ The area that has received the most attention has been whether military expenditure helps or hinders economic growth. Much of the current work on this topic has stemmed from the work of Benoit's work (1973).

The underpinnings of their claim lie in the crowding-out effect; that is scarce, resources are siphoned off from productive sectors of military activities. Unless such economic resource transfers can result in profitable commercial applications in the future, most of the economists and researchers expect to see a negative correlation between defense spending and economic growth in developing or low income countries, or in the region of heightened conflict and civil war.

Empirical results, nonetheless, have been rather disappointing the relationship between military expenditure and economic growth could be positive, negative and inconclusive, or independently depending on length of sample data, model and methodology used. Many of the prior researchers

employed cross-sectional data or country-specific. Such an analysis is intrinsically static for it ignores the vital properties of time. For instance, the results may be biased or of limited use. With the recent advancements in panel data Econometrics, academics and researchers begin to classify panel's model based on regions (e.g., the EU, the Middle East, Sub Saharan Africa and Latin America) or based on their income levels (e.g., high, medium and low income level). Note that crowding-out effects are particularly predominant in developing counties. And some regions are historically war-prone, for instance the Middle East, South Asia and part of Africa. Thus, we could expect that higher military spending for these countries, which might very well produce different results.

Furthermore, many of the earlier studies applied panel data model to only one given region except for Knight et al. (1996) whose applied panel data comprised six regions. Well known in the literature, failure to use multiple-region framework can render conclusions to be of limited value. While multiple-region and the large-scale study by Knight et al. (1996) has the broader policy implications across different regions and countries, it does not take dynamic elements into consideration and thus cannot

really address the true dynamic relations between military spending and economic growth.

To address the country-specific and time-specific impacts, and to allow for different economic developmental phases and varying endowment levels (regional effects), this paper applies a large panel data of 67 countries over 2002–2010 to examine the relationship between military expenditure and economic growth. In addition, we apply the random effect, fixed effect and system GMM estimator to analyze the relationship between military expenditure and economic growth in the sample countries. The remainder of this paper is organized as follows: Section 2 provides literature review. Section 3 econometric methodology and data sources. Section 4 discussion of results. A conclusion is given in Section 5.

LITERATURE REVIEW

The literature on military expenditure and economic growth dated back to the seminal work done by Benoit (1973) in which a positive relationship between military spending and economic growth was found. Benoit's work inaugurated a massive array of studies in the hope of identifying a definitive pattern between the two variables (e.g., Atesoglu and Mueller, 1990; and Biswas, 1993; Faini et al., 1984; Ram, 1986; Smith, 1980). Research methods used in earlier literature largely employed unconditional correlation coefficients (Benoit, 1973, 1978). On the other hand, majority of later studies relied on cross-sectional regressions (Antonakis, 1997; Biswas and Ram, 1986; Lin, Ali et al. (2013), Cohen et al., 1996; Ahmed (2012), Deger, 1986; Grobar and Porter, Wijeweera and Webb (2011), 1989; Heo, 1996; Yildirim, Sezgin et al. (2005), and Lim, 1983) Because cross sectional regression lacks the time series effect.

That is, it has little inferential power beyond the sample period studied. In addition, it has a problem of heterogeneity and as such normally has low coefficient of determination. To circumvent these problems, our system GMM model includes 67 countries spanning over 2002–2010. To economize space, we limit the literature review of the military expenditure economic growth correlation to multi-country models Frederiksen and Looney (1982) studied the relationship via a growth equation using, among other variables, military spending and investment to explain economic growth. Countries were divided into less developed countries (LDCs) with rich resource endowments and those with limited resources.

