Military Burden Determinants in Southern Africa, 1996-2005: A Cross-section and Panel Data Analysis*

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ABSTRACT

A few studies have focused on the determinants of military expenditure in Africa in general and southern Africa in particular. Most of the studies are not exclusively on this region but cover developing countries in general, with a few countries from southern Africa. Those that have focused on southern Africa are longitudinal case studies rather than cross-sectional. For instance, Batchelor et al (2002), for South Africa and Tambudzai (2006), for Zimbabwe. This article tries to fill this gap in the literature by econometrically testing for the factors that affect military expenditure in southern Africa, utilizing cross-section and pooled data estimations methods. The findings of this study confirm the importance of both economic and strategic variables in the determination of the level of military expenditure in developing countries. The strategic variables, however, have greater influence on military burden in southern Africa.

1. Introduction

The end of the Cold War and the demise of Apartheid in South Africa were expected to reduce the incidence of armed conflict in Africa and usher in a new era of peace and tranquillity. Indeed, despite perceptions to the contrary, the *Human Security Report* (Human Security Centre, 2005) has convincingly demonstrated that the number of and intensity of wars in Africa has fallen since 1990, particularly since 1998/9. Military expenditure (milex) fell significantly during the 1990s but this was largely explained by a 57% cut in real terms in South Africa's milex 1990-99 (SIPRI, 2000 p271). Subsequently, the region's milex has increased by about 45% in real terms from 2000 to 2003 (Harris, 2005). Irrespective of the trends, the economist's concern with a more optimal resource allocation suggests a reduction of budget allocations away from the military towards welfare-improving and growth-enhancing activities. The assumption here is that military expenditures are at best unproductive and may have negative economic externalities.

Military spending in Africa between 1996 and 2005 milex rose by a staggering 48% in real terms (SIPRI, 2006 pp 312). According to (SIPRI, 2006 pp313), the main drivers of milex in Africa are military reforms being pursued by different countries and conflicts between and within countries. The recent years were characterized by professionalization of defence forces and the renewal of equipment. The conflict factor is apparent in the increase of milex in Eritrea, Ethiopia, Burundi and the Democratic Republic of Congo (DRC).

This article provides an examination of the driving forces behind military expenditures for 12 members of the Southern Africa Development Community. There has been a dearth of empirical work with regard to milex in southern Africa as a region. Most of the studies undertaken so far are not exclusively on this region but cover developing countries in general, with only a few inclusions from southern Africa. Those studies that have focused on southern Africa are longitudinal rather than cross-sectional, for instance, Batchelor et al (2002) for South Africa and more recently Tambudzai (2006) for Zimbabwe. The ultimate aim of this research is to increase the rationality of the defence budgetary process in southern Africa through identifying the main factors that influence milex.

The next section identifies and analyses the movements of milex in southern Africa. The third section reviews related literature and outlines the empirical model. The fourth section presents empirical results on determinants. Finally, the fifth section provides some conclusions.

2. Military Expenditure Trends

Angola, Botswana, Lesotho, Namibia and Zimbabwe exhibited very high military burdens (milex as a proportion of GDP) between 1996 and 2004. The high usage of national resources for military purposes could have been aggravated by the civil wars in some of these countries in the 1980s and early 1990s. Angola had the highest burden reaching a peak of 10.3% in 1997. As from 1996 to 2004 the average estimate for the

Angolan military burden was 5.1%, which is very high by world, and African, standards and is a consequence of the protracted civil war between the government and UNITA rebels, which ended in 1999. Between 2000 and 2004, Angola's milex increased by 283% from US$297 million to US$1137 million (see Table 1). Angola, together with Botswana, Lesotho, Namibia and Zimbabwe, are classified under countries with the highest defence burdens in Africa between 1996 and 2004 (SIPRI, 2006 pp314). The recent surge in Angola's milex has also been attributed to military reforms, including demobilisation and integration of former rebel soldiers, and the repayment of substantial military debts.

