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Is Military Spending Converging Across Countries? An Examination of Trends and Key Determinants

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Is Military Spending Converging Across Countries? An Examination of Trends and Key Determinants[1]

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Abstract

This paper studies the evolution of worldwide military spending during 1970-2018. It finds that military spending in relation to GDP is converging, but into three separate groups of countries. In the largest group, responsible for 90 percent of worldwide spending, outlays have remained stubbornly high. Military spending in developing economies reacts to improvements in security conditions and military spending in neighboring countries, suggesting that further increases in the peace dividend are possible. In developing economies, rising social spending tends to crowd out military outlays, but this is not the case in advanced economies. With social outlays projected to rise as developing countries look to achieve the Sustainable Development Goals (SDGs), military spending could come under pressure to fall further.

JEL Classification Numbers: H50, H51, H52, H56

Keywords: Military spending, social spending, convergence.

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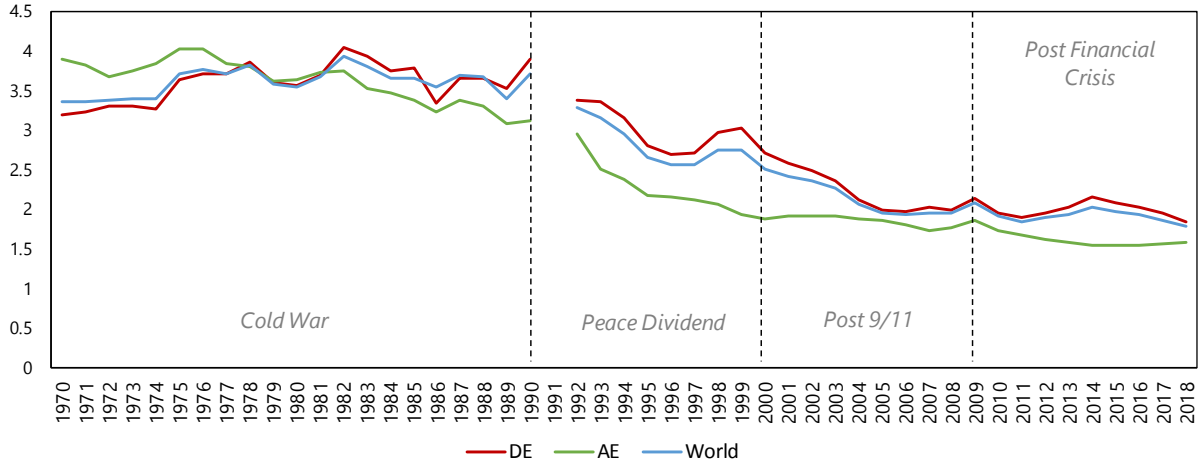
I. INTRODUCTION

Worldwide military spending, when estimated on the basis of unweighted country averages, appears to have nearly halved from 3.6 percent of GDP during the Cold War period (1970-1990) to 1.9 percent of GDP in the most recent years after the global financial crisis (2010-2018) (Figure 1 and Table 1). A similar trend emerges in the share of the budget allocated to the defense sector, which fell by three percentage points during this period. A disaggregation by advanced economies and developing countries suggests that while the decline as a share of GDP was broadly similar in the two groups, developing countries experienced a sharper fall as a share of total spending. These developments would be viewed positively by those concerned about budgetary pressures arising from changing demographics and the spending needs for achieving the Sustainable Development Goals (SDGs) by 2030 (Clements et al. (2017) and Gaspar et al. (2019).

Figure 1. Military Expenditure, 1970-2018
(as percentage of GDP)



Note: Military expenditure as percentage of GDP calculated as the unweighted country average within each country group. DE and AE denote the developing economies and the advanced economies, respectively. Data for 1991 on a global basis are not available due to the breakup of the former Soviet Union.

Source: Stockholm International Peace Research Institute (SIPRI).

Table 1. Military Expenditure: Summary Statistics

	As Percent of GDP				As Percent of Total Expenditure			
	1970-1990	1992-2000	2001-2009	2010-2018	1970-1990	1992-2000	2001-2009	2010-2018
All:								
Mean	3.61	2.79	2.10	1.90	9.58	9.12	7.46	6.42
St.Dev.	(3.79)	(3.09)	(1.80)	(1.60)	(7.80)	(7.56)	(5.94)	(5.34)
Advanced:								
Mean	3.60	2.23	1.85	1.59	6.98	5.31	5.07	4.33
St.Dev.	(3.80)	(1.72)	(1.29)	(1.01)	(6.21)	(5.17)	(4.88)	(4.10)
Developing:								
Mean	3.62	2.98	2.18	1.99	12.58	10.54	8.20	7.07
St.Dev.	(3.72)	(3.40)	(1.93)	(1.73)	(8.36)	(7.82)	(6.05)	(5.52)
Sub-Saharan Africa:								
Mean	2.61	2.78	1.87	1.67	11.16	9.26	7.28	6.48
St.Dev.	(2.27)	(4.44)	(2.18)	(1.27)	(6.99)	(8.14)	(5.01)	(4.42)