The result of the cross-sectional study over the period of 1960–78 suggests that military expenditure is beneficial to economic growth for the LDCs with rich resource. For the LDCs with limited endowment,

there existed no positive relationship between the two variables. Applying the Harrod-Domar growth model to 54 LDCs over the period of 1965–73, results by Lim (1983) pointed out huge amount of military spending was harmful to economic growth. Making use of Feder's two-sector growth model (1983), Biswas and Ram (1986) examined (i) the impact of private sector spending and military expenditures on economic growth and (ii) externality of military spending. Partitioning 58 LDCs into low income (17 countries) and lower-middle income (41 countries) groups and dividing sample period into 1960–1970 and 1970–1977 segments in order to consider a potential structural break, Biswas and Ram (1986) identified a positive relationship for lower-middle income group over the period 1960–1970. Deger (1986) criticized the validity of non-defense growth rates used in Benoit's paper. Moreover, Deger (1986) added a third variable, savings, into the defense spending and economic growth model.

Furthermore, that is, a system of three simultaneous equations with 50 developing countries over the period 1965–73 was estimated and the results showed (i) a positive relationship between defense spending and economic growth, (ii) a negative relationship between defense spending and savings, and (iii) a negative relationship between military spending and economic growth after taking savings into consideration. Mintz and Stevenson (1995) attributed the divergent results to (i) lacking a consistent theory regarding defense spending and economic growth, (ii) inappropriate research methodology and (iii) the failure to take into considerations the role of externality that defense spending plays in the model. They criticize the limitation of cross-sectional regression, which at best gives comparative static results. As a result, they employed a panel data model of 103 LDCs countries in which military spending positively leads economic growth only in less than 12 of the sample countries (Mintz and Stevenson, 1995).

To increase the scope of the study, Knight et al. (1996) incorporated 22 developed countries on top of 102 developing countries, which encompass six geographical regions: Asia, East Europe, Middle East, North Africa, Sub-Sahara and West Hemisphere. Furthermore, the sample period was divided into 1975–1985 and 1986–1990 to account for a possible structural break. Different from previous studies, their empirical investigation was built upon the growth model by Solow (1956) and Swan (1956). The result recognized a direct negative relationship between defense spending and economic growth via productivity and investment. The important message was that decreased defense spending gave rise to more peace dividend. However, built on Barro's growth model (1990) and using Levine and Renelt's cross-sectional data (19

countries over the period 1974–1989), Brumm (1997) found a significant and positive relationship between military spending and economic growth.

To investigate the existence of so-called “peace dividend” after the Cold War, Heo (1998) applied a nonlinear regression model to the longitudinal data consisting of 80 countries over the period 1961–1990. Not surprisingly, negative relationship between defense spending and economic growth was found in two thirds of the countries. Based on the three-equation model (growth, savings, and military spending), Galvin (2003) applied two-stage and three-stage least squares methods to the 1999 cross-sectional data from 64 countries. The result revealed to a negative relationship between the two variables. Regrouping the 64 countries into low-income and middle-lower income categories, Galvin found negative impact of the lower income group and the spin-off impact of its defense spending was negligible. Up to now, the literature on the topic in general dealt largely with large samples, world or longitudinal data.

Some of the literature already has taken into consideration the regional segmentation resource endowments (Frederiksen and Looney, 1982; Galvin, 2003; Lim, 1983). Linden's application (1992) of Feder's two-sector model (1983) to the 13 countries from the Middle East suggested the existence of a negative relationship between defense spending and economic growth, but a positive relationship between the size of government, capital formation, oil price, and economic growth. In a similar vein, McNair et al. (1995) applied the three-sector (national defense, private and the public sector of non-national defense) Feder (1983) and Ram (1986) models for 10 NATO countries over the period of 1951–1988. Applying the fixed and the random effect models of panel data, they found a positive relationship between defense spending and economic growth from the supply side. While, by not considering demand side, the potential crowding-out impact was left out.

Dunne and Mohammed (1995) selected 13 Sub-Saharan countries over the period 1967–1985 for cross-sectional and panel data analyses. Including important variables such as size of the army in the time series, they detected a negative relationship via accumulated human capital formation, investment allocation and international balance account. Similarly, Hassan et al. (2003) sampled 5 of 7 South Asian Regional Cooperation Council members (India, Pakistan, Nepal, Bangladesh and Sri Lanka) over 1985 -1996 in their study. They concluded that, military expenditure, foreign direct investment, human capital, domestic gross investment, information and communication technology and infrastructure significantly explained economic growth within the framework of the neoclassic

growth model. In contrast, Kollias et al. (2004) first tested the existence of a unit root and co-integration of the 15 EU countries. Results from the Granger causality test indicated that the majority of the countries showed economic growth led military expenditure, but not vice versa.

