MILITARY SPENDING, CONFLICT AND ECONOMIC GROWTH IN AFRICA

J Paul Dunne
School of Economics and SALDRU
University of Cape Town
John.Dunne@uct.ac.za

Nan Tian
School of Economics
University of Cape Town
Nan.Tian@uct.ac.za

May 2013

Abstract:
This paper examines the impact of military expenditure on economic growth on a large balanced panel, using an exogenous growth model and dynamic panel data methods for 104 countries over the period 1988-2010. A prime objective of the paper is to consider the nature of the relationship between military spending and growth in Africa and to see how it compares to the rest of the world. This is done by estimating and appraising the full sample and stratifying based upon a range of potentially relevant factors – income, conflict experience, geography, natural resources abundance, aid and openness. This is done both for the group of African countries and non-African countries to consider spatial group heterogeneity. The results suggested that there is a clear significant negative effect of military burden on growth for the overall sample and for both groups, but one which is stronger for African countries. When the robustness of the results was investigated, some heterogeneity was discovered, but the only grouping for which both the long and short-run military burden effects were insignificant were middle income African countries, African countries with no experience of conflict, non-African countries with natural resource abundance and non-African countries with relatively closed economies. It is striking that across all of the groups investigated here there was no evidence of any significant positive effects of military burden on growth.

Keywords: Economic growth; development; Africa; military expenditure.

JEL code: O11; O56

Preliminary Draft: Comments and suggestions are welcome. Please do not quote without authors approval.

INTRODUCTION

There is an impressively large and growing literature regarding the effects of military spending on economic growth that reflects a continuing lack of consensus.As more data, that does not reflect the particular geopolitical environment of the Cold War, become available, there is more information in the data and thus allowing researchers to revisit earlier analysis and identify definitive effects of military spending; one which continues to be the subject of considerable debate. The end of the Cold War was accompanied by considerable reductions in worldwide military expenditure. However, in recent years (since 1998), the declining trend has bottomed out and military spending is once again on the increase across medium and high income countries.Interestingly, the lowest income group continues to experience declines in military spending and military spending as a share of GDP remains lowest for the low income countries relative to the other income groups (SIPRI, 2012 & Own Calculations, 2013). SIPRI (2013) reported that global military expenditure in 2012 reached $1.75 trillion, representing 2.5 percent of global gross domestic investment (GDP) or equivalent to $250 per person.While the end of the Cold War has led a drop in military spending and fewer major international conflicts, there was an increase in internal conflicts in the developing world and although the number of conflicts has been declined recently, the remain a predominant source of concern for the developing world.Yet, the major pressure to maintain or increase the level of military spending have not been the result of these strategic needs, but rather from internal pressures by vested interests.

One issue that has received little attention has been the consideration of geopolitical heterogeneity within the sample, particularly focusing on the differences between African and non-African countries. This paper contributes to the existing literature by continuing this investigation with a particular focus on parameter heterogeneity between Africa and non-Africa using a post-Cold War balanced panel of 104 countries for the period 1988-2010. The following section reviews the existing literature on the military spending growth relation and provides an exposition of the growth model based on Dunne et al (2005), which overcomes some limitations of earlier models. Section 3 offers a discussion of the dataset and introduces the variables used in sub-sample stratification. Section 4 presents the estimation results of the growth model using cross-country data and considers the variation in results across African and non-African countries across various sub-samples when the sample is stratified by developing; income groups (low and medium); conflict (conflict or not and civil); net recipients of aid, natural resources and trade openness. The final section presents some conclusions.

MILITARY SPENDING AND GROWTH

Perhaps the first entity to understand in the literature is the complex relationship between military spending and development. In applied work, this relation is often restricted to the use of economic growth rather than development because of the problems in defining and measuring development. While a theoretical model is quintessential for any empirical work, most economic theories do not have an explicit role for military spending as an activity and

thus there is no obvious choice. Since there is no agreed theory of growth among economists, there is no standard framework to fit military spending into. In an effort to properly incorporate military spending to economic growth, various schools of thought emerged (Dunne and Coulomb, 2008). Four theoretical approaches have since been developed: the Neoclassical, Keynesian, Institutional and Marxist perspectives, allowing for the potential identification of a number of channels through which military spending impacts economic growth. Recent empirical work has been focused on some exogenous or endogenous form of the neoclassical growth model to provide a consistent and flexible framework for the analysis of military spending growth relation (Dunne et al, 2005). These will inevitably focus on particular aspects of the growth process and may miss indirect complexities, such as the effect of geopolitics, conflict, natural resources, net recipients of aid and trade openness.

Research within the military spending and growth literature was started by the contributions of Benoit (1973, 1978) where he surprised development economists by presenting positive cross-country association between military expenditure and economic growth in less developed countries (LDCs). This has stimulated a great deal of research activity and an impressive build-up of literature that has tended not to support Benoit's initial findings. The effects of military spending on growth is often divided among two camps; one camp views military spending as necessary for the guarantee of peace, security and social welfare, while the second camp believes such spending as a wasteful enterprise that influences the economy beyond the resources it consumes, especially when it leads to or facilitates conflict. Although the effects of military spending have been debated for over forty years, the answer almost always remains an empirical one. Irrespective of which perspective one takes or which camp one is in, the topic of military expenditure is, most definitely, nontrivial; often leading to important economic consequences for both the developing and developed countries.

Studies that find a positive impact of military spending upon economic growth include Fredericksen and Looney (1982); Murdoch *et al* (1997); Aizenman and Glick (2006) and Yildirim, Ocal and Keskin (2011). Conversely, other studies such as Smith (1980); Dunne *et al* (2001) and Mylondis (2008) finds defence spending to exert a negative impact on growth. Additionally, other studies find that the relationship between military spending and economic growth may be mixed (e.g. Deger and Smith, 1983; Chowdhury, 1991) or non-existent (e.g. Landau, 1986; Huang and Mintz, 1990). Moreover, surveys of the existing literature by Ram (1995), Dunne (1996) and Smith (2000) did not point towards any robust empirical relationship, positive or negative, though Smith did indicate that there was the possibility of finding a small negative effect in the long-run, however, more sophisticated techniques would be required to uncover such a relationship.

What is clear regarding past research is the inconclusiveness on the economic effects of military spending, though more recent studies have begun to show more consistent support for a negative impact of military spending on economic growth. Dunne and Tian (2013a) surveyed 168 studies[1] on the economic effects of military expenditure and revealed that by

[1]This study extends and updates an earlier survey by Dunne and Uye (2009) which covered 102 studies.

splitting the studies into ones that used predominantly Cold War period data and those with more equal or predominantly post-Cold War data, almost 53% of post-Cold War cross-country studies find military expenditure to exert a negative impact, compared to 38 percent for the Cold-War data period. The recent rise in the popularity of cross-country studies has also led to increasing concerns over group heterogeneity, endogeneity and non-linearity. These include Smaldone (2006) who suggested that differences in results for countries within Africa were due to the experience of conflict, Yakovlev (2007) who considered non-linearities, Looney and McNab (2007) who considered economic freedom and governance, Dunne and Tian (2013b) who allowed for non-linearity and group heterogeneity and d'Agostino, Dunne and Pieroni (2013) who account for endogeneity.

In focusing on conflict experience and geography, a number of studies have found Africa to be uniquely different from the rest of the world. Currently, Africa contains a significant portion of the world's most underdeveloped economies, while nearly a third of its countries have experienced active civil wars or conflicts (Blattman and Miguel, 2010). Additionally, Africa experienced average growth rate of GDP per capita, over the period 1990-2005, of only 2.05%, the slowest of any continent. Moreover, Ahmed (2012) found the region boasts the lowest adult literacy rates, human poverty index scores and socio-economic developments, while defence spending was often prioritised over sectors such as education and health. Given these facts, it seems critical to investigate the effect a cut in military spending will have on not on the economy but also the civil sector.