Botswana has a relatively high military burden, of 3.8% on average. Botswana shows some consistence in the share of its national income allocated to defence over the 9 years under consideration. However, for a small country of around two million people with virtually little or no external threats, that could be excessive. According to SIPRI (2006) the burden is high because of military reform and modernization programme. The political instability in Zimbabwe that many thought would degenerate into civil conflict may be a threat to Botswana's peace and stability as well.

Between 1999 and 2000, the region experienced an upsurge in military burden because of the DRC war and political instability in some southern African countries (Tambudzai, 2005 pp159). Zimbabwe, which was mainly affect by political and economic upheavals, had the third largest military burden in the region, a worrying phenomena given the high levels of poverty, unemployment and economic decline. Its milex in US dollar terms was on the increase after decreasing from US$444 million in 2000 to US$177 million in 2003. Recently it purchased 12 trainer jets from China and 127 vehicles for senior defence personnel. On the other hand, South Africa's burden was consistently declining over time as compared to its neighbours. In 1996, South Africa's military burden was at 1.8% and thereafter declined significantly to 1.3% in 1999, before increasing again to 1.6% by 2003. The peace prevailing in that country after the demise of Apartheid is the main contributing factor (Batchelor et al 2002). However, SIPRI (2006) argues that the low military burden is explained by the large size of its economy, which can contain its milex.

Lesotho's burden reached a peak of 3.7% in 1999 and thereafter declined to 2.3% in 2004. Namibia had an increasing although erratic military burden after 1996, which reached a peak of 3.4% before a decline to 3.1% in 2003. The rest of the SADC countries have on average military burdens less than 2.1%, a sign of a demilitarisation in the region. The general decline in the military burden among these countries after 2000 may be testimony of the peaceful conditions prevailing in the region in the past decade. The military expenditure trends in the region it seems have been affected by internal and external factors, particularly wars and internal instability.

In terms of military expenditure South Africa dominates the region (see Table1). Its expenditure of US$ 2 741 million in 2005 was almost 22% larger than for all the other countries added together. Increases in South Africa's military expenditure for the period 2000 to 2005 was a result of a major arms deal for ships and aircraft signed in late 1999 and the ongoing 1999-2010 Strategic Defence Procurement programme.

3. Determinants of Milex in Developing Countries

In recent years there has been a surge of studies on developing countries militarization. These studies have focused on five broad areas: the effect of milex on economic growth and development, development of indigenous arms industries, arms transfers to the developing world, budgetary trade-offs between defence and other socio-economic sectors, and the main factors affecting the level of military expenditure. The theory of the determinants of milex is well surveyed by Maizels and Nissanke (1986), Ball (1988), Hartley and Sandler (1990), West (1992), and Smith (1995). Smith (1998, pp 465) summarizes the demand for military forces in developing countries as being necessitated by the desire; "to ensure autonomy from imperialist powers; to maintain external security in the face of deep-rooted regional antagonisms; to preserve internal unity against the divisive pressures of domestic conflicts; and to provide a symbol of national status and prestige".

Despite the many arguments for military build-ups, the fact remains that millions of people have perished because of wars in developing and developed countries alike, military regimes have caused untold misery and poor countries are becoming worse because of heavy military outlays. Such factors bring into perspective the need for efficiency in crafting and management of security budgets. Policy makers need to know the appropriate level of spending and the associated opportunity cost. Some representative studies on the determinants of milex based cross-section and panel data analysis are summarized in Appendix.

Maizels and Nissanke (1986), Ball (1988), West (1992), and Harris (2002) have identified the factors that influence milex in developing countries as the influence of external conflicts, requirements of regime (internal) security, domestic bureaucratic and budgetary factors, the influence of armed forces and, the role of super powers. More generally these factors are grouped into two broad categories, external and internal influences (Tambudzai, 2006 pp 107). The dependent variable is in most cases the ratio of military spending to GDP, commonly referred to as the 'military burden'.