In brief, the above mentioned studies did not seem to address the heterogeneity factors between countries. It appears that choice of data is more and more in favor of grouping countries over time or using longitudinal data in place of homogeneous cross sectional data. However, cross-sectional data models assuming the homogeneity for each member of the cross section have limited inferential power due to country-specific effects. In contrast, a time series model may address this problem; however, the paucity of data (only annual data are available) renders unit root and co-integration tests biased due to small sample groups. Yildirim et al. (2005) applied the dynamic panel data (DPD) approach to analyze the relationship between military spending and economic growth for the 13 countries (the Middle East and Turkey) from 1989 to 1999. Using the generalized method of moments (GMM) developed by Arellano and Bond (1991), they found a positive relationship between military expenditure and economic growth.

ECONOMETRIC METHODOLOGY AND DATA SOURCES

The Data

In order to investigate the relationship between military expenditure, population and economic growth in the 67 less developed countries over the period 2002-2010 and a balanced panel of time series data was constructed. The data set is balanced because the same time periods are available for all cross section units. The data are taken from the SIPRI Yearbooks for military expenditure (Stockholm International Peace Research Institute, various years) and the data on GDP and population are drawn from the World Bank Economic Indicators.

Table I variables descriptions: Annual data: (2002-2010; N=67)

Variable	Description	Source
ME	Military expenditure	SIPRI (2010)
RGDPC	Real Gross domestic product per Capita	WDI (2010)
POP	Population	WDI (2010)
Albania, Algeria, Angola, Argentina, Benin, Bolivia, Botswana, Burkina Faso, Cambodia, Cameroon, Central African, Chad, Chile, China, Colombia, Congo, Cuba, Dominican, Ecuador, El Salvador, Guinea, Ethiopia, Fiji, Gabon, Gambia, Guatemala, Haiti, India, Indonesia, Iran, Iraq, Jordan, Kenya, Laos, Lebanon, Madagascar, Malawi, Malaysia, Mali, Malta, Mongolia, Morocco, Mozambique, Nepal, Niger, Nigeria, Pakistan, Panama, Papua Guinea, Paraguay, Peru, Rwanda, Saudi Arabia, Senegal, Sierra Leone, South Africa, Sri Lanka, Sudan, Syria, Tanzania, Thailand, Togo, Tunisia, Uganda, Viet Nam, Zambia.		

ECONOMETRIC METHODOLOGY

The empirical specification of this study is aimed at explaining the relationship between military

$$ME_{it} = \alpha_1 + \alpha_2 ME_{it-1} + \alpha_3 RGDP_{it-1} + \alpha_4 POP_{it-1} + \lambda_i + \varepsilon_{it}, \quad i = 1, \dots, N; t = 1, \dots, T \tag{1}$$

expenditure and economic growth in the less developed countries. Thus, the empirical model employed in the analysis is as follows:

Equivalently, Eq. (1) may be written as follows:

$$ME_{it-1} = \alpha_1 + \alpha_2 ME_{it-2} + \alpha_3 RGDP_{it-1} + \alpha_4 POP_{it-1} + \lambda_i + \varepsilon_{it-1}, \quad i = 1, \dots, N; t = 1, \dots, T \tag{2}$$

Where *ME* is military expenditure, *RGDP* is real gross domestic product (GDP) per capita, *POP* is population, and the subscripts *i* and *t* index countries and time, respectively. In addition, the specification also contains an unobservable country-specific effect μ and error-term ε .