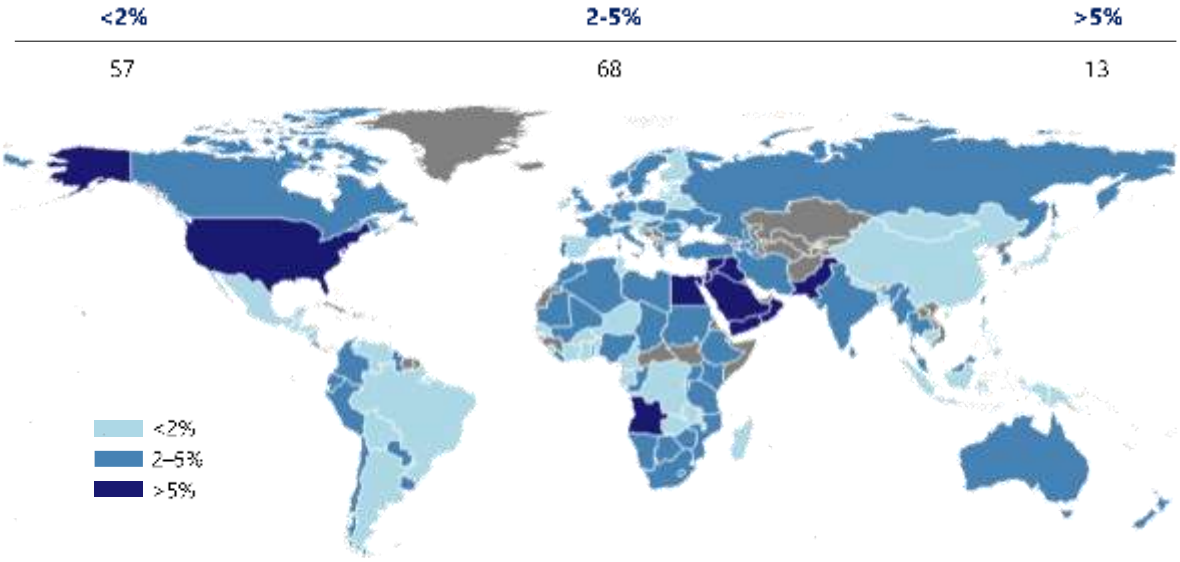
Sources: SIPRI, IMF World Economic Outlook.

Total global military spending rose from an annual average of US$410,927 million during 1970-1990 to US$1,703,810 million during 2010-2018. Countries in the Middle East spend the most on the military; on average, they spent 4.5 percent of GDP during the 1992-2018 period. By contrast, countries in the Western Hemisphere spent the least at around an average of 1.4 percent of GDP.

Trends in military spending in Sub-Saharan Africa indicate a decline, on average, in these outlays as a share of GDP. For the entire period, it averaged 2.1 percent of GDP, which is substantially higher than the average for the Western Hemisphere. In part, this is due to the high share of fragile states in Sub-Sahara Africa (nearly half). Fragile states, which have the lowest tax capacity, allocate more to the military vis-à-vis nonfragile states. This is consistent with the International Monetary Fund (2019), which explores the adverse fiscal, macroeconomic, and social effects of conflict in the region.

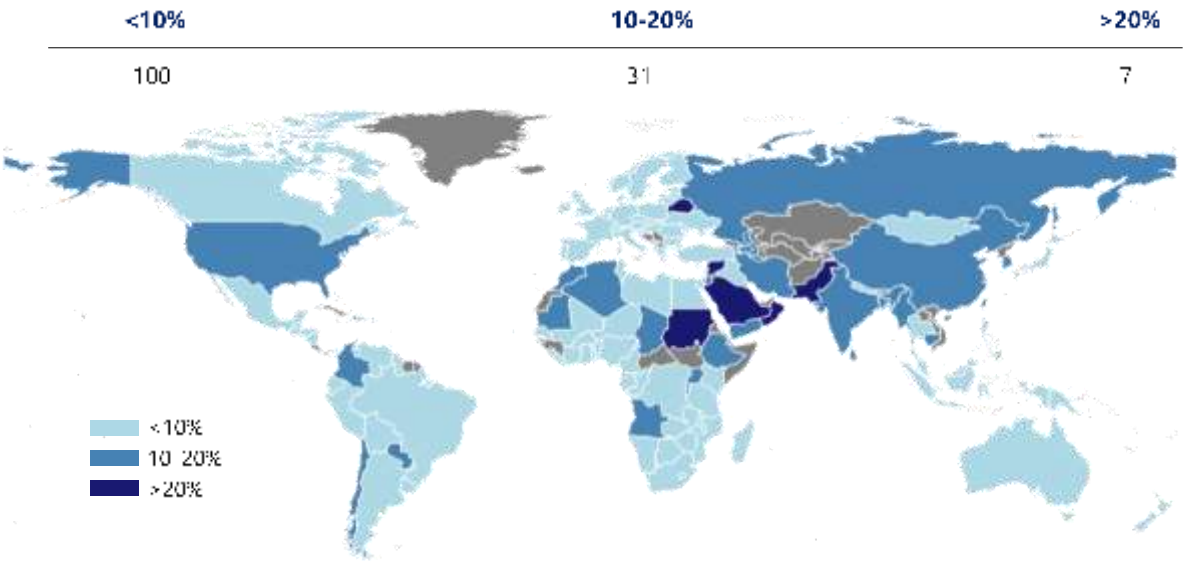
While military spending has, on average, declined, there is considerable heterogeneity across countries. Figure 2 indicates countries with military spending under 2 percent of GDP (57 in total), between 2-5 percent of GDP (68), and in excess of 5 percent of GDP (13). Figure 3 presents a similar distribution in relation to total spending. There are 100 countries with less than 10 percent of the budget allocated to the military, 31 that allocate between 10 and 20 percent, and only 7 countries allocate more than 20 percent of their budget to defense. It is worth noting that several advanced economies are in the top 15 military spenders and responsible for over 80 percent of worldwide military spending.