Dunne and Mohammed (1995) tested the impact of economic and strategic factors on the pattern of sub-Saharan African military expenditures over the period 1967 to 1985.By focusing on a single region their study is different from earlier studies which used a cross-section approach (see for instance Maizels and Nissanke, 1986; Dommen and Maizels, 1988; Rosh, 1988; and Looney, 1989) focusing on many regions of the world. Using cross-sectional and pooled time series data analysis, economic factors played a major role in determining milex. Pooled data analysis showed that military burden in significantly affected by strategic factors such as wars, size of the armed forces and previous year's military burden.

Dunne and Perlo-Freeman (2003a) conducted a cross-section study with data from 1981 to 1997 and their findings seem to agree with some of the findings of Dunne and Mohammed (1995), and Collier and Hoeffler (2002). They estimated two log-linear models, one for the Cold War period and the other for the post-Cold War era. Population size, security web militarisation, external threats and internal threats affected the demand for milex in developing countries.

Dunne and Perlo-Freeman (2003b) also estimated the same model using dynamic panel data analysis. In the fixed effects model military burden in developing countries was significantly influenced by potential enemies, other countries milex, external and civil wars, the level of democracy, population size and the trade balance. In the dynamic effects model, military burden depended on potential enemies, previous year's burden, civil and external wars, democracy, population, trade, security web countries, GNP and the great power enemies. The dynamic effects model performed better than the fixed effects one. The results showed that cross section studies are inadequate in capturing dynamic processes.

Most cross-sectional studies included the size of the armed forces, intensity of conflict and wars, military regimes, level of income and geographical factors as the major determinants of milex in developing countries. Although the empirical studies have produced varying results, there seems to be an agreement that economic factors are less important in developing countries. Differences have been observed across countries and types of regimes. This has led some researchers to conclude that determinants of milex cannot be generalized (Deger and Sen, 1990).

4. Empirical Model

4.1 Cross Section and Panel Data Analysis

Panel data analysis has been used to study the behaviour a particular group of variables over a given time period. With recurring observations of adequate cross-sections, panel analysis allows a researcher to investigate the dynamics of adjustment with short-time series. The combination of time series with cross-sections can improve the quality and quantity of data for analysis. Panel data provides regression analysis with both a spatial (a cross-section of units) and sequential (periodic observations) dimension. There are several types of panel data analytical models. These comprise constant coefficients, fixed effects and random effects models. In the midst of these types of models you will find dynamic panel, robust and covariance structure models.

4.2 The Pooled Regression Model

Also known as the constant coefficient model, is a panel data model with constant coefficients (both intercepts and slopes). This model is relevant when there is neither significant country nor significant temporal effects. In such an event we pool all the data and run an OLS regression model.

$$y_{it} = \beta_1 + \sum_{k=2}^{K} \beta_k x_{it} + e_{it} \quad \text{……………………………………..(1)}$$

for i = 1,2,…,N cross-section units and periods t = 1,2,…,T and k = 2,…,K are number of the explanatory variables and β_k are the slope coefficients and are assumed to be constant over countries and time. e_{it} is the random error term for the i^{th} country and t^{th} year. Y is a dependent variable and X an independent variable and x_{kit} is an observation on the k^{th} explanatory variable for the i^{th} country and the t^{th} time period.. This model has the drawback that it assumes that all parameters are the same for each country, thus ignoring country-specific factors. Also the cross-section variation will drown the time-series effects.

4.3 The Fixed Effects Model

This panel model allows the intercept to differ across groups (countries in our case) but the model will have constant coefficients (slopes). There will be no significant temporal effects but significant countries differences. The intercepts are cross-section specific and differ from country to country, but they may not differ over time.

$$y_{it} = \beta_{1i} + \sum_{k=2}^{k} \beta_k x_{it} + e_{it} \quad \text{……………………………………………….(1)}$$

where β_{1i} represent the country-specific effects. The intercepts are assumed to be different for individual countries but constant over time. This type of fixed effects model is called the Least Squares Dummy Variable model.