Arellano and Bond (1991) propose transforming equation (2) into first differences (FD) to eliminate country specific effects (λ) as follows:

$$ME_{it} - ME_{it-1} = \alpha ME_{it-1} - ME_{it-2} + \beta RGDP_{it} - RGDP_{it-1} + POP_{it} - POP_{it-1} + \varepsilon_{it} - \varepsilon_{i,t-1}$$

$$\Delta ME_{it} = \alpha ME_{i,t-1} + \beta \Delta RGDP_{it} + \Delta POP_{it} + \Delta \varepsilon_{it} \tag{3}$$

As difference GMM estimation. Following Arellano and Bond (1991), we set the following moment conditions:

$$E[ME_{i,t-s} (\varepsilon_{it} - \varepsilon_{i,t-1})] = 0 \text{ for } s \geq 2; t = 3, \dots, T \tag{4}$$

$$E[RGDP_{i,t-s} (\varepsilon_{it} - \varepsilon_{i,t-1})] = 0 \text{ for } s \geq 2; t = 3, \dots, T \tag{5}$$

$$E[POP_{i,t-s} (\varepsilon_{it} - \varepsilon_{i,t-1})] = 0 \text{ for } s \geq 2; t = 3, \dots, T \tag{6}$$

Although the difference estimator above is able to control for country-specific effects and simultaneity bias, it nonetheless has one major shortcoming. Alonso-Borrego and Arellano (1999) and Blundell and Bond (1998) illustrate that when the independent variables are persistent the lagged levels of the variables become weak instruments. They illustrate that weak instruments may lead to biased parameter estimates in small samples and larger variance asymptotically. Before, Arellano and Bover (1995)

proposed an alternative system estimator that combines the difference Eq. (3) and the level Eq. (2). Blundell and Bond (1998) show that this estimator is able to reduce biases and imprecision associated with difference estimator. Following Arellano and Bover (1995), the additional moment conditions for the second part of the system (the regression in levels) are set as follows:

$$E[(ME_{i,t-s} - ME_{i,t-s-1}) (\lambda_i + \varepsilon_{it})] = 0 \text{ for } s = 1 \tag{7}$$

$$E[(RGDP_{i,t-s} - RGDP_{i,t-s-1}) (\lambda_i + \varepsilon_{it})] = 0 \text{ for } s = 1 \tag{8}$$

$$E[(POP_{i,t-s} - POP_{i,t-s-1}) (\lambda_i + \varepsilon_{it})] = 0 \text{ for } s = 1 \tag{9}$$

The consistency of the GMM estimator depends on two specification tests. The first is the Hansen (1982) J-test of over-identifying restrictions. Under the null of joint validity of all instruments, the empirical moments have zero expectation, so the J statistic is distributed as a χ^2 with degrees of freedom equal to the degree of over identification. The second test examines the hypothesis of no second-order serial correlation in the error term of the difference Eq. (3)

(Arellano and Bond, 1991). Failure to reject the null of both tests provides support to the estimated model. The GMM estimators are typically applied in one- and two-step variants (Arellano and Bond, 1991). The one-step estimators use weighting matrices that are independent of estimated parameters, whereas the two-step GMM estimator uses the so-called optimal weighting matrices in which the moment conditions are weighted by a consistent estimate of their covariance matrix. This makes the two step estimator

asymptotically more efficient than the one-step estimator.

On the other hand, the use of the two-step estimator in small samples, in a simulation analysis, Windmeijer (2005) shows that the two-step GMM estimation with numerous instruments can lead to biased standard errors and parameter estimates. Furthermore, Bowsher (2002) shows that numerous instruments may lead to a weakened over identification test. The author shows that the test is undersized and never rejects the null of joint validity at 0.05 or 0.10, rather than rejecting it 5% or 10% of the time as a well-sized test would. In order to alleviate the problems induced by the proliferation of instruments, Roodman (2009b) recommended reducing the dimensionality of the instrumental variable matrix.

System GMM and Structural Breaks

Generalized Method of Moments (GMM) is a semi-parametrically efficient estimation method. Since Hansen (1982) established its large sample properties, GMM has gained an abundant deal of attention in the field of economics in the last two decades. The GMM estimation methodology begins with a set of over-identified population of moment conditions and seeks to find an estimator that minimizes a quadratic norm of the sample moment vector.