Figure 2. Global Distribution of Military Expenditure, 1970-2018
(as percentage of GDP)



Sources: SIPRI and authors' calculations.

Figure 3. Global Distribution of Military Expenditure, 1970-2018
(as percentage of total expenditure)



Sources: SIPRI, IMF World Economic Outlook, and authors' calculations.

Previous research has suggested several factors that could explain the observed decline in military spending. The first and foremost is the end of the Cold War and the improved global security environment which has lowered military tensions (Gleditsch et al. (1996), Gupta, Schiff, and Clements (1998), Rockoff (1998), and Avranitidis, Kollias and Anestasopoulos (2014), referred to hereon as "AKA"). Second, in the advanced economies, the pressure for fiscal consolidation

has persisted with the average debt-to-GDP ratio exceeding 100 percent in the post-financial crisis period (IMF 2018). Third, since the early 2000s, developing countries have sought to allocate a larger share of the budget to social sectors and infrastructure to meet the growing needs of their populations and to promote growth by investing in physical and human capital. More recently, the focus has shifted to the achievement of the Sustainable Development Goals (SDGs), which requires a major increase in government spending on the social sectors. Finally, advanced economies are faced with a rapidly aging population. In the absence of major reforms of pension and health systems, rising age-related spending will continue to exert pressure on other public spending including on the military (Clements et al. 2017).

The paper deploys a new approach to assess whether there is convergence (in terms of spending to GDP) across countries toward a common, lower level of outlays in the post-Cold War era. It finds that military spending in relation to GDP is converging, but into three separate groups of countries. For the largest group, comprising the highest military spenders and about 90 percent of total global military spending, outlays appeared to have plateaued at around 1.8 percent of GDP; and for a smaller group of 13 countries experiencing high degrees of conflict, spending has risen to a substantially higher level and diverged from the global trend. For a third group, comprising 27 countries, spending has converged to a lower level of about 1 percent of GDP. This paper also argues—based on a careful examination of the recent drivers of military spending—that further declines are possible in the developing economies, especially if progress can be made in reducing conflict and further increases in social spending are realized. In advanced economies, in contrast, social spending does not appear to exert much down pressures on military outlays.

The remainder of the paper is organized as follows: in the next section (II), we briefly review the literature on convergence and present a new approach to testing convergence in military spending. In section III, we look at the determinants of military spending, employing a new approach that explicitly captures the effect of social spending on military outlays. We also assess the impact of IMF-supported programs on military spending, revisiting an issue that was studied some twenty years ago (Gupta, de Mello and Sharan (2001).

II. Convergence Tests: Literature Review, Model, and Empirical Tests

A. Literature on Convergence in Military Spending

AKA were the first to study global convergence in military expenditure. Their study estimated both sigma and beta convergence for 128 countries during 1989-2008.[2] The first technique entails comparing the cross-section variation of military spending at two or more points of time, and the latter examines the relationship between the initial value of the converging variable and its growth rate. This methodology has been widely used in the literature to study convergence in growth rates and other economic variables across groups of countries Barro and Sala-i-Martin (1992). AKA concluded that there is worldwide convergence in military expenditure, mostly driven by major powers (i.e., USA, Russia, China, and India). They also find that the developing

[2] They took five snapshots of four-year averages of military spending in relation to GDP.

countries are converging at a faster pace than advanced economies, and that this convergence process leveled off in the second half of the 2000s.

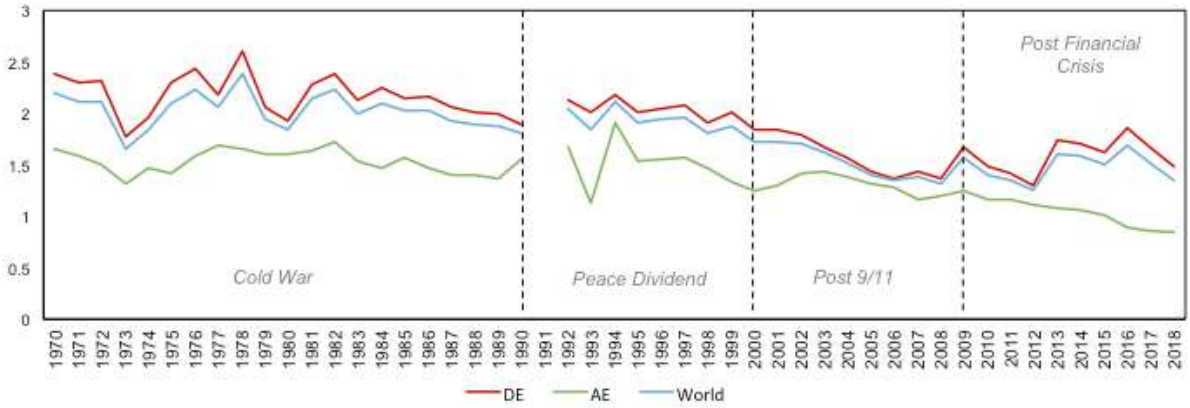
One concern with the sigma convergence tests is that a standard distribution of conventional statistics (e.g., t-statistics) under the null hypothesis does not exist. Because of this it is not possible to assess whether an observed convergence is statistically significant. Further, both sigma and beta convergence tests typically divide countries into subgroups based on prior information (e.g., geographical location, income level). By not allowing countries to be transitionally divergent between groups, there is a risk of biasing the convergence results.