There are other four types of fixed effects models. Another type of fixed effects model could have constant slopes but intercepts that vary according to time. A third type is where the slope coefficients are constant, but the intercept varies over the country and time. A fourth type is where the model has differential intercepts and slopes varying according to the country. The last type is where a fixed effects model in which both the intercepts and the slopes might vary over time and across the countries.

4.4 The Random Effects Model

It is a regression model with a random constant term. The constant in this model is not fixed, but is an independent random variable. The model can be presented as follows,

$$Y_{it} = \beta_{1i} + \sum_{k=2}^{k} \beta_k X_{kit} + e_{it}$$

where β_{1i} is an independent random variable with mean $\bar{\beta}_1$ and σ_μ^2.………………(2)

While $\beta_{1i} = \bar{\beta}_1 + \mu_i$

Equation (3) becomes

$$Y_{it} = \bar{\beta}_1 + \sum_{k=2}^{k} \beta_k X_{kit} + \mu_i + e_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

4.5 Model Specification

The model is based on the standard neoclassical model as outlined in Smith (1995) and Dunne and Mohammed (1995). It assumes that there is a rational state, which maximizes a welfare function subject to some resource constraint. The current analysis is a modification of the approach used by Dunne and Mohammed (1995) in sub-Saharan Africa, in order to check if the same results can be obtained for southern Africa. While

Dunne and Mohammed were interested in a relatively homogeneous group of countries (geographical, ethnic, cultural, social and economic criteria), this study is focusing on countries with close economic, historical and socio-political ties, and within the same regional location. Their model covered thirteen sub-Saharan Africa countries while the current analysis covers SADC member countries in southern Africa. The following specification will be used,

$$MB_t = a_0 + a_1 GDPC + a_2 CGE + a_3\, MB_{t-1} + a_4 AP + a_5\, DEM + a_6 WAR + e \text{ ------ } (4)$$

Where MB_t is the share of milex in GDP, *GDPC* is the GDP per capita, *GDPG is GDP growth rate, CGE* is the share of total government spending in GDP, AP is the proportion of armed forces in the population, *DEM* is the democracy variable, *WAR* is a dummy taking the value of 1 if a country was at war, 0 otherwise, and *e* is an error term.

Dunne and Mohammed (1995) pooled data analysis used a model with country specific dummies. The southern Africa model will use similar variables but at times different proxies depending on data availability. Given the small time series period fixed and random effects models will be tested. These will be compared to see which one fits the data best.

4.6 Estimation Procedure

The estimations were carried out in three stages. More emphasis was put on the panel data analysis because it improves the quality of estimation and analysis.

Stage 1: Determinants of military expenditure overtime for the whole sample

To accomplish this task we use the variables aggregated over all of the 12 countries, to estimate equation (4).

Stage 2: Determinants of military expenditure across the countries

To estimate the factors that influence milex across countries we use average values for the whole time period to provide a 15 observation cross-section data. The OLS procedure will be used to estimate equation (4) but across countries.

Stage 3: Determinants of military expenditure across countries and overtime

Panel data analyses will be utilized, after pooling the data over time and across the countries. This approach takes all of the data available for the 15 countries. Country and time-specific effects can be accounted for by using dummy variables. A random effects model will also be estimated. The limited time series sample does not allow the estimation of a dynamic model. In this section we estimate equations (1), (2) and (3).

5. Sample and Data

To estimate these models a sample of time series data from 1996 to 2005 for each of the 12 countries is used, which includes most of the countries in southern Africa. Data for macroeconomic variables is from the *IMF* (2006) database, while military spending was obtained from the *SIPRI Yearbook* (2006), and the data on democracy, disputes and war was obtained from the *Dyadic Militarized Interstate Disputes* database (Maoz, 2005).