The resulting estimation has been revealed to be consistent and asymptotically normal under many circumstances. Nonetheless, the GMM first difference estimator suffers from a significant shortcoming. Blundell and Bond (1998) have found that when the independent variables are persistent over time, lagged levels of these variables are weak instruments for the regression equation expressed in first differences. Blundell and Bond (1998) also found that the instrument variables used with the first-difference GMM method (i.e. the endogenous variables lagged two or more periods) become less informative in models where the variance of the fixed effects is mainly relative to the variance of the transitory shocks. This is likely to lead to biased coefficients, and the issue is generally intensified in small sample size. To avoid this bias, Blundell and Bond (1998) suggested a system GMM (SGMM) estimator.

This method essentially combines with a system the first-difference with the same equation expressed in levels. The instruments for the regression in differences are the same as those labeled above, while the instruments for the equation in levels are lagged differences of the corresponding variables. The main advantage of the SGMM method comprises in the fact that unlike (between or within - first differences) approaches, it does use the estimation in levels for

estimation and this exploits not only the variation in data but also among the countries as well. It therefore allows preserving most information to identify the parameters of interest. Arellano and Bond (1995) display on the basis of Monte-Carlo simulation that this additional information results in a considerable gain in the precision of the estimates.

DISCUSSION OF RESULTS

Our sample includes 67 developing countries for which data are available for over the period 2002–2010. Thus, our sample dataset is balanced. We report first estimates of Eq. (3) For the whole sample period with the standard panel data estimates viz., pure cross section or total estimates, random effects models REM viz., between and within and the fixed effects models. Additionally, we shall use the systems GMM approach (SGMM) of Blundell and Bond (1998) in which the specifications in the first differences and levels of the variables are estimated simultaneously. Estimates with these alternative methods are in Table II. Two sets of subsample estimates with REM and SGMM are reported in Table III and Table IV.

In order to specify whether a random or a fixed effects model is more appropriate for our study we performed the Hausman test. The Hausman test is distributed as χ^2 , where the degrees of freedom are equal to the number of regressors. The results show that the fixed effects model is rejected, and this finding is consistent with Murdoch et al. (1997) since random effects models are considered more appropriate, than fixed effect models. Thus, the fixed effects model is not necessary in our case. Parameter estimates of the random effect and fixed effect are presented in Table II and Table III for the 67 developing countries. The results obtained, similar to Smith and Dunne (2001); show a significant positive effect of the growth rate and the share of military expenditure.

Furthermore, we have employed System GMM analysis based on balanced data-set, in order to investigate the relationship between military expenditures and economic growth in the context of different political and welfare developing countries regimes. We have used an AR(1) and an AR(2) model to capture the persistence in our sample data. Moreover, AR(1) and AR(2) models are desirable based on the Arellano and Bond (1995) test for AR(2). To consider any cross-sectional dependence, we also have included time dummies as instruments in some regressions. Since there may be an endogeneity problem for most of our explanatory variables.

The GMM estimation results of this study, presented in Table IV, indicate a statistically significant relationship between military expenditure, economic

growth and population for the rest of the sample countries. All diagnostics for the models in each table are satisfactory. Overall, military size and population effects are positively related with economic growth in this study, and all variables are statistically significant at the 1% level. Dynamic panel analyses' findings in the table show that lagged values of military expenditures have a positive effect on their present value. The results show that as economic growth (GDP) and population are increase military expenditures as a percentage of government expenditures are increase as well. Additionally, this finding suggests that military expenditure play a significant role in the less developed countries despite of many problems (i.e. civil war, conflicts and border tensions), and this finding supported by earlier works done by Benoit (1973&1978) for 44 developing countries. Moreover, our findings confirm and support Ali's (2007) findings that civil war and terror are a significant factor that affects both the level of military spending in the developing countries. Additionally, our findings, which raise a major issue/question about why governments of less developing countries have higher military expenditures than developed countries. The correlation coefficients between defense expenditures of each developing countries and total world military expenditures still provides a modest indication that one possible aspect is due to arms races, in which developing nations are more likely to follow the world rearmament trend than developed economies. Another important explanation is that since total budgets of developing countries are less than developed countries, the share of military expenditures is still high. That means there is a 'subsistence level' of defense spending that each developing country has to bear, which is not insignificant compared to overall spending.

