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Converging Defence Burdens? Some Further Findings

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Abstract: Building on recently published findings that point to a process of convergence in terms of defence burdens internationally, this paper readdresses the issue for the period 1970–2015 using SIPRI's new dataset. The new consistent data constructed by SIPRI offers the opportunity to extend the time period of the empirical investigation into the convergence issue, thus allowing for better insights over a longer time horizon that covers both the Cold and post-Cold War periods.

Keywords: convergence, defence burden, military spending

1 Introduction

Two recent papers by Lau et al. (2016) and Arvanitidis et al. (2014) examined whether or not on an international level the defence burdens – i.e. military spending as a share of GDP – are converging towards similar levels. Lau et al. (2016) use a sample of 37 countries covering the period 1988–2012 and apply a nonlinear unconditional β -convergence methodology to address the issue at hand. The reported results suggest a process of convergence towards the world's average defence burden as well as club convergence between groups of countries. Standard, σ -convergence and β -convergence methodologies are used by Arvanitidis et al. (2014) to address the same question but with a significantly larger sample over a slightly shorter period (1988–2008). Their findings stemming from a sample of 128 countries, also render support in favour of a convergence hypothesis. The convergence theme is taken up by this paper using SIPRI's new consistent dataset that offers the opportunity to extend the time period of the empirical investigation to include the Cold War era (Perlo-Freeman and Sköns 2016; Sandler and George 2016). SIPRI's military spending data is the only long run, consistent dataset on

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such public expenditures with a global coverage. However, as discussed in detail by Perlo-Freeman and Sköns (2016), due to a number of constraints, limitations and shortcomings, methodologically consistent data series has up to now been available only from 1988 onward. SIPRI has now reconstructed in a methodologically consistent manner its data that now in the case of some countries extends as far back as 1949 and can be used in empirical research¹. Thus, the availability of appreciably longer time series on defence spending that extend well into the Cold War period, offers the opportunity for better insights and inferences on the defence burden convergence issue. Ultimately of course, given data constraints, the sample chosen for the empirical tests conducted herein was a compromise between T and N. It consists of 86 countries and covers the period 1970–2015.

2 Methodology and findings

Within the broader policy convergence discourse (*inter alia*: Bennett 1991; Knill 2005; Seeliger 1996) defence policy convergence may be defined as any increase in the similarity between one or more policy aspects – i.e.: objectives, means, instruments, practises – across a given set of countries over a defined period of time (Pannier and Schmitt 2014). A number of factors have been identified as influencing cross-national policy convergence in general (*inter alia*: Drezner 2005; Holzinger and Knill 2005; Obinger, Schmitt, and Starke 2013; Plumper and Schneider 2009). For example, drivers such as independent but similar problem solving, coercion, competition, communication, emulation and learning, increase the likelihood for policy harmonisation. In particular, when it comes to defence policy convergence, determinants and drivers include the emergence of new but common global security challenges such as transnational terrorism; the enhanced role of transnational networks and institutions that promote cross country cooperation and problem solving through diplomatic and political means rather than resorting to violence; the peace promoting impact of globalisation and international trade (*inter alia*: Kollias and Paleologou 2016; Mayer 2014; Nohrstedt and Hansen 2010; Pannier and Schmitt 2014; Zaiotti 2012).

To examine the issue at hand, two widely used convergence methodologies are employed: β -convergence and club-convergence. The former, also referred

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¹ A detailed discussion of the issues associated with the reconstruction of the database can be found in Perlo-Freeman and Sköns (2016). Before its official public release in late 2016, this database was made available to a select international group of researchers to use and evaluate in empirical studies.

to as absolute or unconditional β -convergence, examines the relation between the initial value of the converging variable and its subsequent growth rate in a specified period (Barro and Sala-i-Martin 1991, 1992, 1995). A negative such relation indicates a catch-up movement whereby high spenders reduce the share of defence expenditures to GDP over time, or laggards spend relatively more, or both, and in the long run they all converge to the same level of military burden (Arvanitidis et al. 2014). In formal terms, the model estimated has the following form:

$$g_{i,t} = \alpha + \beta y_{i,0} + \varepsilon_i \quad (1)$$

where $g_{i,t}$ is the natural logarithm of the growth rate of the converging variable (in the $[0, t]$ period for the n countries), $y_{i,0}$ is the natural logarithm of the converging variable at time 0, ε_i is the error term [$\varepsilon \sim N(0, \sigma^2)$], α is the constant term and β is the convergence coefficient. A negative and statistically significant β indicates unconditional β -convergence across countries for the examined time period, while a positive sign indicates unconditional β -divergence. The convergence process is traditionally characterised by its convergence speed and half-life². The convergence speed can be estimated as follows: $b = -\ln(1+\beta)/T$ (where T is the number of time intervals) and the half-life is estimated by $\tau = -\ln(0.5)/b$. However, conventional β -convergence studies tend to disregard the relative importance of each unit (country) in the total setting (world), treating all observations as equal. As such, ordinary least square (OLS) regression analysis is typically used. Yet, countries vary widely in terms of relative size. For instance, in terms of population or surface area. Both can bear an influence on the level of defence expenditures. Hence, OLS analysis may give rise to erroneous and misleading results (*inter alia*: Firebaugh 1999; Petrakos, Rodriguez-Pose, and Rovolis 2005; Sala-i-Martin 2002). The weighted least square (WLS) regression method is able to overcome this drawback, allowing countries to have an influence on the regression results analogous to their relative size (Artelaris, Arvanitidis, and Petrakos 2011; Petrakos and Artelaris 2009). For our purposes here, the surface area of each country at the initial period (1970) is used to weight our observations in WLS³ estimations. Another methodology used in convergence studies is club convergence. This methodology transcends the “all-or-nothing” logic behind conventional analysis and maintains that countries with similar characteristics lump together in groups which exhibit different convergence dynamics (Quah 1996).

² The half-life is the time necessary for the countries to fill half of the variation that separates them from their steady state satisfying the condition $e^{-\beta\tau} = 1/2$.

³ Data drawn from the World Bank.

To test for existence of club convergence Baumol and Wolff (1988) propose the following quadratic specification:

$$g_{i,t} = \alpha + \beta y_{i,0} + \gamma y_{i,0}^2 + \varepsilon_j \tag{2}$$

This function introduces nonlinearities in convergence implying the existence of two groups of countries. If parameter β is negative and γ is positive the quadratic function is a parabola that opens upward, indicating that countries converge up to a threshold, while divergence trends dominate afterwards. In turn, a positive β and a negative γ indicate divergence of laggard counties for values below a threshold point, followed by convergence of the initially higher spenders.

To proceed with the estimation of (1) and (2) we take two snapshots of the defence burden (i.e. military spending as a share of GDP) at 1970 (t_1) and at 2015 (t_2) for each of the 86 countries that makeup our sample. Following Arvanitidis et al. (2014), each snapshot is the average defence burden of the previous 5 years. This mitigates two problems: first, idiosyncratic values of the variable concerned due to year specific circumstances (political, social, economic, etc.) that a country might have faced, and second, lack of country data, in some cases for specific years, which would have resulted in a smaller sample of countries. The results of estimating (1) using both OLS and WLS are presented in Table 1. For each model we report the estimated β coefficients and their statistical significance, the speed of convergence b and the half-life τ . As can be observed, the β coefficients are negative and statistically significant in both cases, indicating cross-country convergence in terms of defence burdens. However convergence is weaker and slower when the size of each country is taken into account. Thus, whereas in unweighted estimates the speed of convergence is about 7.9% (at the 5-year period examined) and the half-life is about 8.8 terms (at a 5-year period), in the WLS estimation the speed and half-life drops by almost half (4.3% and 16 terms, respectively). Furthermore, as Chatterji (1992) points out, the small values of the β coefficients (less than zero in both the OLS and WLS estimations) indicate a rather weak world convergence process. Figure 1, is a graphical representation of the both the OLS and WLS β -convergence analysis where the dotted lines are the regression lines

Table 1: β -convergence results.

	β	t-stat	N	R ² -adj	b (5-year period)	τ (5-year period)
OLS	−0.509***	7.310	86	0.382	0.0791	8.7665
WLS	−0.323***	4.080	86	0.168	0.0434	15.9862

***Significant at 0.005 level.

Figure 1: Cross-country β -convergence.

Figure 2: Detailed cross country β -convergence in military burdens.

and the size of bubbles in the second graph correspond to the country size i.e. the weights in the WLS estimation.

As a next step, further visual scrutiny is offered in Figure 2 with respect of the evolution of the sample’s defence burdens based on the β -convergence analysis. The vertical and horizontal lines of the cross in the centre of the diagram, represent the average defence burden of the sample: the vertical at the initial period 1970 (which was 3.25%) and the horizontal the change between 1970 and