Natural resource endowment has been investigated as having an impact and can be considered a good candidate for a factor that might indirectly influence the relation between military spending and economic growth. Similar to the greed and grievance argument put forward by Collier and Hoeffler (2004), where rebellions or civil wars are motivated by greed, primary commodity exports can substantially increase conflict risk. They argue that in the presence of abundance in natural resources, opportunities may arise through extortion and looting of profits, thus making conflict or rebellion feasible or perhaps even attractive. Recent analysis, from a conflict perspective, by Berdal and Keen (1997) suggest that the incentive structure for rebellions or civil wars have changed from the political insurrections of the Cold-War era to a more explicit economic agenda.In the post-Cold War period,"wars" are no longer seen as anti-Colonial or ideological and as a result have increasingly become economics orientated. Rebels are finding it much harder to acquire assistance from the outside and thus resorting to living off the land and looting valuable resources (Keen, 1998). Other research, from the growth literature, provides similar hypotheses, Sarr *et al* (2011) explains that in a resource rich country, an unchecked ruler can use the abundance of natural resources as collateral and facilitate the acquisition of loans for self-benefit and loot the economy. Looting can then lead to political instability and hence diminished growth. It certainly seems reasonable to suggest that countries that are natural resource abundant may differ in their relation between conflict, military spending and economic growth.

Another potential important variable to consider is foreign aid. In the conflict literature Collier and Hoeffler (2006) identify diaspora and their impact on conflict through the flows

of funds that can support insurrection. In the growth literature, recent developments have considered the impact of foreign aid on developing countries; however, there remains no consensus. Burnside & Dollar (2000) found that aid has a beneficial impact on growth in developing countries with sound policies (fiscal, monetary and trade) and no impact in the presence of poor policies. On the other hand, Easterly, Levine & Roodman (2004) and Hansen & Tarp (2000) rebut Burnside & Dollar (2000)'s claim and find that aid works for countries with poor policies. While there is no consensus regarding the impact of aid on growth, it is recognised that aid fungibility can result in discretionary spending in the form of military expenditure. Thus it is reasonable to suppose that the impact of military spending may differ between countries that are net aid recipients and those that are non-recipients.

Geography can be seen as another source of heterogeneity. As Bloom and Sachs (1998) and earlier assessment shows, Africa is considered as significantly different from other geographical locations such as Europe, Western Offshoots, Latin America and Asia. While these geographical differences could be the result of exogenous consequences such as climate, soil, topography and disease ecology; the main concern within this paper is to consider heterogeneity and thus the stratification of geography – by continents – is sensible in identifying differences in the military spending growth relation.

Following globalisation and trade liberalisation, the issue of trade openness and its impact on economic growth has become a significant topic of research within the growth literature. While there remains no consensus – Edwards (1998), Frankel and Romer (1999) and Dollar and Kraay (2004) finding trade openness to have a positive impact on growth; Rodriguez and Rodrik (2000) and Yanikkaya (2002) found a negative relation – regarding the effects of trade openness on economic growth there has been recent developments in the literature of trade, military spending and conflict.The literature involving trade and conflict include Polachek (2007) who found that countries that trade are less likely to engage in "war". In addition, involvement in the arms trade can impact upon economic growth for a given level of military expenditure (Yakovlev, 2007). In 2012, 7 of the top 10 suppliers of arms in the world (USA, Russia, China, Germany, France, UK and Italy) are also within the list of top 10 military spenders. Since the majority of the world's economies are net arms importers, a more open economy could represent greater arms imports than an equivalent closed economy, thus representing an opportunity cost to development.

Following from these contributions this paper estimates a growth model for the sample of 104 countries, stratified into various sub-samples in order to compare the results across conflict experience, natural resource abundance, net recipients of aid,geography and trade openness; with a particular focus on investigating the differences between Africa and the rest of the world.

MODELLING MILITARY SPENDING AND GROWTH

Due to the theoretical and empirical deficiencies of the Feder-Ram model, the empirical analysis used in this paper follows from the model developed by Dunne *et al* (2005), whereby

the effect of military spending on economic growth is based on the augmented Solow growth model with Harrod-neutral technological progress. Similar to that of Knight *et al* (1996), military spending, measured as a share of GDP (*m*=M/Y), is assumed to affect factor productivity via a level effect on the efficiency parameter, which controls Harrod-neutral technical change.Putting it differently, a permanent change in *m* does not affect the long-run steady-state growth rate, but has the potential to have a permanent effect on per capita income along the steady-state growth path. The share of military spending can also affect the transitory growth rates along the path to the new steady-state equilibrium. To see this, consider an augmented Solow growth model with an aggregate Neoclassical Cobb-Douglas production function featuring Harrod-neutral technological progress.

1. $$Y(t) = K(t)^{\alpha}[A(t)L(t)]^{1-\alpha}$$

where α ∈ [0,1], and *t* denotes time. *Y* denotes aggregate real income, *K* is the real capital stock, *L* is labour and *A* is the technology parameter evolving according to:

2. $$A(t) = A_0 e^{gt} m(t)^{\theta}$$

where *g* is the exogenous rate of Harrod-neutral technical change and *m* is the share of military expenditure in total output (GDP). The production function is seen to exhibit constant returns to scale in its two factors: physical capital (*K*) and productivity augmented labour (*AL*). Together with the standard Solow model assumptions of perfectly competitive inputs and outputs, exogenous savings rate *s,* constant labour force growth rate *n,* and constant depreciation δ, one can display the dynamics of physical capital accumulation by:

3. $$\dot{k}_e(t) = s_K k_e^{\alpha}(t) - [n + g + \delta]\dot{k}_e \Leftrightarrow \frac{\partial lnk_e}{\partial t} = se^{(\alpha-1)lnk_e} - (n + g + \delta)$$

where$k_e = \frac{K}{AL}$ denotes the effective capital-labour ratio and α is the constant capital-output elasticity. The steady-state level of k_e is:

4. $$\tilde{k}_e^* = \left[\frac{s}{n+g+\delta}\right]^{1/(1-\alpha)}$$

where the asterisk denotes the steady-state value of the variable. Having found the steady-state level of K, it is now possible to solve for the steady-state value of output. Linearising (3) via a truncated Taylor series expansion around the steady-state[2] and substituting (4), the result is:

5. $$\frac{\partial lnk_e}{\partial t} = (\alpha - 1)(n + g + \delta)[lnk_e(t) - lnk_e^*]$$

[2]Re-writing (3) in the form $\frac{du}{dt} = f(u), u = lnk_e$, the linearised form is $f(u^*) + f'(u^*)[u(t) - u^*]$

and since $lny_e = ln\frac{Y}{AL} = \alpha lnk_e$, then one can approximate the transitory dynamics of income per effective worker around the steady-state as:

6. $$\frac{\partial lny_e}{\partial t} = (\alpha - 1)(n + g + \delta)[lny_e(t) - lny_e^*]$$

where the steady-state level of output per effective worker is:

7. $$y_e^* = \left[\frac{s}{n+g+\delta}\right]^{\alpha/(1-\alpha)}$$

Equation (6) estimates the transitory dynamics of output per effective worker in the neighbourhood of the steady-state. Following Dunne *et al* (2005), in order to operationalise (6) for empirical estimation, it is intergrated forward from *t*-1 to *t,* giving:

8. $$lny_e(t) = e^z lny(t-1) + (1 - e^z)lny_e^*,\ z = (\alpha - 1)(n + g + \delta)$$

Now, using equations (2), (7) and (8), per capita income (y=*Y*/L) can be written in the form:

9. $$lny(t) = e^z lny(t-1) + (1 - e^z) * \left\{lnA_0 + \frac{\alpha}{1-\alpha[lns - \ln(n+g+\delta)]}\right\} + \theta lnm(t) - e^z\theta lnm(t-1) + (t - (t-1)e^z)g$$