Because of these considerations, Lau, Demir, and Bilgin (2015) took a different approach to testing convergence, instead applying a nonlinear unit root test. They use their nonlinear model on 37 countries spanning from 1988 to 2012. Convergence is tested on predetermined pairwise countries. They found a nonlinear convergence path which exists only when the military expenditure gap between pairwise countries reaches a certain threshold level. The results reveal that 53 percent of the sample countries converge to the world's average military expenditure, 39 percent to Germany, 32 percent to China, 22 percent to the USA, and 11 percent to Russia. However, their methodology cannot be applied to a group of countries (for example, advanced economies) to ascertain whether convergence is occurring within that group.

B. Testing Convergence

We begin by first applying sigma and beta convergence tests to the annual military expenditure data from Stockholm International Peace Research Institute (SIPRI). The country sample consists of 140 economies: 34 advanced economies (AE), and 106 developing economies (DE) and covers the period 1970-2017. The SIPRI data includes current and capital spending on armed and paramilitary forces, government agencies engaged in defense projects, and military space activities. It thus includes expenditures on personnel (including pensions), operations and maintenance, procurement and construction, research and development, civil defense, and demobilization. Figure (4) shows the sigma convergence within three groups of countries – AEs, DCs, and the world as a whole. The results show convergence in each of the subgroups.

Figure 4. Sigma Convergence in Military Expenditure, 1970-2018
(as percentage of GDP)



Sources: SIPRI and authors' calculations.

The baseline specification for studying beta convergence is as follows, where y is defined as military expenditure as a percentage of GDP:

$$\frac{y_{iT}-y_{i0}}{T} = a + \beta y_{i0} + \varepsilon_i \quad (1)$$

where the dependent variable is the average annual change in *y* over the *T* period and the independent variable is the is the initial *y*. The coefficient β is expected to be negative which indicate that a country with a higher (lower) initial *y* has a faster speed to decrease (increase).

Table 2 shows the baseline results for the whole sample, advanced economies, and developing economies. For the whole sample, the point estimate of the "beta" coefficient is -0.02 and it is statistically significant. A one-percentage higher initial value is associated with a 0.2 percentage faster decrease in the military expenditure as a percentage of GDP. Similar results are found for advanced and developing economies when they are tested as separate groups.

Table 2. Cross-Sectional Beta Convergence Test

	All	Advanced	DE
y_0	-0.0237***	-0.0250***	-0.0236***
	[0.0018]	[0.0012]	[0.0023]
Cons	0.0364***	0.0277***	0.0400***
	[0.0082]	[0.0051]	[0.0106]
Obs.	140	34	106
R-Sq	0.56	0.93	0.51

Sources: SIPRI and authors' calculations.

We then proceed to apply the methodology developed by Philips and Sul (2007), which does not suffer from the limitations of the sigma and beta tests noted earlier. Fritsche and Kuzin (2011) used this technique to analyze price level convergence in 12-member states of the euro area, in addition to Denmark, Sweden and the United Kingdom. In a similar vein, Monfort, Cuestas,

Ordonez (2013) applied it to their analysis of income per capita convergence in the European Union (EU). Under the approach, country data are decomposed in the following way:

$$y_{it} = \varphi_i \mu_t + \epsilon_{it}, \tag{3}$$

where y_{it}, the behavior of military expenditure as percent of total outlays or GDP of country i is explained by the common factor μ_t (e.g., threat from other countries), the unit characteristic component φ_i, and the error term ϵ_{it}. With simple manipulation, a time-varying factor representation can be derived from equation (3):

$$y_{it} = \left(\varphi_i + {}^{\epsilon_{it}}/_{\mu_t}\right)\mu_t = \delta_{it}\mu_t, \tag{4}$$

where the idiosyncratic part δ_{it} absorbs the unit characteristic component and the error term, and it varies over time. This equation explains military expenditure as an idiosyncratic ratio of the common dynamic path that a group of economies follow. A relative transition coefficient can be derived based on equation (4):

$$h_{it} = {}^{y_{it}}/_{N^{-1}\sum_{i=1}^{N} y_{it}} = {}^{\delta_{it}}\Big/_{N^{-1}\sum_{i=1}^{N} \delta_{it}}. \tag{5}$$

Coefficient h_{it} represents the transition path of military expenditures in an economy i relative to the cross-country common dynamic path. When military expenditures in all countries move toward the same transition path, i.e., are converging, $h_{it} \to 1$ for all countries as $t \to \infty$. Hence, the cross-country variance of $V_t = N^{-1}\sum_{i=1}^{N}(h_{it} - 1)^2 \to 0$. Parameter δ_{it} is can be modeled as:

$$\delta_{it} = \delta_i + {}^{\sigma_i \theta_{it}}/_{L(t)t^{\alpha}}, \tag{6}$$

where δ_i is fixed for each country i; σ_i is an idiosyncratic scale parameter; $L(t)$ is a slowly varying function with decay rate α; and error term $\theta_{it} \sim N(0,1)$. Therefore, the null and alternative hypotheses of convergence can be written as:

$$H0\text{: } \delta_i = \delta \text{ and } \alpha \geq 0, \tag{7a}$$

$$Ha\text{: } \delta_i \neq \delta \text{ or } \alpha < 0. \tag{7b}$$

As shown in Phillips and Sul (2007), cross-sectional variance of h_{it} has the limiting form of:

$$V_t \sim {}^{A}/_{(L(t)t^{\alpha})^2} \tag{8}$$

as $t \to \infty$ and $A > 0$. Practically, the convergence can be tested based on the following model:

$$\log(V_1) - \log(V_t) - 2\log L(t) = a + b\log t + \varepsilon_t, \tag{9}$$

for $t = rT, rT+1, \ldots, T$. Based on equation (9), using $b = 2a$, we can test the null hypothesis that b=2*$a \geq 0$, via a one-sided test, which in effect tests whether α in equation (8) ≥ 0. From the results reported in Table (3), for the coefficient b in equation 9, we see that the t-statistic for all three groups is above the 5% critical value of -1.65. This suggests convergence within each of the three groups. We also note that Group 1 converges at a faster rate than the other two groups.