The years 1996 to 2004 are chosen because most of the countries were stable and statistical data is reasonably reflective of the situation on the ground. The data used is approximate because of the deficiencies in the defence expenditure data especially in developing countries. Most governments are secretive or misleading about their military budgets (Omitoogun, 2003). Conversion of domestic values into constant price US dollars faces the difficulties of purchasing power parity (Smith, 1998) and SIPRI Yearbooks consistently warn against using their data for cross-country comparisons rather than for analysing trends within a country over time.

6. Empirical Results

The results are based on the three themes already outlined in the methodology. The different models (aggregate time series, cross-section averages and the panel data models) were estimated using different estimation methods. OLS and GLS estimators were used. The panel data models focused on the fixed effects model. The dynamic model was not included because of the small sample size.

6.1 Determinants of military expenditure overtime

The model in differences performs better than the one in levels (see Table 2). The model in logarithms performs far much better as well, which is in line with the findings of Dunne and Mohammed (1995). Most of the variables in model (1) are significant at 5% level of significance. The central government expenditure as a share of GDP is significant at 10%, while the previous milex level variable was dropped because it was not significant in differences. However, in levels the inertia variable is significant at 10%. The implication of the difference in the two models is that the change in military burden is not explained by previous growth rates of milex but by the absolute value or level of previous milex. The central government expenditure as a share of GDP and the war dummy have negative signs contrary to prior expectations. The lower central government expenditure-GDP ratio implies that the rate of increase of military burden was lower than the rate of growth of CGE in the short term.

Contrary to Dunne and Mohammed (1995), the strategic variables were significant factors in the SADC region for the period under consideration. Of importance is the democracy variable that is negatively related to milex. The openness variable was excluded because most countries did not have recent data, according the IMF online data sources. The adjusted R^2 of 0.91 in model (1) for the aggregated data model is slightly higher than the one in Dunne and Mohammed (1995) model, which was 0.87. The p-value for the regression model as a whole of 0.06 shows that there is no multicollinearity and that milex in southern Africa is significantly explained by both economic and strategic variables.

6.2 Determinants of military expenditure across the countries

The average of military burden and the independent variables over the sample period for each country provides a cross-section of 12 observations. Compared to other previous studies outlined in the Appendix, the averaging was done over a much longer period (nine years). The specification of the model is log-linear. There is a significant positive relation between military burden and war, inertia, and the share of central government expenditure in GDP (see Table 3). There is also a significant negative relation between the armed forces-population ratio and per capita GDP, which is contrary to initial theoretical expectations. The negative effect of GDP per capita could mean that there is a trade-off between the two variables. To increase military expenditure resources are diverted from the productive sectors of the economy. This is likely to be true in the case of war affected and politically unstable countries like the DRC, Angola, and Zimbabwe. The coefficient of the democracy variable is negative as expected but insignificant at 10%. The main difference with the findings of Dunne and Mohammed (1995) is that internal and external war and inertia have a positive significant impact on military burden, while relative army size and GDP per capita have negative impact on milex in developing countries.

6.3 Determinants of military expenditure across countries and overtime

6.3.1 The Fixed Effects Model

Three variables determine military burden in southern Africa, according to Table 4. Previous military burden, wars and the GDP per capita positively influence milex, as expected. The proportion of population in the army has positive influence on military burden but is not significant at 10% level. The share of government expenditure in GDP has a negative and insignificant impact on military burden contrary to expectations. These results agree with the findings of Dunne and Mohammed (1995) who found a positive and significant impact of the war, inertia and the GDP per capita. The inertia variable has the most significant coefficient as well. The democracy variable, although it had an accepted sign, was dropped because it was highly insignificant.

6.3.2 Random effects model

The random effects model (Table 4) confirms the importance of GDP per capita and war as determinants of military expenditure in southern Africa. The introduction of the inertia variable causes the other variables to be insignificant, unlike in the fixed effects model where the previous level of milex is significant. The inertia variable was therefore dropped from the model. The fixed effects model seems to perform far much better than the random effects model.