Where z is still equivalent to (α-1)$(n + g + \delta)$, while θ is the elasticity of steady-state income with respect to the long-run military expenditure share. Equation (9) is conceptual and can be adapted to provide the basis for empirical analysis, Dunne *et al* (2005) suggest that the dynamic panel specification can now be written in the form:

10.

$$lny_{i,t}, = \gamma lny_{i,t-1} + \sum_{j=1}^{3} \beta_j\, lnx_{j,i,t} + \sum_{k=1}^{2} \alpha_k\, lnz_{k,i,t-1} + \eta_t + \mu_i + \upsilon_{i,t}\ \ ; i = 1,2,\dots,N\ ; t = 1,2,\dots,T$$

where $x_1 = s =$ gross investment/GDP; $x_2 = (n + g + \delta)$ = labour force growth rate plus $(g + \delta)$, which is a constant, assumed to be equal to 0.05[3]; and $x_3 = m_{i,t}$ which is equal to military spending as a share of GDP. The variables, $z_1 = m_{i,t-1}$ and $z_2 = s_{i,t-1}$ which is the lagged variable of military spending and gross investment as a share of GDP respectively. The variable n_t reflects the time specific effects, μ_i represents group specific effects and $\upsilon_{i,t}$ is the error term. This paper also follows from Knight *et al* (1996) and Islam (1995) in

[3]The assumption that (g+δ)=0.05 follows from Mankiw et al (1992); whereby they chose values to match available data. By using U.S data on capital consumption allowance and captial-output ratio a value of 0.03 was obtained for δ, this number was supported by Romer (1989) where he used a broader sample of countries and found δ to be between 0.03 and 0.04. Mankiw et al (1992) also found that growth in per capita income averaged 1.7 percent per year for the U.S and 2.2 percent per year for their intermediate group of countries, suggesting that a g of 0.02 is a reasonable assumption.

treating s and n as variant across countries and time, while taking $g$and δ to be uniform time-invariant constants and exogenous across time and country.

DATA DESCRIPTION

All the Solow-style regressions estimated within this paper are based on the same balanced panel, comprising of 104 countries covering the period 1988-2010. This includes all countries that had a maximum of three missing observations for the military spending variable. The two main variables of concern, real GDP per capita (growth) and military expenditure as a share of GDP are obtained from the World Bank and SIPRI respectively. Unlike Islam (1995) or Yakovlev (2007), this paper does not use five year averages of GDP per capita; the motivation being that business cycles effects are integral and form part of the long-run determinants of growth.The variable gross fixed capital formation as a share of GDP was taken from the World Bank's World Development Indicators (WDI) database. Due to difficulties obtaining reliable data for the average growth rate of the working-age population, the common alternative of population growth is used.

Classification of countries into different income groupings are taken from the WDI, where economies are divided into income groups according to 2010's gross national income (GNI) per capita[4]. In order to homogenise the sample size for the different income groupings, the low and low-middle income countries were combined to form low-income. High-middle income countries are now defined as middle-income, while the definition of high-income countries has been left unchanged. The conflict indicator was constructed using the Uppsala Conflict Data Program and International Peace Research Institute Oslo (UCDP/PRIO) database. As is common within the literature, conflict is defined as having at least 25 combat-related deaths per year, but a cumulative battle death of over 1,000 throughout the duration of the conflict is also considered. A country is given a numerical value of one if it has experienced a conflict between the periods 1988-2010 or zero otherwise. In addition, a civil war variable was created. The construction of the variable follows identically from the conflict variable but also considers the location of the conflict.

Natural resource abundance is measured by using natural resource dependence, a commonly used proxy. Natural resource dependence is measured as the ratio of mineral exports to total exports. A country is classified as mineral dependent if mineral exports constitute more than 25 percent of a country's total exports, a definition that is consistent with the IMF's definition of export dependence. Data on natural resource dependence is obtained using data from Hagland (2011) and UNCTADstat. Here, the focus is on the six types of fuel and non-fuel minerals defined by the Standard International Trade Classification (SITC) codes shown in Table 1.

The natural resource indicator is divided into three variables, each variable is allocated a value of one or zero. The first variable (*comnat*) characterises where a country is natural resource dependent via a combination of fuel and non-fuel minerals. The second variable

[4]The groups are: low-income, $1005 or less; lower-middle income, $1006-3975; upper-middle income, $3976-12275; and high-income, $12276 or more.

(*fuel*) indicates whether a country is fuel dependent, while the third variable (*non-fuel*) records countries that are non-fuel mineral dependent. The mineral dependence variable (where mineral exports constitute at least 25 percent of total exports) is calculated on 2010 data. While there exists data for the years 1996 and 2005, it seems reasonable to use only 2010 data given the variable is unlikely to show much variation over time.

Table 1: Types of minerals as classified by SITC codes

SITC code and description	
SITC 27: Crude fertilizers, other than those of division 56, and crude minerals (excluding coal, petroleum and precious metals)	Non-fuel minerals
SITC 28: Metalliferous ores and metal scrap	
SITC 68: Non-ferrous metals	
SITC 667: Pearls and semi-precious stones	
SITC 971: Gold, non-monetary	
SITC 3: Mineral fuels (including natural gas), lubricants and related materials.	Fuel

Data on net aid recipient (*Aid*) is taken from the World Bank's WDI. The sample is first divided into countries which are net recipients of aid and those which aren't. As the net recipients of aid is measured as a share of GDP, any country that on average received less than 0.01 percent of aid as a share of GDP was considered as non-aid recipients. Aid recipients are then divided into countries that receive low (less than 1% of GDP), medium (between 1% and 3% of GDP) and high amounts of aid (greater than 3% of GDP).

As mentioned earlier, the geography variable is categorised to the continents with the exception of the Middle East countries. Openness is calculated by taking the sum of a country's imports and exports and dividing that its GDP[5]. A country is defined as open if its share of imports and exports to GDP is higher than, the similarly calculated, world average and vice versa for a closed economy. As with the other variables, trade openness (*trade*) takes on the value of one for open or zero for closed. The imports, exports and GDP figures are all recorded in constant US dollars, while GDP figures have also been deflated using Purchasing Power Parity (PPP). Due to missing observations we were unable to take the sample average of a 23 year period or the initial period (1988). Thus we have chosen two arbitrary years in our time-series data, namely 2000 and 2009 to identify for changes in openness[6].

Table 2 below provides a summary of the final data set containing 104 countries over a twenty-three year period. The sample includes 28 developed countries, 76 developing

[5]Written as $(X_{i,j} + M_{i,j})/Y_{i,j}$, where*i*and *j* refer to country and year respectively, while X is exports, M is imports and Y is GDP.

[6]The full sample is divided into 79 open and 25 closed countries for the year 2000 and 78 open and 26 closed countries for the year 2009. During the 10 year period countries such as Uganda and China moved from closed to open while others such as France and Greece moved the opposite direction.

countries, 29 African countries, 20 Asian and Oceania countries, 26 European countries, 21 North and South American and 10 Middle East countries[7].