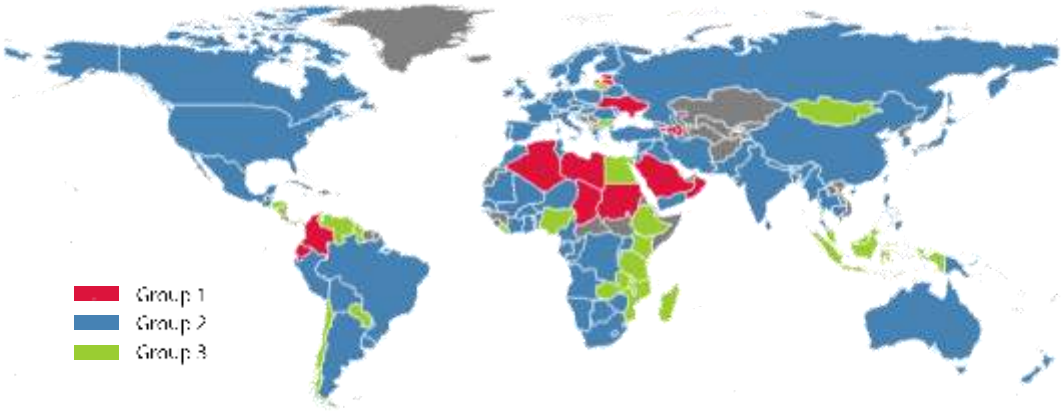
Table 3. Convergence Group Classification,1970-2018

Group	Countries	Time periods	Coefficient	S.E.	t-stat.
1	13	49	0.55**	0.35	1.58
2	98	49	-0.02**	0.01	-1.60
3	27	49	-0.19**	0.23	-0.82

Note: The null hypothesis is that all countries within each group converge to the same level. This test is a one-sided t-test and the critical value of 5% level is -1.65.

Figure 5 below provides a visual presentation of how convergence groups are distributed around the globe.

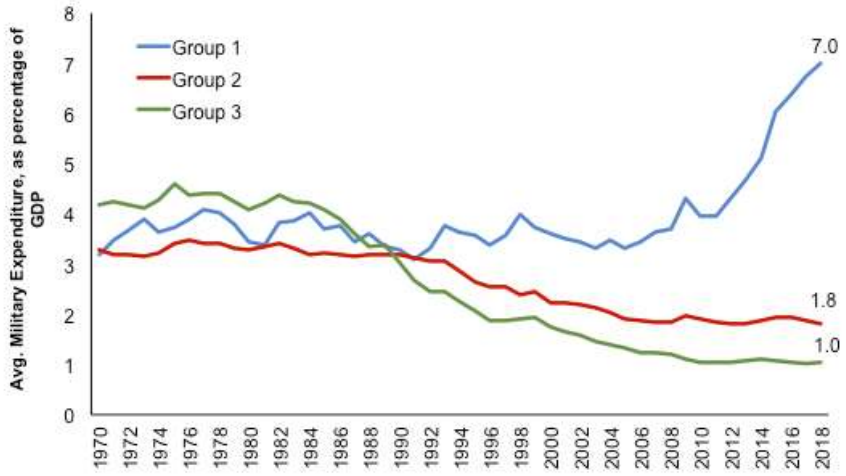
Figure 5. Global Distribution of Convergence Groups



Sources: SIPRI and authors' calculations.

Figure 6 shows the path of military spending as percentage of GDP for each group.

Figure 6. Average Military Expenditure as a Percentage of GDP in Each Group (1970-2018)



Note: USSR is not included in the above analysis and Russia is included after year 1991.

Source: SIPRI, IMF World Economic Outlook, and authors' calculations.

It is notable how group 2 and 3 follow the same downward trend after 1990, but at different rates. Group 2 is the largest of all three, on average accounting for 94 percent of global military expenditure and consisting of 98 countries—30 of which are advanced economies. Their average military outlays in relation to GDP fell significantly from 1990 through the mid-2000s, but have changed little since then. This group includes China, India, Russia, the United Kingdom and the United States. All these countries are members of the top 15 military spenders in absolute terms. Group 3 accounts merely for 2.2 percent of total global military expenditure and consists of 27 countries, only 2 of which are advanced economies–Lithuania and Slovenia. Unlike Groups 2 and 3, Group 1 trends upward. However, this is the smallest of the three groups, consisting of only 13 countries, 2 of which are advanced economies and accounting for 4.1 percent of global military expenditure. This group includes high-spending countries, such as Oman, Libya, and Saudi Arabia (A complete list of countries within each group is reported in the Appendix 1).[3]

III. Determinants of Military Spending

In the previous section, we found that military outlays remained virtually unchanged in recent years in countries incurring over 90 percent of global military spending. This naturally raises the question about the factors that have influenced military spending in the past 47 years, and what this suggests for military spending outlays going forward. This is addressed next.