Table II. Random Effects Results: Dependent variable is ME.

	<i>Coeff</i>	<i>T ratio</i>
Constant	-19.79333	0.000*
Ln RGDP	.8069275	0.000*
Ln POP	1.196282	0.000*
Hausman test	0.1139	-
N	603	
Countries	67	
Min obs	9	
Max obs	9	
Av obs	9.0	
Rsquared within	0.7114	
Rsquared	0.7776	

*, **, *** denote significance at 10%, 5% and 1%, respectively. Values in parentheses are heteroscedasticity consistent *t*-statistics and values in brackets are *p*-values.

Table III. Fixed Effects Results Dependent variable is ME.

	<i>Coeff</i>	<i>T ratio</i>
Constant	-26.73074	0.000*
Ln RGDP	.7356716	0.000*
Ln POP	1.648362	0.000*
Bresch-pagan LM test		
Hausman test	0.1139	
N	603	-
Countries	67	-
Min obs	9	
Max obs	9	
Av obs	9.0	
Rsquared within	0.7131	
Rsquared	0.7244	

*, **, *** denote significance at 10%, 5% and 1%, respectively. Values in parentheses are heteroscedasticity consistent *t*-statistics and values in brackets are *p*-values.

Table IV Results of system GMM estimations: Dependent variable is ME. (Sample period: 2002-2009)

	One step difference GMM	two step difference GMM	Two-step difference GMM with robust SE
CONSTANT	-4.145012* (-2.04)	-3.256215* (-0.52)	-3.256215 (-0.52)
LnMIXit-1	.783148* (15.04)	.8042223* (27.89)	.8042223* (7.17)
Ln RGDPcit-1	.1902265* (4.50)	.1622614* (7.77)	.1622614* (2.33)
Ln POP1t	.2486972** (1.90)	.1996092* (2.23)	.1996092 (0.50)
Ln Sargant Test (p-value)	102.4967 (0.0000)	47.99661 (0.0563)	-
AR(1)	-	-2.8283 (0.0047)	-2.8283 (0.0047)
AR(2)	-	.61753 (0.5369)	.61753 (0.5369)
N	67		
T	9		

Notes: All models are estimated using the Arellano and Bond dynamic panel GMM estimations (Stata *xtabond* command). The variables are defined as follows: ME = Military expenditure; RGDP = real GDP per capita (in US dollars; POP = Population. Figures in the parentheses are *t*-statistics. *** And **

indicate significance at the 1% and 5% levels, respectively. Time dummies were jointly significant and are not reported here to save space.

CONCLUSION

There is a long history of correlation studies that try to establish causal investigation and conclusions about the effects of military spending on economic growth. More than 35 years ago, Benoit (1973) studied the development effects, by estimating relationships between military spending and growth performance in developing countries. More recently, in a follow-on study, Tongur and Elveren (2013), Wijeweera and Webb(2011), Christos Kollias (2009) and Ali (2012) tried to study the relationship from the viewpoint of lead-lag pattern using panel analysis. Precious little attention is being paid to underlying structural analysis, using widely accepted analytical construct of economics .Combining this with panel data methods gives us the best chance of recognizing any empirical relation between military spending and economic growth. Static and dynamic fixed effects, random effects and system GMM models were estimated. The dynamics were found to be important and gave the result that military expenditure does indeed have a positive and significant impact on GDP. Using a more satisfactory approach to dynamic panel data models, the Arellano–Bond GMM technique, provided estimates that were consistent with this finding.

ACKNOWLEDGEMENTS

We thank dear (Editor-in-Chief), and four anonymous referees for their valuable comments on earlier drafts of this article.

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