Table 2: Variable Description and Summary Statistics

Variable Name	Variable Description	Mean	Std. Dev.
y	Real per capita GDP	12157	12718
m	Military expenditure as share of GDP	2.74	3.73
k	Gross fixed capital formation as share of GDP	21.28	6.57
ly	Natural log of real per capita GDP	8.73	1.29
lm	Natural log of military expenditure as share of GDP	0.71	0.75
lk	Natural log of gross fixed capital formation as share of GDP	3.02	0.30
ly1	Lagged natural log of real per capita GDP	8.73	1.30
lm1	Lagged Natural log of military expenditure as share of GDP	0.72	0.75
lk1	Lagged Natural log of gross fixed capital formation as share of GDP	3.02	0.30
cly	Growth rate of real per capital GDP (log)	0.02	0.05
clm	Growth rate of military expenditure as share of GDP (log)	-0.02	0.20
clk	Growth rate of fixed capital formation as share of GDP (log)	0.00	0.15
lngdpop	Population growth rate *(clpop)*+0.05 (assumed value for g+d) used in Solow-style regressions	-2.74	0.18
cont	Continent indicator (1=Africa, 2=N&S. America, 3=Asia & Oceania, 4=Europe, 5=Middle East	2.71	1.35
inc	Income indicator (1=Low income, 2=Middle income, 3=High income)	1.93	0.84
conflict	Conflict indicator (1=Conflict, 0=No conflict)	0.37	0.48
civilwar	Civil war indicator (1=Civil war, 0=No civil war)	0.32	0.47
intwar	Interstate war indicator (1=Interstate war, 0=No interstate war)	0.11	0.31
aid	Aid Indicator (1=Net recipient of aid, 0=Non-net recipient of aid)	0.63	0.48
aid2	Aid Indicator (0=Non-net recipient of aid, 1=Low aid, 2=Medium aid, 3=High aid)	1.39	1.28
fuel	Fuel dependent countries (1=fuel dependent, 0=non-dependent)	0.17	0.38
nonfuel	Non-fuel mineral dependent countries (1=dependent, 0=non-dependent)	0.18	0.39
nat	Aggregate natural resource dependence (inc fuel and non-fuel) (1=dependent, 0=non-dependent)	0.35	0.47
comnat[8]	Combined fuel and non-fuel natural resource dependence. (1=dependent, 0=non-dependent)	0.41	0.49
open00	Openness indicator (1=open, 0=not open) in 2000	0.76	0.43
open09	Openness indicator (1=open, 0=not open) in 2009	0.75	0.43

[7]A list of countries featured in the sample can be found in tableA1 in the appendix.

[8]Refer to footnote 9 and 11 for the difference between the variable *nat*and *comnat.*

EMPIRICAL ANALYSIS

In undertaking empirical analysis of military spending and economic growth, a problem worth noting is that in developing countries, military burden as a share of GDP is relatively small compared to other components of the economy (i.e. healthcare or education) and as a result greatly diminishes the ability to find a statistically significant relationship between military spending and growth, when there are other, larger, influences. In such scenarios, apart from when countries are engaged in conflict, one might not expect to find significant impacts on the military spending growth relation. Another important problem has been poor data quality and the lack of exogenous variation within the data. However, since the end of the Cold War, data quality and leverage has improved and developments of novel techniques have helped overcome the lack of exogenous variation in the data Dunne et al (2002); Dunne *et al* (2004)). Panel data methods such as simple fixed effects, random effects and random coefficient estimators have been increasingly used; and as longer time-series data becomes available dynamic specifications have been introduced into panel data methods (Smith & Dunne, 2002). This has raised a number of issues, as in the following example of a simple bivariate dynamic model:

11. $y_{it} = \alpha_i + \beta\, x_{jt-1} + \lambda\, y_{jt-1} + u_{it}\,;\; i = 1,2,\ldots,N;\; t = 1,2,\ldots,T$

In equation (11)'s dynamic form, the fixed effects estimator is inefficient due to lagged dependent variable ($y_{i,t-1}$) bias, which biases the OLS estimator β, coefficient of ($x_{i,t-1}$), downwards. Moreover, it is also inconsistent as *N* (number of groups) tends towards infinity for fixed *T* (years). It is, however, consistent as *T* tends to infinity where *T* is large the bias is relatively small[9]. There is further heterogeneity bias when the parameters differ over the groups, and in the case of positive serial correlation in the independent variables, the resultant heterogeneity bias will bias the estimates of λ upwards. Yet, this bias can be dealt with by estimating each equation individually and taking an average of the individual estimates (Pesaran and Smith, 1995).

Since the data available is not long enough to employ large-N and large-T methods a dynamic model is specified and fixed effects is used to estimate it. For the long-run estimates, the overall biases is trivial since the estimates of β (downwards) and λ (upwards) work in opposite directions, making each other obsolete (Dunne et al, 2002). The estimated general first-order dynamic model takes the form of:

[9] *T* in this case is 23 years (1988-2010) and can be considered large enough for the resultant bias to be seen as inconsequential.

12.

$$lny_{i,t}, = \gamma lny_{i,t-1} + \sum_{j=1}^{3} \beta_j \, lnx_{j,i,t} + \sum_{k=1}^{2} \alpha_k \, lnz_{k,i,t-1} + \eta_t + \mu_i + \upsilon_{i,t} \;\; ; i = 1,2, \dots, N \;\; ; t = 1,2, \dots, T$$

where *y* is GDP per capita*;* $x_1$is gross investment/GDP; x_2 is military spending/GDP; x_3 is the labour force growth rate or *(n+g+δ)*. The re-parameterised general first order dynamic model has all variables are in log form; with *c* representing the change in the independent and dependent variables (i.e. *cly* = change in per capita GDP) and *ly1, lk1* and *lm1* representing the lagged level of per capita GDP, gross investment as a share of GDP and share of military spending to GDP respectively. The results of the full sample are reported in Table 3, Column 1.

The empirical results of the full sample show a very well-defined empirical model; all the traditional growth models, consistent with Solow (1956) and Mankiw*et al* (1992) are statistically significant with signs as expected. The change in log of capital or gross investment as a share of GDP (*clk*) is positive and significant; indicating that for the full sample of countries, the higher the investment, the richer the country. The variable log of population growth rate plus 0.05 (*lngdpop*) is negative and significant, supporting the theory of conditional convergence. The two most important variables within the regressions below are the two military expenditure variables *clm* and *lm1*. The change in log of military expenditure (*clm*) measures the short-run relationship between military expenditure and growth, while the lagged level term (*lm1*) measures the long-run effect. Estimation results from Table 3, Column 1, clearly show a negative relationship (short and long-run) between military expenditure and economic growth[10]. A result which is consistent with recent cross-country studies (Dunne and Tian, 2013).

Considering possible heterogeneity in the sample, Table 3 also provides estimation results for African and non-African countries, in Columns 2 and 3 respectively. The results from the group of non-African countries are consistent with those of the overall sample, with all growth variables significant and of the expected sign and the two military spending variables are negative and significant at the one percent significance level. For the Africa group of 28 countries, the results are less impressive with the change in log of capital and population growth rate plus 0.05 insignificant, though this seems a common feature in Africa growth regressions. While the growth variables of the African group did not perform well, the military burden variables are still significant and negative, interestingly, the coefficients for the African group are considerably larger than that of the non-African group.

[10]Unit root tests were performed using both the Im et al (2003) and Fisher-Dickey Fuller method; the results suggest no unit root for lm, cly and clm, while, as expected, GDP (y) does exhibit unit root.

Table 3: The Growth Effects of Military Expenditures in the Solow Growth Model

	(1)	(2)	(3)
Sample	All Countries	Africa	Non-Africa
Variables	cly	cly	cly
clk	0.0554***	-0.0171	0.143***
	(8.53)	(-1.54)	(17.64)
clm	**-0.0280*** **	**-0.0364*** **	**-0.0209*** **
	(-5.69)	(-3.42)	(-4.18)
lngdpop	-0.0542***	-0.0271	-0.0861***
	(-6.09)	(-1.30)	(-8.60)
ly1	-0.0917***	-0.119***	-0.0799***
	(-12.16)	(-7.28)	(-9.46)
lk1	0.0273***	-0.0040	0.0468***
	(5.63)	(-0.43)	(8.19)
lm1	**-0.0170*** **	**-0.0293*** **	**-0.0114*** **
	(-4.81)	(-3.79)	(-3.13)
year	0.00199***	0.0034***	0.0015***
	(9.01)	(7.56)	(6.08)
Constant	-3.369***	-5.981***	-2.686***
	(-8.5)	(-7.14)	(-5.99)
Observations	2,148	575	1573
Number of id	104	28	76
R-squared	0.127	0.152	0.241

Dependent variable: Growth rate of real per capita GDP *(cly)*
t-ratios in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As Dunne (2012) and Pieroni (2007) argue, the effect of military expenditure may well be very different for countries with different income levels, suggesting a non-linear relation. To consider such differences, the African and non-African sample was stratified into different income groups, giving the results in Table 4. Since no African country is classified as high income, Table 4 only shows stratifications for low and middle-income countries. The empirical growth model is generally well specified across the groups. The disaggregation of the sample into low and middle income countries shows clear differences between African and non-African countries. For the low-income non-African group, the coefficient on military burden are only significant at the 5 percent level for the long-run, while, for African countries, military spending is seen to have a negative impact on growth (short and long-run) at the 1 percent level. Again the coefficients for the African group are larger than those for the non-African group. The non-African middle-income countries have significant coefficients estimates for the short-run military spending variable, but not in the long-run, while the military spending estimates for the African middle-income group is generally insignificant. It must be noted that there are insufficient observations to make comparison worthwhile.