A. Baseline Specification

Our central focus is to understand the factors that drive changes in military spending. We follow Kaufman and Segura-Ubiergo (2001) in employing an error correction model that can separate both the short-term and long-term effects of different factors driving government spending. Under this framework, we assume a long-term, cointegrating relationship between the level of the dependent variable (Y) and independent variables (X). In long term equilibrium (signified as *), this relationship can be described as $Y*_{i,t-1} = \gamma X*_{i,t-1}$. This relationship may not hold during all periods, but if the variables are cointegrated, deviations from the long-term equilibrium will be corrected in subsequent periods. Thus, for any given period t, changes in the independent variables will affect the dependent variable, but there may also be additional changes to correct any of the deviation from the long-term relationship observed in period t-1. More formally, this is reflected in the following equation:

$$\Delta Y_{it} = \alpha + \Delta X_{i,t-1} + \delta (Y_{i,t-1} - \gamma X_{i,t-1}) + \varepsilon_{it} \quad (10)$$

The coefficient on δ reflects how quickly the error in period t-1 from the estimated long-term relationship (that is, the difference between $Y_{i,t-1}$ and $\gamma X_{i,t-1}$) is corrected on an annual basis.

To see how this formulation can help identify both short- and long-term effects of the independent variables, let *Zj* be defined as $-(\delta\gamma)$, with δ and γ coming from equation (10). Making the appropriate substitutions of *Zj* into equation 10, the model can be transformed to:

[3] Performing the convergence test on a shorter period (1992-2018) yields similar results—the only difference is that the test yields two groups. This period has better quality data since it covers the period following the breakup of the former Soviet Union.

$$\Delta Y_{it} = \alpha + \delta Y_{i,t-1} + Zj\Delta X_{i,t-1} + \beta j X_{i,t-1} + \varepsilon_{it} \quad (11)$$

where ΔY_{it} is the change in the military expenditure of country i in year t, measured in percent of GDP. The first term on the right-hand side of the equation, $Y_{i,t-1}$, is the lagged level of military spending to GDP, and the coefficient estimate δ measures the annual rate at which the deviation from the long-term equilibrium relationship between the dependent and independent variables is corrected. $X_{i,t-1}$ is a vector of independent variables in levels, including the presence of an IMF-supported program (IMF_{it}) and the level of social spending in relation to GDP ($Social$). ΔX_{it} is the first difference of these variables.

This approach has several advantages. First, the coefficients on the levels captures the long-term relationship between variables. This can help determine, for example, if long-term trends in military spending are related to trends in social spending. The coefficients on the short-term variables helps explain whether there are short term or temporary effects that can be identified. The long-term effect of a permanently higher level of social spending is captured by the appropriate coefficient from vector γ in equation 10, which can be calculated (on the basis of the coefficients estimated in equation 11) by βj divided by –(δ). Another advantage of this formulation is that it can be estimated with OLS, while endogeneity concerns are reduced by the use of lagged variables.

The independent variables used in the model fall in four categories. The first category focuses on the impact of IMF programs on the level of military spending.[4] Gupta, Schena, and Yousefi (2018) list the conditionalities in IMF-supported programs, specifically on the expenditure side. They find that the utilization of expenditure conditionality has increased in the Fund programs since 1992, mostly in developing countries. At the same time, they find there were no conditions on military spending per se. Even without conditionality, however, IMF programs could still have an effect on military spending, given the need to adjust aggregate spending levels as part of countries' consolidation efforts. Furthermore, in recent years, the design of programs has undergone a significant change—with more emphasis on the composition of fiscal adjustment—making it important to reexamine this issue. This variable is measured as a dummy variable equal to 1 if the country has an IMF-supported program in that year and 0 otherwise.

A second category focuses on measures of security needs, based on both external and internal threats. Following Hewitt (1996), Davoodi et al. (2001), Collier and Hoeffler (2002), Zielinski, Fordham and Schilde (2017), and Nordhaus, Oneal, and Russett (2012), we use the level of military spending in neighboring countries to help capture perceived external threats. Average neighbor's military spending is calculated as a simple average of military expenditures of all countries that are defined as border countries, according to the Central Intelligence Agency's (CIA) World Factbook. The level of internal threats is captured by a country's political stability and level of violence/terrorism. Countries with a high degree of political stability and the absence of violence/terrorism face low internal threats and should have lower military spending needs. The political stability/absence of violence/terrorism indicator is drawn from the World Governance Indicators (WGI) and measures perceptions of the likelihood of political instability and politically

[4] See Zielinski, Fordham and Schilde (2017) for further discussion of the determinants of military spending identified in the literature.

motivated violence, including terrorism. To control for the potentially non-linear relationship association between military spending and internal threats, we split this variable into 2--high (for observations above the sample mean for this variable) and low (below the sample mean). Where political stability is relatively high and there is little terrorism (e.g., the majority of advanced economies), a change in this variable may have little impact on military spending; but in conflict afflicted countries, where the military may play a larger role in addressing terrorism and violence, the relationship could be expected to be stronger.

The third category focuses on governance and its effects on military outlays. Empirically, Gupta, de Mello, and Sharan (2001) show that countries with greater corruption are associated with higher military expenditure, whereas more transparent governments spend less. We use the polity score for this purpose, which measures key qualities of governing institutions. It ranges from -10 to 10, with the lower bound representing total autocracy and an upper bound a total democracy. Countries that are undemocratic are hypothesized to spend more on the military because of the need to use extra-judicial means to stay in power.