7. CONCLUSIONS

The findings of this study confirm the importance of both economic and strategic variables in the determination of the level of milex in developing countries. The strategic variables, however, have more influence on military burden contrary to the findings of Dunne and Mohammed (1995). The increase in milex in southern African countries like South Africa and Botswana demonstrates the importance of high levels of GDP or economic growth. As SIPRI (2006) argues, the modernisation of equipment in the region was partly driven by economic capability. The prevalence of civil wars and some cross-border adventures has led to high levels of military expenditure, in Zimbabwe, Namibia, Angola and the DRC.

The estimation results of the different models have shown that SADC's military expenditure since 1996 was influenced by internal threats to security (civil wars), external adventures like incursions into the DRC and economic performance, as measured by the GDP growth and GDP per capita. A number of SADC countries have had significant increases in their official military expenditure as a result of their involvement in conflicts other than their own. The trends in SADC's defence expenditure in the period under study were influenced more by regional strategic factors than by economic factors.

Despite the increasing levels of poverty, HIV and AIDS, and low economic growth in most of the SADC countries, their defence expenditures were on the increase in recent years. The subsequent trade-off between milex and other social expenditures should be a worry to the governments. Recent military outlays and acquisitions may not be necessary, given the peaceful conditions that were ushered in by the end of the DRC war, the civil wars in Angola and Mozambique and the demise of apartheid in South Africa.

Table 1 Southern Africa Military Expenditures, 1996-2004

(Measured in US $m, at constant 2003 prices, and exchange rates)

YEAR	ANGOLA	BOTSWANA	DR CONGO	LESOTHO	MALAWI	MADAGASCAR	MAURITIUS	MOZAMBIQUE	NAMIBIA	SEYCHELLES	SOUTH AFRICAA	SWAZILAND	TANZANIA	ZAMBIA	ZIMBABWE
1996	1076	161	68.7	27.9	54.3	13.0	12.4	31.2	67.6	12.4	2314	30.2	83.6	53.6	300
1997	809	186	56.6	27.9	69.2	16.7	10.3	34.7	83.3	13.5	2128	29.6	83.5	68.7	317
1998	288	240	17.0	30.1	66.9	13.4	9.4	41.2	89.0	12.7	1917	32.6	..	69.2	259
1999	1054	236	62.0	37.5	62.7	13.0	9.9	49.4	124	12.8	1816	34.0	..	35.3	444
2000	297	247	46.1	36.0	63.2	11.1	10.3	51.2	136	12.0	2120	31.3	103	22.1	435
2001	153	251	..	32.0	79.2	11.8	10.4	58.4	116	12.4	2371	29.2	119	..	259
2002	195	292	..	29.3	..	12.8	10.6	60.4	125	12.3	2538	..	138	..	229
2003	298	299	118	29.2	..	13.1	10.9	59.8	118	12.2	2588	..	132	..	177
2004	668	284	185	27.4	..	..	10.9	67.4	132	15.6	2544	..	128	..	260
2005	1137	230	136	26.2	..	..	11.8	68.1	143	12.3	2741	..	130	..	..