Table 4: The Growth Effects of Military Expenditure, Stratifying for Income

	(1)	(2)	(3)	(4)
Sample	Low Africa	Low Non-Africa	Middle Africa	Middle Non-Africa
Variables	cly	cly	cly	cly
clk	-0.0243*	0.0878***	0.0280	0.183***
	(-1.83)	(5.84)	(1.62)	(12.89)
clm	**-0.0406*** **	**-0.0167***	**-0.0211**	**-0.0262*** **
	(-3.17)	(-1.66)	(-1.38)	(-2.70)
lngdpop	-0.0270	-0.0693*	-0.0383	-0.00745
	(-1.38)	(-1.89)	(-1.14)	(-0.29)
ly1	-0.120***	-0.0772***	-0.131***	-0.0873***
	(-6.18)	(-4.49)	(-4.56)	(-6.01)
lk1	-0.00750	0.0608***	0.0142	0.0431***
	(-0.69)	(5.15)	(0.79)	(4.48)
lm1	**-0.0410*** **	**-0.0135** **	**0.00923**	**-0.0122***
	(-4.22)	(-2.12)	(1.01)	(-1.78)
year	0.0037***	0.0016***	0.0032***	0.0031***
	(6.69)	(2.99)	(3.95)	(6.17)
Constant	-6.484***	-2.876***	-5.449***	-5.542***
	(-6.33)	(-3.06)	(-3.87)	(-6.22)
Observations	425	396	150	482
Number of id	21	19	7	24
R-squared	0.174	0.168	0.193	0.344

Dependent variable: Growth rate of real per capita GDP *(cly)*
t-ratios in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As mentioned earlier, geopolitical heterogeneity may indeed impact a country's military spending growth relation and thus Table 5 provides estimation results stratified by geographical location. In order to homogenise the sample size, the continents of North and South America were combined to form "Americas"; countries in the Oceania region were grouped with Asia; while the Middle East was separated from the full sample due to its unique historical and geopolitical characteristics. As Table 5 shows, there are significant differences in the effect of military spending on growth between African subcontinent and the other continents. The negative effects of military spending on growth (short and long-run) experienced in Africa was only mimicked by the Middle East (Table 5, Column 5), in the short-run, and Europe (Table 5, Column 4) in both the short and long-run. The estimation results for Europe are not surprising since military spending as a percentage of GDP has been steadily declining while per capita GDP growth is increasing. As for Asia and Americas, military burden has no significant impact on economic growth, an interesting result that

potentially could be driven by growth drivers[11] within both regions. While Africa is seen to exhibit different sets of results as compared to the rest of the world, this could indirectly be due to other heterogeneous effects such as conflict, natural resource abundance, aid or openness; issues that are considered below.

Table 5: The Growth Effects of Military Expenditure. Stratifying for Geographical Location

	(1)	(2)	(3)	(4)	(5)
Sample	Africa	Americas	Asia	Europe	Middle East
Variables	cly	cly	cly	cly	cly
clk	-0.0171	0.1887***	0.0892***	0.2158***	0.0674***
	(-1.54)	(13.25)	(6.18)	(14.61)	(3.06)
clm	**-0.0364*** **	**-0.0114**	**-0.0137***	**-0.0346*** **	**-0.0794*** **
	(-3.42)	(-1.53)	(-1.76)	(-2.64)	(-3.85)
lngdpop	-0.0217	-0.1088**	-0.0901***	-0.0500**	-0.0849***
	(-1.30)	(-2.23)	(-3.69)	(-2.56)	(-5.03)
ly1	-0.1192***	-0.0965***	-0.0484***	-0.1155***	-0.2799***
	(-7.28)	(-4.98)	(-3.89)	(-7.00)	(-7.49)
lk1	-0.0040	0.0416***	0.0437***	0.0795***	0.0196
	(-0.43)	(3.94)	(4.63)	(7.10)	(1.14)
lm1	**-0.0293*** **	**-0.0079**	**-0.0090**	**-0.0221*** **	**-0.0054**
	(-3.79)	(-1.56)	(-1.30)	(-2.72)	(-0.34)
year	0.0034***	0.0014***	0.0011**	0.0020***	0.0052***
	(7.56)	(2.91)	(2.22)	(3.98)	(5.54)
Constant	-5.891***	-2.418***	-2.094**	-3.192***	-8.081***
	(-7.14)	(-2.99)	(-2.36)	(-3.57)	(-4.91)
Observations	575	396	426	559	192
Number of id	28	20	20	26	10
R-squared	0.152	0.379	0.142	0.367	0.360

Dependent variable: Growth rate of real per capita GDP *(cly)*
t-ratios in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Previous studies, particularly in Africa, have found differences in the military spending growth relation for countries in conflict and those not (Dunne, 2012), but the results here support this assertion. Stratifying into African (14) and non-African (24) countries that have experienced conflict and those that have not (14 and 52 respectively) gave the results in Table 6. Military spending seems to have a significant negative effects on growth in the short and long-run for both the African and non-African countries[12]. Looking at the no conflict groups, military spending is negative and significant in the short and long-run for the non-African sample, but, this is not the case for the 14 African countries.

[11]For example, China, India or the Asean 5 for Asia and Brazil or Chile for the Americas, where per capita GDP and military spending are both increasing.
[12]Albeit only at the 10 percent significance level for long-run conflict experience non-African countries.

To allow for the possibility that the type of conflict may be relevant, column 5 and 6 of Table 6 also reports results for countries that experienced civil conflicts. Due to the limited number of observations, the interstate conflict group could not be included in empirical analysis, thus only experience of civil conflicts is considered. This gives a total of 33 countries, of which 13 are African and 20 are non-African.The estimation results are in fact consistent with those for conflict overall, with significant negative short and long-run effects of military burden for African countries and only a negative and significant short-run effect for non-African countries.

Table 6: The Growth Effects of Military Expenditure, Stratifying for Conflict

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	Conflict Africa	Conflict Non-Africa	No Conflict Africa	No Conflict Non-Africa	Civil War Africa	Civil War Non-Africa
Variables	cly	cly	cly	cly	cly	cly
clk	0.0010	0.162***	-0.0532***	0.136***	0.0001	0.193***
	(0.07)	(10.19)	(-2.80)	(14.35)	(0.01)	(11.45)
clm	**-0.0363*** **	**-0.0223*** **	**-0.0318* **	**-0.0225*** **	**-0.0358*** **	**-0.0209** **
	(-2.90)	(-2.76)	(-1.67)	(-3.52)	(-2.75)	(-2.57)
lngdpop	-0.0315*	-0.0815***	0.00611	-0.0836***	-0.0308*	-0.0520
	(-1.78)	(-3.06)	(0.15)	(-7.46)	(-1.68)	(-1.56)
ly1	-0.132***	-0.118***	-0.112***	-0.0679***	-0.129***	-0.0980***
	(-6.08)	(-6.92)	(-4.14)	(-6.93)	(-5.56)	(-5.52)
lk1	0.0104	0.0621***	-0.0301*	0.0414***	0.0103	0.0620***
	(0.84)	(5.17)	(-1.90)	(6.23)	(0.79)	(5.05)
lm1	**-0.0360*** **	**-0.00935* **	**-0.00885**	**-0.0174*** **	**-0.0349*** **	**-0.00829**
	(-3.90)	(-1.83)	(-0.63)	(-3.24)	(-3.62)	(-1.59)
year	0.00388***	0.00276***	0.00315***	0.00095***	0.00388***	0.00275***
	(6.93)	(5.82)	(3.86)	(2.95)	(6.24)	(5.16)
Constant	-6.869***	-4.892***	-5.306***	-1.579***	-6.887***	-4.994***
	(-6.46)	(-5.95)	(-3.68)	(-2.72)	(-5.85)	(-5.38)
Observations	283	490	292	1,083	261	413
Number of id	14	24	14	52	13	20
R-squared	0.257	0.264	0.089	0.240	0.239	0.314