The fourth category encompasses the effect of social spending. As noted earlier, many developing countries have sought to raise their spending on education and health to achieve international development goals. This implies that the defense sector in these countries could meet competition for budget allocations vis-à-vis the social sectors. At the same time, countries with the tax capacity to finance a large role for government may be able to allocate high levels of spending both for social spending and military outlays. Thus, the hypothesized effect of social spending on military outlays is ambiguous. Government health and education expenditure data are taken from the World Bank. We also add to the model, as a control variable, the log of real GDP per capita, drawn from the IMF's World Economic Outlook (WEO).

B. Empirical Results

Estimation results—which include country- and time-fixed effects—are reported in Table 5. Due to data limitations, the econometric results cover the period 1996 to 2014. The one-period lagged level variables are designated as "L." and the first differences of variables are designated as "D."

Consistent with the results from the convergence tests, the model results suggest that military spending has fallen at the fastest pace for countries with the highest initial levels of spending, given the negative coefficient for the lagged level of military expenditure to GDP. This relationship holds for both advanced and developing economies, but is relatively stronger in the latter group. With respect to the effect of Fund programs, these appear to have no statistically significant effect, both in the short and long-run.[5]

[5] We also tested whether Fund-supported programs affected military outlays through their impact on social spending. That is, Fund-supported programs, through their positive effect on social spending, might have an indirection impact on military outlays. The results from these estimates, however, were statistically insignificant.

Table 4. Error Correction Model of Military Spending
(dependent variable: annual change in military spending as a share of GDP)

	All	AEs	DEs
L. Military Expenditure (as percentage of GDP)	-0.3364***	-0.1997***	-0.3450***
	[0.0427]	[0.0322]	[0.0455]
L. IMF Program	0.0087	-0.0567	0.023
	[0.0396]	[0.0477]	[0.0434]
D. IMF Program	-0.0076	0.0229	-0.0089
	[0.0331]	[0.0300]	[0.0369]
L. GDP per Capita	0.1756	-0.0361	0.1642
	[0.2082]	[0.1722]	[0.2465]
D. GDP per Capita	-0.2553	0.5977	-0.3902
	[0.5297]	[0.4227]	[0.6073]
L. Polity Score	0.0027	0.0046	0.0005
	[0.0071]	[0.0161]	[0.0077]
D. Polity Score	0.0043	-0.0428**	0.0055
	[0.0057]	[0.0185]	[0.0061]
L. High Political Stability and Absence of Violence/Terrorism	-0.0735	-0.1637**	-0.0774
	[0.0587]	[0.0664]	[0.0638]
D. High Political Stability and Absence of Violence/Terrorism	-0.1937	-0.2284***	-0.186
	[0.1331]	[0.0470]	[0.1356]
L. Low Political Stability and Absence of Violence/Terrorism	-0.1264	-0.0227	-0.1505*
	[0.0787]	[0.0684]	[0.0900]
D. Low Political Stability and Absence of Violence/Terrorism	0.0162	-0.0147	0.0235
	[0.0588]	[0.0369]	[0.0708]
L. Average Neighbors' Spending (as percentage of GDP)	0.0859***	0.0553	0.0855***
	[0.0242]	[0.0624]	[0.0241]
D. Average Neighbors' Spending (as percentage of GDP)	-0.0977*	0.0512	-0.1074**
	[0.0512]	[0.2034]	[0.0518]
L. Health and Education Spending (as percentage of GDP)	-0.0379***	-0.0054	-0.0405***
	[0.0143]	[0.0094]	[0.0146]
D. Health and Education Spending (as percentage of GDP)	0.0092	0.0162	0.0061
	[0.0195]	[0.0104]	[0.0217]
Obs.	1357	317	1040
R-Squared	0.31	0.42	0.32

Note: Country– and time-fixed effects are included in all specifications. Robust standard errors are clustered at country level in parentheses. *, **, and *** indicate significance at the 10, 5, and 1 percent level, respectively.

Sources: SIPRI, IMF World Economic Outlook, World Bank World Development Indicators, World Bank World Governance Indicators, and authors' estimates.

The model results underscore the importance of internal security concerns in driving military spending. Surprisingly, this relationship also holds in the advanced economies, where both first difference and level variables are significant and negative—indicating both a short and long-term relationship between reducing domestic conflict and reducing military outlays.[6] In the developing economies, there is a significant long-term relationship between internal security and military spending. The results suggest a significant peace dividend can come from reducing internal conflicts. For example, improving political stability and the absence of violence/terrorism for countries from the worst 25 percentile of developing countries to the top 75 percent would, over the long run, reduce spending by about ½ a percent of GDP.[7]

For advanced economies, military spending does not appear to react to defense outlays in neighboring countries. In developing economies, however, the long-term relationship is positive between the level of spending in neighbors and a country's own spending. Based on the long-term coefficient estimate (Appendix 2), a 1 percent of GDP decline in neighbors' spending in developing economies would reduce a country's outlays by 0.25 percent of GDP.

With respect to the effects of governance and military spending, the results are mixed. Surprisingly, a higher polity score does not appear to have an effect on defense outlays in developing countries. In advanced economies, a higher polity score does reduce military spending, but only in the short run. The size of the coefficient is also quite small.

The results suggest that social spending does not crowd out defense outlays in advanced economies, but does so in the developing world. The long-term coefficient estimates indicate that vigorous increases in these outlays to meet the SDGs would indeed put significant pressure on defense spending. An increase in social spending of 5 percent points of GDP in social spending, for example, would cut defense spending by ½ percentage point of GDP over the long term—a sizeable decrease in many developing countries, including in sub-Saharan Africa, where this would cut spending by more than quarter from present levels.