Source: SIPRI YEARBOOK 2006

Table 2 Models for determinants of military expenditure over time

Sample size: 1997-2004 *Method: Least Squares*	**Model (1) in 1st difference**		**Model (2) in levels**	
Variable	**Coefficient**	**t-Statistic**	**Coefficient**	**t-Statistic**
C	29.97*	7.39 [0.02]	-3.76	-1.16 [0.33]
LOG(AP)	5.96*	7.47 [0.02]	-3.45**	-2.32 [0.10]
#DEM	-0.44*	-7.39 [0.02]	0.075	1.76 [0.18]
LOG(GDPG)	0.35*	6.16 [0.03]	-0.20**	-2.73[0.07]
LOG(CGE)	-1.49**	-2.85 [0.10]		
LOG(MBt(-1))			1.84**	2.60 [0.08]
#WAR	-0.33*	-7.24[0.02]		
R-squared	0.98		0.79	
Adjusted R-squared	0.91		0.52	
S.E. of regression	0.02		0.05	
Log likelihood	25.15		16.88	
F-statistic	16.00 [0.06]		2.87[0.21]	
Durbin-Watson stat	1.45		2.49	
ARCH Test: F-statistic	0.66 [0.45]		0.0004[0.98]	
ARCH Test: Obs*R-squared	0.82 [0.37]		0.001[0.98]	
Normality Test: Jarque-Bera)	0.43 [0.81]		0.27[0.87]	
Akaike info criterion	-4.787201		-2.97	
Schwarz criterion	-4.727620		-2.92	

Probabilities are in square brackets[ ]; LOG- logarithms; # Not diffrenced; * significant at 5%;
** significant at 10% level.

Tabe 4 Determinants of military expenditure across countries and over time (Panel data models)

Sample size: 1997-2004 Method: GLS	**Fixed Effects Model**		**Random Effects Model**	
Variable	**Coefficient**	**t-Statistic**	**Coefficient**	**t-Statistic**
C			14.51	4.28 [0.00]
AP?	0.010	0.90 [0.37]	0.002	0.18 [0.86]
CGE?	-0.003	-0.89 [0.37]	-0.002	-0.32 [0.75]
GDPC?	0.018**	1.89 [0.06]	0.02	1.69 [0.09]
MB?(-1)	0.439*	10.39 [0.00]		
WAR?	0.363*	2.41 [0.01]	0.10	2.32 [0.02]
Weighted Statistics			**GLS Transformed Regression**	
R-squared	0.99		0.95	
Adjusted R-squared	0.99		0.94	
S.E. of regression	1.55		1.96	
F-statistic	2795.7[0.0]			
Durbin-Watson stat	2.30		0.88	
Unweighted Statistics			**Unweighted Statistics including Random Effects**	
R-squared	0.97		0.95	
Adjusted R-squared	0.96		0.95	
S.E. of regression	1.56		1.85	
Durbin-Watson stat	2.03		0.97	

Probabilities are in square brackets[ ]; LOG- logarithms; # Not differenced; * significant at 5%; ** significant at 10% level.

Table 3 Determinants of military expenditure across the countries

Dependent Variable: LOG (MBt)

Sample (adjusted): 4 14

Variable	Coefficient	t-Statistic
C	-3.18	-1.41 [0.23]
LOG(AP)	-1.34	-2.16 [0.10]
LOG(CGE)	2.18	2.26 [0.09]
DEM	-0.12	-1.93 [0.13]
LOG(GDPC)	-0.79	-2.36 [0.08]
LOG(MBt(-1))	0.97	2.87 [0.05]
WAR	4.49	2.92 [0.04]
R-squared	0.81	
Adjusted R-squared	0.52	
S.E. of regression	0.53	
F-statistic	2.84 [0.17]	
Log likelihood	-3.04	
Durbin-Watson stat	1.76	
Serial Correlation LM Test: F-statistic	0.10 [0.91]	
Obs*R-squared	0.97 [0.62]	
ARCH Test: F-statistic	0.02 [0.88]	
ARCH Test :Obs*R-squared	0.03 [0.87]	
Normality Test: Jarque-Bera	0.11 [0.94]	

Probabilities are in square brackets[ ]; LOG- logarithms; # Not diffrenced; * significant at 5%; ** significant at 10% level.