Dependent variable: Growth rate of real per capita GDP *(cly)*
t-ratios in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Resource rich countries tend to have higher military spending than non-resource rich countries, allocating on average 3.4 percent of the GDP to military expenditure compared to the 2.3 percent of non-resource rich countries. To investigate the effect of this heterogeneity, the UNCTADstat database was used to divide the sample, giving 43 resourceabundant and 61

non-resource abundant countries[13].Of the 28 Africa countries, 15 are classified as resource abundant, while the remaining 13 are seen as non-resource abundant. As Table 7 shows, there are indeed differences between the results for the African and non-African group, with military burden having no significant effect on growth for resource abundant non-African countries, but a negative and significant effect (short and long-run) for the African group. This result is reversed for the non-resource abundant countries. Military spending for the African group is seen to have no short-run impact on growth but there exists a negative and significant long-run impact. As for the non-African group, military expenditure hinders growth for both the short and long-run.

Table 7: The Growth Effects of Military Expenditure, Stratifying for Natural Resource

	(1)	(2)	(3)	(4)
	Natural Resource	Natural Resource	No Resource	No Resource
	Africa	Non-Africa	Africa	Non-Africa
Variables	cly	cly	cly	cly
clk	-0.0171	0.115***	-0.0163	0.174***
	(-1.30)	(8.88)	(-0.83)	(16.47)
clm	**-0.0372*** **	**-0.0138**	**-0.0319**	**-0.0247*** **
	(-3.17)	**(-1.50)**	**(-1.60)**	**(-4.21)**
lngdpop	-0.0287*	-0.0849***	-0.0238	-0.0894***
	(-1.74)	(-5.41)	(-0.58)	(-6.66)
ly1	-0.169***	-0.109***	-0.0914***	-0.0596***
	(-7.17)	(-6.72)	(-3.91)	(-6.17)
lk1	-0.01	0.0543***	0.00155	0.0394***
	(-0.77)	(5.30)	(0.11)	(5.67)
lm1	**-0.0312*** **	**-0.00991**	**-0.0301** **	**-0.0137*** **
	(-3.40)	(-1.58)	(-2.33)	(-3.01)
year	0.00471***	0.00233***	0.00236***	0.000919***
	(8.16)	(5.41)	(3.23)	(2.95)
Constant	-8.156***	-4.036***	-4.060***	-1.624***
	(-7.82)	(-5.34)	(-3.02)	(-2.91)
Observations	301	563	274	1,010
Number of id	15	28	13	48
R-squared	0.255	0.223	0.092	0.279

Dependent variable: Growth rate of real per capita GDP *(cly)*
t-ratios in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Interestingly, the coefficients for the non-African group suggest that even though, on average, natural resource abundant countries spend more on military than non-natural resource

[13]It should be noted that within some natural resource abundant countries (Table 7, Column 1) no one type of mineral export constitutes more than 25% of total exports, but, the combination of all mineral exports exceeds the 25% threshold.

abundant countries, there is no negative effect for the resource abundant countries. This could mean that resource abundance for non-African countries makes military burden more affordable. However, the same could not be said for the African countries. A potential explanation for this finding would relate to the different ways natural resource income is used. For African countries, this additional income could be used to fund civil wars, a feature that generally does not exist in non-African countries.

Moving to consider the possible impact of aid, Table 8 shows the results for countries that receive aid and those that do not while also stratifying those that receive aid into African and non-African countries. Due to the classification of net aid recipients, all African countries are seen to receive aid and thus it is impossible to compare the effects of military spending for the non-aid recipient group. Although this is clearly an issue, by stratifying net recipients of aid on the full sample this paper hopes to provide some insight into the military spending growth relation with respect to countries that are either net recipients of aid or those that are not.

Table 8: The Growth Effects of Military Expenditure, Stratifying for Net Recipients of Aid

	(1)	(2)	(3)	(4)
	Aid	No Aid	Aid	Aid
	All Countries	All Countries	Africa	Non-Africa
Variables	cly	cly	cly	cly
clk	0.0300***	0.165***	-0.0171	0.126***
	(3.82)	(13.45)	(-1.54)	(11.49)
clm	**-0.0305*** **	**-0.0212*** **	**-0.0364*** **	**-0.0212*** **
	(-4.75)	(-3.02)	(-3.42)	(-2.95)
lngdpop	-0.0427***	-0.0868***	-0.0217	-0.0819***
	(-3.87)	(-5.69)	(-1.30)	(-5.89)
ly1	-0.108***	-0.0692***	-0.119***	-0.0984***
	(-10.43)	(-6.6)	(-7.28)	(-7.00)
lk1	0.0171***	0.0468***	-0.00398	0.0457***
	(2.85)	(5.35)	(-0.43)	(5.96)
lm1	**-0.0182*** **	**-0.0171** **	**-0.0293*** **	**-0.00967** **
	(-4.27)	(-2.51)	(-3.79)	(-2.13)
year	0.00270***	0.000968***	0.00339***	0.00221***
	(9.22)	(2.76)	(7.56)	(5.46)
Constant	-4.676***	-1.607**	-5.891***	-3.922***
	(-8.86)	(-2.52)	(-7.14)	(-5.51)
Observations	1,325	823	575	750
Number of id	65	39	28	37
R-squared	0.131	0.245	0.152	0.248

Dependent variable: Growth rate of real per capita GDP from 1988-2010 (cly)
t-ratios in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The estimation results from Table 8 show negative and significant short and long-run effects of military burden irrespective of whether a country receives foreign aid. This results also holds for African and non-African countries. Moreover, once stratification was done for African and non-African countries that receive low, medium and high levels of aid, the negative coefficients of military burden in the short and long-run increases in size as countries move higher up the levels of aid received.

Finally, the impact of openness is considered[14]. Table 9 presents the estimation results and shows negative and significant effects for military spending on growth in both the short andlong-run for open non-African economies.

Table 9: The Growth Effects of Military Expenditure, Stratifying for Trade Openness

Variables	(1) Open 2000 Non-Africa cly	(2) Open 2000 Africa cly	(3) Closed 2000 Non-Africa cly	(4) Closed 2000 Africa cly
clk	0.118***	-0.0309**	0.236***	0.0384*
	(12.77)	(-2.39)	(15.63)	(1.67)
clm	**-0.0244*** **	**-0.0364*** **	**-0.0123**	**-0.00669**
	(-4.05)	(-2.85)	(-1.59)	(-0.36)
lngdpop	-0.0773***	0.0327	-0.0528	-0.0558***
	(-7.27)	(1.21)	(-1.07)	(-3.27)
ly1	-0.105***	-0.108***	-0.0296**	-0.170***
	(-9.98)	(-5.13)	(-2.38)	(-6.40)
lk1	0.0428***	-0.016	0.0529***	0.0426**
	(6.61)	(-1.36)	(4.64)	(2.55)
lm1	**-0.0164*** **	**-0.0182***	**-0.00324**	**-0.0398*** **
	(-3.68)	(-1.78)	(-0.57)	(-3.90)
year	0.00178***	0.00351***	0.00120***	0.00389***
	(5.64)	(5.98)	(2.77)	(6.36)
Constant	-2.890***	-6.013***	-2.419***	-6.857***
	(-5.15)	(-5.66)	(-3.26)	(5.95)
Observations	1,202	428	371	147
Number of id	58	21	18	7
R-squared	0.23	0.129	0.441	0.406

Dependent variable: Growth rate of real per capita GDP *(cly)*
t-ratios in parentheses
*** p<0.01, ** p<0.05, * p<0.1

[14]Stratification of arms imports and exporters was considered as an alternative to using openness, since one might expect the effect of military spending to be different for a country that is a net exporter compared to a net importer. However, of the 104 country sample only 9 countries were classified as net arms exporters, thus providing insufficient observations for meaningful regression analysis.