IV. Concluding Remarks

Our results, using the improved technique of Philip and Sul, show that there is indeed convergence in military spending, but into 3 distinct groups. For the largest country group (group 2) accounting for over 90 percent of global military spending, outlays have fallen from their Cold War levels, but appear to have plateaued at an average of around 1.8 percent of GDP. In a small group of countries, conflict has driven increases in outlays to a substantially higher level (about 7 percent of GDP) while in a group of primarily developed economies, spending has fallen from around 3 percent of GDP in the pre- Cold War era down to about 1 percent of GDP.

[6] Almost all of the advanced countries are classified as having a high degree of political stability and absence of violence and terrorism. Thus, the most relevant coefficients in the case of the advanced economies are those associated with countries with a high (above average) score on this variable. For the developing economies, the coefficients for countries with a low (below) average score are most relevant.

[7] Based on the long-term coefficient estimate in Table 5 (.15), divided by the lagged dependent variable from Table 5 times minus 1 (see appendix 1), and the change in the political stability and absence of violence/terrorism between countries in the top 25 percent and bottom 75 percent (1.24).

These results naturally raise the question of regarding the key determinants of military spending. Unlike earlier studies, we find no significant effect from IMF programs. We could also not find any impact of governance on military spending in developing economies. Nevertheless, many of the other key determinants of military spending identified in previous research remain important, although not across all country groups. For example, external threat levels, as measured by the level of defense spending of neighbors, only appear to be a factor in developing economies. Our findings also underscore the potential impact of reducing internal conflict on military spending. For developing economies, improvements in the measure of internal threats (higher political stability and absence of conflict/terrorism) from the bottom 25 percent of the distribution to the top 25 percent could lead to a reduction of ½ percent of GDP in military spending. Our results suggest that there remains a substantial "peace dividend" to be realized by reducing external and internal threats, which could help finance other categories of spending or fiscal consolidation.

Our analysis also suggests that social spending could put pressure on military spending, but only in the developing economies. As health and education spending rises in these economies as they seek to achieve the SDGs, military spending can be expected to decline.

Appendix 1. Convergence Groups, 1970-2018

Group	Countries
Group 1	Algeria, Armenia, Azerbaijan, Chad, Colombia, Ecuador, Estonia, Latvia, Libya, Oman, Saudi Arabia, Sudan, Ukraine.
Group 2	Angola, Argentina, Australia, Austria, Bahrain, Bangladesh, Belarus, Belgium, Belize, Benin, Bolivia, Botswana, Brazil, Brunei Darussalam, Burkina Faso, Burundi, Cambodia, Cameroon, Canada, China, Democratic Republic of the Congo, Republic of Congo, Croatia, Cyprus, Czech Republic, Côte d'Ivoire, Denmark, Dominican Republic, Fiji, Finland, France, Gabon, Gambia, Germany, Ghana, Greece, Guatemala, Hungary, India, Iran, Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Korea, Kuwait, Lebanon, Lesotho, Luxembourg, Mali, Malta, Mauritania, Mauritius, Mexico, Moldova, Morocco, Myanmar, Namibia, Nepal, Netherlands, New Zealand, Niger, Norway, Pakistan, Papua New Guinea, Peru, Philippines, Poland, Portugal, Romania, Russia, Rwanda, Senegal, Sierra Leone, Singapore, Slovak Republic, South Africa, Spain, Sri Lanka, Swaziland, Sweden, Switzerland, Syria, Taiwan, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, United Kingdom, United States, Uruguay, Yemen, Zimbabwe.
Group 3	Albania, Bulgaria, Cabo Verde, Chile, Egypt, El Salvador, Ethiopia, Guyana, Honduras, Indonesia, Kenya, Liberia, Lithuania, Madagascar, Malawi, Malaysia, Mongolia, Mozambique, Nicaragua, Nigeria, Panama, Paraguay, Seychelles, Slovenia, Tanzania, Venezuela, Zambia.

Sources: SIPRI, IMF World Economic Outlook, and authors' estimates.

Appendix 2. Estimating Long-Term Effects

The coefficients (β) of the lagged-level variables measure the long-term effects on the change in military spending. When the coefficient estimate is statistically significant, it indicates the long-term trend in military spending is associated with the trend in such an independent variable. To gauge the strength of these effects, we follow Kaufman and Segura (2001) and divide these coefficients β by the coefficient of lagged military spending times minus 1 ($-\delta$), which indicates the long-term impact of a change in independent variable in question on military spending as a share of GDP.

For the whole sample, the long-term trend in military spending is negatively associated with social spending, and is positively associated with neighbors' military outlays. These results are driven by the developing economies. In both advanced and developing economies, high political stability and the absence of violence/terrorism (that is, less internal conflict) is negatively associated with military spending.

Appendix 2.1. Long Term Coefficients for Determinants of Military Spending

	All	AEs	DEs
Health and Education Spending (as percentage of GDP)	-0.1127***	-0.0270	-0.1174***
Average Neighbors' Spending (as percentage of GDP)	0.2554***	0.2769	0.2478***
Polity Score	0.0080	0.0230	0.0014
GDP per Capita	0.5220	-0.1808	0.4759
IMF Program	0.0259	-0.2839	0.0667
Low Political Stability and Absence of Violence/Terrorism	-0.2185	-0.8197**	-0.2243
High Political Stability and Absence of Violence/Terrorism	-0.3757	-0.1137	-0.4362*

Note: Robust standard errors are clustered at country level in parentheses. *, **, and *** indicate significance at the 10, 5, and 1 percent level, respectively.

Source: Authors' calculations, based on econometric results in Table 5.

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