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APPENDIX

DETERMINANTS OF MILEX IN DEVELOPING COUNTRIES- REPRESENTATIVE STUDIES, 1995-2003

AUTHOR (S) & YEAR OF STUDY	COUNTRY OR REGION	SAMPLE PERIOD	MODEL TYPE & ESTIMATION PROCEDURE	DEPENDENT VARIABLE/S	INDEPENDENT VARIABLES	SIGNIFICANT VARIABLE/S &SIGN OF IMPACT	REMARKS
Paul Dunne and Sam Perlo-Freeman (2003a)	*Developing Countries*	1981-1988 (Cold-War) & 1990-1997 (Post Cold-War)	**Neoclassical Model - Smith (1989, 1995)** **Cross-section data analysis** 2 Log linear models **(i)**During Cold-War **(ii)**Post Cold-War	Military burden	GNP, population, External War dummy, Civil war dummy, Milex of enemies, milex of potential enemies, security web milex, great power enemy dummy, Democracy-autocracy Middle East dummy, China proximity dummy	Population (-) Security web (+) Milex of potential enemies (+) External war in (i) (+) Civil war (+) China proximity dummy (+) Middle East dummy (+)	(i) adjusted $R^2 = 0.61$ (ii) adjusted $R^2 = 0.57$ - Income has expected sign but is insignificant. - Milex of enemies' effect might have been captured by potential enemies and security web variables. -Very small difference in results for the two periods.
Paul Dunne and Sam Perlo-Freeman (2003b)	*Developing Countries*	1981-1997	**Standard Neoclassical Model -Smith (1980), Hewitt (1991)** **Panel Data Analysis -Arellano & Bond (1991)**	Military burden	**Model 1** log GNP, log Military burden (t-1), log Population, log Trade, External War dummy, Civil war dummy, log potential enemies milex, log security web milex, Great Power enemy dummy, Democracy	**Fixed effects model** Potential enemies (+) Others milex (+), External war (+), Civil war (+), Democracy (-) Population (-), Trade (-) **Dynamic effects model** Potential enemies (+) Military burden (t-1) (+) External war (-), Civil war (+), Democracy (-), Population (-) Trade (+), -Security web (+)	-No difference between model 1 & 2 -Structural break tests show a change in the demand for milex after the Cold War. -Cross section studies are limited when analysing dynamic processes -Panel data estimation is recommended for such studies

					Model 2 excludes the security web milex of non-hostile countries, (log Others milex)	GNP (-), Great Power Enemy (+)	
Paul J. Dunne and Nadir A.L. Mohammed (1995)	*Sub-Saharan Africa*	1967-1985	**Standard Neoclassical Model -Smith(1980) & Hewitt 1991) OLS estimation procedure** Log-linear form	Military Spending/ GDP ratio	GDP per capita, Government spending/GDP ratio, Trade/GDP ratio, proportion of armed forces in population, military government dummy, War dummy	**Model 1** -Per capita income (-) & Per capita income(-1) +) -Δ in share of govt spending in output (-) -Trade /output ratio (-) **Model 2** -Share of govt spending in output (+) **Model 3** -Per capita income (+) -Proportion of armed forces in population (+) -Military burden (t-1) (+)	**Model 1** $R^2 = 0.87$ **Model 2** $R^2 = 0.61$ **Model 3** $R^2 = 0.91$

Paul Collier and Anke Hoeffler (2002)	Developed and Developing Countries	1960-1965 …. 1995-1999	**Pooled Regression Model**	Defence Burden	**Model 1** international war, Civil war, External threat, Neighbours milex, population*, internal threat, 1995-99 dummy, democracy, GDP per capita*, Israel dummy **Model 2** Model 1 +, Aid/ GDPt-1 • * natural logs	**Model 1** International war (+) , Civil war (+), External threat (+) Neighbours military expenditure (+), Population* (-), Internal threat (+), 1995-99 dummy (-) Democracy (-), GDP per capita* (+) ,Israel (+) **Model 2** International war (+) Civil war (+), Neighbors military expenditure (+), Population* (-), Internal threat (+), Democracy (-), GDP per capita* (+), Israel (+)	**Model 1** ➢ R^2 =0.56 ➢ All variables are significant at 10% level **Model 2** ➢ Aid variable not significant ➢ R^2 =0.62