For open African economies, military spending was negative and significant in the short-run while the long-run coefficient was only significant at the 10 percent significance level. Estimates for closed economies show military spending in non-African economies to have no effect on growth, while the negative effect is only evident in the long-run for African economies. The evidence shown in Table 9 points to a clear difference between open and closed economies as well as African and non-African countries. The mean estimate of military burden for open economies for the year 2000 is 2.8 percent, which is about 1.5 percentage point of GDP greater than the closed economies. Moreover, while non-African open economies spend more on military than closed ones[15] (a statistically significant difference), no significant difference in military burden was found between open and closed African countries for the year 2000.

CONCLUSION

Military spending by governments is indeed important in the influence it has, especially when it leads or facilitates conflict, but its impact on the economy remains subject of continuing debate. While studies include a large amount of post-Cold War data seem to be more consistently finding negative impacts of military spending on growth, there is no remains no general consensus (Dunne and Tian, 2013). This paper has made further contribution to the debate, developing and analysing a comprehensive post-Cold War balanced panel dataset for the period 1988-2010, using the modelling framework suggested by Dunne *et al* (2005). It has not only produced cross country growth equation results, but has also considered the robustness of those cross country results in the form of possible group heterogeneities and non-linearities. This paper has also been concerned with comparing the results for the African subcontinent with the rest of the world, following the suggestion of Dunne (2012), that the nature of the African polities and economies and their experience of conflict may well have influenced the role military spending plays in the economy.

Within a well specified growth model and using a dynamic first order model with fixed effects, the first finding in the paper is the surprisingly strong support for the negative impact of military burden on growth in both the short and long-run. As the summary results in Table 10 show, this result is apparent for both the African and non-African country groups, but the coefficients for the African group are considerably larger. Breaking up countries into income groups to investigate non-linearities showed some differences across the groups, with low-income African countries having higher military burden coefficients than the total African group, but the middle income African countries showing no significant effects. In contrast, the non-African countries in both groups show less significant effects than the full group.

[15]Non-African open economies spend on average 3 percent of their GDP on the military compared to 2.3 percent in non-African closed economies.

Table 10: Summary Results for Military Burden

	Africa		Non-Africa	
	clm	lm1	clm	lm1
Overall	-0.0364***	-0.0293***	-0.0209***	-0.0114***
Low-Income	-0.0406***	-0.0410***	-0.0167*	-0.0135**
Middle-Income	-0.0211	0.00923	-0.0262***	-0.0122*
Conflict	-0.0363***	-0.0360***	-0.0223***	-0.00935*
No Conflict	-0.0318*	-0.00885	-0.0225***	-0.0174***
Civil War	-0.0358***	-0.0349***	-0.0209**	-0.00829
Natural Resource	-0.0372***	-0.0312***	-0.0138	-0.00991
No Natural Resource	-0.0319	-0.0301**	-0.0247***	-0.0137***
Aid	-0.0364***	-0.0293***	-0.0212***	-0.00967**
Open	-0.0364***	-0.0182*	-0.0244***	-0.0164***
Closed	-0.00669	-0.0398***	-0.0123	-0.00324

Significance levels: *** p<0.01, ** p<0.05, * p<0.1

When the incidence of conflict was considered there were again some interesting differences across the groups. The African group that had experienced conflict showed significant negative effects of military burden on growth, but those that had no experienced conflict did not. This was in contrast to the non-African group, where the only insignificant effect was for the long-run in the conflict group. Focussing on civil wars did not change this pattern of results. Looking at the other variables again showed some differences between the African and non-African group, but a remarkably consistency in sign – negative. The only groupings for which both the short and long-run military burden effects were insignificant were middle-income African countries, African countries with no experience of conflict, non-African countries with natural resource abundance and non-African countries with relatively closed economies. Furthermore, t-tests were used to compare the coefficients[16] of military spending (short and long-run) in Africa and non-Africa samples, with the results suggesting statistically significant differences between the two groups.

These results do seem to provide valuable robustness checks and support strongly the view that military spending has an adverse effect on economic growth and that this is particularly strong for Africa. It does seem as though in a post-Cold War setting it is possible to see this result developing as a consensus view. But while a compelling conclusion can be drawn across countries, care is needed in applying the conclusion to individual countries, as some groupings of countries did differ. It is striking, however, that across all the groups investigated here, there was no evidence of any significant positive effects of military burden on growth.

[16] Two-tailed t-tests were used to test whether the coefficients of military spending for the different samples were statistically different from each other.

REFERENCE

D'Agostino, G., Dunne, P. J. and Pieroni, L. 2013. Military Expenditure, Endogeneity and Economic Growth.*MPRA Paper 45640,* University Library of Munich, Germany.

Ahmed, A. D. (2012) Debt Burden, Military Spending and Growth in Sub-Saharan Africa: A Dynamic Panel Data Analysis. *Defence and Peace Economics,* **23**(5) 485-506.

Aizenman, J. and Glick, R. (2006) Military Expenditure, Threats and Growth.*Journal of International Trade and Economic Development*, **15**(2) 129-155.

Benoit, E. (1973) *Defense and Growth in Developing Countries*. Boston, MA: Heath, Lexington Books.

Benoit, E. (1978) Growth and Defense in Developing Countries.*Economic Development and Cultural Change*, **34**(2) 261-275.

Berdal, M. and D. Keen 1997. Violence and Economic Agendas in Civil Wars: Some Policy Implications, in: *Millennium* **26**(3) 795-818.

Blattman, C. and Miguel, E. (2010) Civil War. *Journal of Economic Literature.* American Economic Association, **48**(1) 3-57.

Bloom, D. E. and Sachs, J. (1998) Geography, Demography, and Economic Growth in Africa.*Brookings Papers on Economic Activity,* **1998**(2) 207-295.

Burnside, C. and Dollar, D. (2000) Aid, Policies and Growth.*The American Economic Review*, **90**(4) 847-868.

Chowdhury, A.R. (1991) A Causal Analysis of Defense Spending and Economic Growth.*The Journal of Conflict Resolution* **35**(1) 80–97.

Collier, P. and Hoeffler, A. (2004) Greed and Grievance in Civil War.*Oxford Economic Papers*, **56**(4) 563-595.

Collier, P. and Hoeffler, A. (2006) Military Expenditure in Post-Conflict Societies. *Economics of Governance*, **7**(1) 89-107.

Deger, S. and Smith, R. (1983) Military Expenditure and Growth in Less Developed Countries. *Journal of Conflict Resolution.***27**(2) 335-353.

Dunne, Paul. J. (1996) Economic Effects of Military Expenditure in Developing Countries: A Survey. In *Making Peace Pay*, edited by N. P. Gleditsch. Claremont, CA: Regina Books, 15.

Dunne, P., Nikolaidoua, E. and Vougas, D. (2001) Defence Spending and Economic Growth: A Causal Analysis forGreece and Turkey.*Defence and Peace Economics* **12**(1) 5–26.

Dunne, Paul. J. (2012) Military Spending, Growth, Development and Conflict.*Defence and Peace Economics*, (forthcoming)

Dunne, Paul. J, Nikolaidou, E. and Smith, R. (2002) Military Spending, Investment and Economic Growth in Small Industrialising Economies.*South African Journal of Economics*, **70**(5) 789-790.