2015 (which was -1.34%). Four quadrants are formed containing the 86 countries of the sample. Area I contains 12 countries with defence burdens that exceed the world average. All had relatively higher (to the sample average) initial military spending as a percentage of GDP. Five of them have increased their defence burdens whereas the rest decreased their burdens but still remained above the world average. In turn, quadrant II includes countries that in 1970 had a lower vis-à-vis the sample average defence burden. Of the 28 countries in this area, 21 have increased their spending, whereas the rest reduced it, but all stayed above the world average. The 11 countries of quadrant III not only had a lower to world average initial defence burden but also they reduced it more than the average over the period examined here. The remaining 35 countries (area IV) initially had a share of military spending to GDP above the world average but over the period examined their defence burdens declined at a rate higher to the average country. Table 2 lists the countries according to the quadrant they belong, ranked in terms of growth in military spending as a share of GDP (from higher to lower). In bold those that increased their defence burdens (positive change) and in plain text those that reduced it over the period examined here. Noteworthy is the fact that major Cold War powers and protagonists such as the USA, the UK, France, Canada, Germany, Netherlands, Belgium fall within quadrant IV (last column in Table 2) i.e. they initially had a share of military spending to GDP above the world average but over the period examined their defence burdens declined at a rate higher to the average country of our sample. In fact, this is the case with most of the older members of the NATO alliance, with Turkey being the only exception (quadrant I) that remained above the sample's average but still with a reduced national defence burden vis-à-vis the initial level.

As the final step in the empirical investigation, the results of the club-convergence methodology using the polynomial analysis proposed by Baumol and Wolff (1988) with both unweighted and area-weighted observations are presented in Table 3. As it can be seen in both the OLS and WLS cases the relevant coefficients are not statistically significant. This can be tentatively interpreted as indicating that there are no econometrically and statistically traceable distinct convergence clubs of countries with similar trends in terms of defence burdens.

3 Concluding remarks

This brief note, re-addressed the defence burden convergence hypothesis that was examined by two recently published papers (Arvanitidis et al. 2014; Lau et al. 2016). It did so by appreciably extending the time period in order to include the

Table 2: Countries per quadrant in β -convergence.

I	II		III		IV	
	Change 1970–2015		Change 1970–2015		Change 1970–2015	
	Positive	Negative	Positive	Negative	Positive	Negative
Algeria (DZA)						Singapore (SGP)
Morocco (MAR)				Argentina (ARG)		Thailand (THA)
Kuwait (KWT)				Philippines (PHL)		Greece (GRC)
Colombia (COL)				Spain (ESP)		Korea, South (KOR)
Libya (LBY)				Benin (BEN)		Pakistan (PAK)
				Luxembourg (LUX)		Italy (ITA)
		Saudi Arabia (SAU)		Austria (AUT)		Brazil (BRA)
		Lebanon (LBN)		Madagascar (MDG)		Denmark (DNK)
		Congo, Rep. (COG)		Nicaragua (NIC)		Australia (AUS)
		Myanmar (MMR)		Guatemala (GTM)		France (FRA)
		India (IND)		Ireland (IRL)		Iran (IRN)
		Chile (CHL)		Switzerland (CHE)		Iraq (IRQ)
		Turkey (TUR)				Paraguay (PRY)
						New Zealand (NZL)
						United States (USA)
						South Africa (ZAF)
						Peru (PER)
						United Kingdom (GBR)
						Canada (CAN)
						Norway (NOR)
						Venezuela (VEN)

Table 2 (continued)

I	II		III		IV	
	Change 1970–2015		Change 1970–2015		Change 1970–2015	
	Positive	Negative	Positive	Negative	Positive	Negative
				Finland (FIN) Sierra Leone (SLE) Liberia (LBR) Afghanistan (AFG) Mali (MLI) Tanzania (TZA) Cameroon (CMR)		Netherlands (NLD) Portugal (PRT) Ghana (GHA) Malaysia (MYS) Germany (DEU) Belgium (BEL) Israel (ISR) Sweden (SWE) Ethiopia (ETH) Hungary (HUN) Dominican Rep. (DOM) Jordan (JOR) Egypt (EGY) Nigeria (NGA)

Table 3: Club-convergence findings.

	Linear OLS	Quadratic OLS	Linear WLS	Quadratic WLS
(ln) Military Exp. 1970	−0.509*** (7.310)	−0.210 (0.554)	−0.323*** (4.080)	−0.363 (0.665)
(ln) Military Exp. 1970		0.039 (0.803)		0.099 (1.271)
Squared				
N	87	87	87	87
Adj-R ²	0.382	0.379	0.168	0.162

***significant at 0.005 level, t-value in parentheses.

Cold War era. To do so, it used SIPRI’s recently constructed consistent database on world military expenditures (Perlo-Freeman and Sköns 2016; Sandler and George 2016). The results reported herein, accord with the earlier findings. For a sample of 86 countries covering the period 1970–2015, a process of convergence in terms of defence burdens was established. Given that the share of military expenditures to GDP represent the resources allocated by countries for the implementation of national defence policy, the findings reported herein can tentatively be interpreted as indicating a process of policy convergence albeit a weak and slow one. Furthermore, allowing for the inevitable exceptions, the predominant trend for most countries is decreasing defence burdens. In principle, allocating a smaller share of national income to defence, frees up resources that can potentially find other, socially more preferable uses, hence propping up development. This is particularly important for countries that are resource constrained.

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