Dunne, Paul. J., and Coulomb, F. (2008) Peace, War and International Security: Economic Theories, *Discussion Papers 0803,* University of West of England, Department of Economics.

Dunne, Paul. J., Smith, R. and Willenbockel, D. (2004) Theoretical and Econometric Issues in Analysing the Military Expenditure-Growth Nexus.*Mimegraph*.Available at http://carecon.org.uk/ Armsproduction/Papers/DirkPaulRonpap3.pdf.

Dunne, Paul. J., Smith, R. and Willenbockel, D. (2005) Models of Military Expenditure and Growth: A Critical Review. *Defence and Peace Economics*, **16**(6) 449-461.

Dunne, Paul. J. and Uye, M. (2010) Military Spending and Development.In *The Global Arms Trade*, edited by A. Tan. London: Routledge.

Dunne, Paul. J. and Tian, N. (2013a) Military Expenditure and Economic Growth: A Survey. *The Economics of Peace and Security Journal,* **8**(1) 5-11.

Dunne, Paul. J. and Tian, N. (2013b) Military Expenditure, Economic Growth and Heterogeneity. *Forthcoming in Defence and Peace Economics.*

Dollar, D. and Kraay, A. (2004) Trade, Growth and Poverty.*Economic Journal*, **114**(493) 22-49.

Easterly, W., Levine, R. and Roodman, D. (2004) Aid, Policies, and Growth: Comment. *The American Economic Review*, **94**(3) 774-780.

Edwards, S. (1998) Openness, Productivity and Growth: What Do We Really Know? *Economic Journal*, **108** 383-389.

Frankel, Jeffrey. A. and Romer, D. (1999) Does Trade Cause Growth? *The American Economic Review*, **89**(3) 379-399.

Fredericksen, P.C. and Looney, R.E. (1982) Defense Expenditures and Economic Growth in Developing Countries: Some Further Empirical Evidence. *Journal of Economic Development* **7** 113–124.

Hagland, D. (2011) Blessing or Curse? The Rise of Mineral Dependence Among Low-and Middle-Income Countries. *Oxford Policy Management*. Oxford, UK.

Hansen, H. and Tarp, E. (2000) Aid Effectiveness Disputed. *Journal of International Development*, **12**(3) 375-398.

Huang, C. and Mintz, A. (1990) Ridge Regression Analysis of the Defense-Growth Tradeoff in the United States. *Defense Economics* **2**(1) 19–37.

Islam, N. (1995) Growth empirics: A panel data approach. *Quarterly Journal of Economics*, **110**(4) 1127--1170.

Keen, D. 1998.*The Economic Functions of Violence in Civil Wars.*(Adelphi Paper 320). Oxford: Oxford University Press.

Landau, D. (1986) Government and Economic Growth in the Less Developed Countries: An Empirical Study for 1960-1980," *Economic Development and Cultural Change, University of Chicago Press,***35**(1) 35-75.

Looney, R. E. and McNab, R. (2007) Can Economic Liberalisation and Improved Governance Alther the Defense-Growth Trade-Off? *Review of Financial Economics.*

Knight, M., Loayza, N. and Villanueva, D. (1996) The peace dividend: Military spending cuts and economic growth. *IMF Staff Papers***43** 1--44.

Mankiw, Gregory. N., Romer, D. and Weil, David.N. (1992) A Contribution to the Empirics of Economic Growth.*The Quarterly Journal of Economics*, **107**(2) 407-437.

Murdoch, J., Pi, C., and Sandler. T. (1997) The impact of defense and non-defense public spending on growth in Asia and Latin America. *Defence and Peace Economics*, **8**(2) 205-224.

Mylonidis, N. (2008) Revisiting the Nexus Between Military Spending and Growth in the European Union. *Defence and Peace Economics,* **19**(4) 265-272.

Pesaran, M.H. and Smith, R. (1995).Estimating Long-Run Relationships from Dynamic Heterogeneous Panels.*Journal of Econometrics, Elsevier***68**(1) 79–113.

Pieroni, P. (2007) Military Spending and Economic Growth.*Discussion Papers***0708**, University of the West of England, Department of Economics.

Polachek, Solomon W. 2007. "How trade affects international interactions," *Economics of Peace and Security Journal*, Economists for Peace and Security (UK), vol. 2(2), pages 60-68, June.

Ram, R. (1995) Defense Expenditure and Economic Growth.In *Handbook of Defense Economics*, edited by K. Hartley and T. Sandler. Amsterdam: Elsevier, 251-273.

Rodriguez, F. and Rodrik, D. (2000) Trade Policy and Economic Growth: A Skeptic's Guide to the Cross-National Evidence.In *Macroeconomics Annual 2000*, edited by B. Bernanke and K, Rogoff.MIT Press for NBER.

Sarr, M., Bulte, E., Meissner, C., and Swanson, T. (2011) On the Looting of Nations.*Public Choice*, **148** 353-380.

SIPRI (Stockholm International Peace Research Institute), various years. *Yearbooks World Armament and Disarmament*, Oxford: Oxford University Press.

SIPRI (Stockholm International Peace Research Institute), 2013, *Trends in World Military Expenditure, 2012.* Available: http://books.sipri.org/files/FS/SIPRIFS1304.pdf

Smaldone, Joseph. P. (2006) African Military Spending: Defense versus Development? *African Security Review*.**15**(4) 18-32.

Smith, R. (1980) Military Expenditure and Investment in OECD 1954–1973. *Journal of Comparative Economics* **4**(1)19–32.

Smith, R. (2000) Defence Expenditure and Economic Growth. In *Making Peace Pay: A Bibliography on Disarmament and Conversion*, edited by N.P. Gleditsch, G. Lindgren, N. Mouhleb, S. Smit and I. de Soysa. Claremont, CA: Regina Books, 15-24.

Smith, R. and Dunne, Paul.J. (2002) Military Expenditure Growth and Investment.*Mimeo,* Birkbeck College.

Yakovlev, P. (2007) Arms Trade, Military Spending, and Economic Growth.*Defence and Peace Economics*, **18**(4) 317-338.

Yanikkaya, H. (2003) Trade Openness and Economic Growth: A Cross-Country Empirical Investigation. *Journal of Development Economics*, **72** 57-89.

Yildirim, J., Ocal, N. and Keskin, H. (2011) Military Expendiures, Economic Growth and Spatial Spillovers: A Global Perspective. *International Conference of Applied Economics.*

APPENDIX

Table A1: List of countries in full sample

Africa	N & S. America	Asia & Oceania	Europe	Middle East
Algeria	Argentina	Australia	Albania	Bahrain
Angola	Belize	Bangladesh	Austria	Egypt
Botswana	Bolivia	Brunei	Belgium	Iran
Burkina Faso	Brazil	Cambodia	Bulgaria	Israel
Burundi	Canada	China, P. R.	Cyprus	Jordan
Cameroon	Chile	Fiji	Denmark	Kuwait
Djibouti	Colombia	India	Finland	Lebanon
Ethiopia	Dominican Rep.	Indonesia	France	Oman
Ghana	Ecuador	Japan	Germany	Saudi Arabia
Kenya	El Salvador	S.Korea	Greece	Syria
Lesotho	Guatemala	Malaysia	Hungary	
Madagascar	Jamaica	Mongolia	Ireland	
Malawi	Mexico	Nepal	Italy	
Mali	Nicaragua	New Zealand	Luxembourg	
Mauritania	Panama	Pakistan	Malta	
Mauritius	Paraguay	Papua New Guinea	Netherlands	
Morocco	Peru	Philippines	Norway	
Mozambique	United States	Singapore	Poland	
Namibia	Uruguay	Sri Lanka	Portugal	
Rwanda	Venezuela	Thailand	Romania	
Senegal			Russia	
Seychelles			Spain	
Sierre Leone			Sweden	
South Africa			Switzerland	
Swaziland			Turkey	
Tansania			UK	
Tunisia				
Uganda				