GLOBAL PATTERNS OF CONVERGENCE AND DIVERGENCE IN DEFENCE BURDENS: 1950-2015. A BIRD'S EYE VIEW

Paschalis Arvanitidis, Christos Kollias

CESPIC WORKING PAPER
2018/03

GLOBAL PATTERNS OF CONVERGENCE AND DIVERGENCE IN DEFENCE BURDENS: 1950-2015. A BIRD'S EYE VIEW

Paschalis Arvanitidis **Christos Kollias**

Department of Economics, University of Thessaly,
43 Korai street, 38333, Volos, Greece

Abstract: Military spending as a share of GDP, represents the resources used in the implementation of national defence policy. A convergence in terms of defence burdens would be an indication of a defence policy convergence in terms of inputs. This theme is examined here using SIPRI's new consistent database that covers both the Cold War era as well as the post-bipolar period. The results reported herein point to a process of convergence only in the post-bipolar period possibly reflecting the emergence of defence policies that share similar characteristics at least in terms of the allocation of resources. However, this convergence pattern seems to be reversing in recent years.

Introduction

Within the broader convergence discourse (*inter alia*: Barro, 1991; Barro and Sala-i-Martin, 1992; De, 2014), a strand of this literature has focused on the question of policy convergence between countries (*inter alia*: Cao, 2012; Busch and Jorgens, 2005; Benett, 1991; Drezner, 2001, 2005; Jordan, 2005). In broad terms, policy convergence may be defined as the gradual process through which countries exhibit similar traits in terms of one or more policy characteristics such as objectives, inputs, instruments, outputs. Without delving into the details of the policy convergence discourse, several factors have been identified as potential drivers of a policy convergence process. Among others, they include harmonization, copying of best practices, compliance, imposition of policies, independent but similar national responses to similar or common challenges such as those emanating from the international security environment.

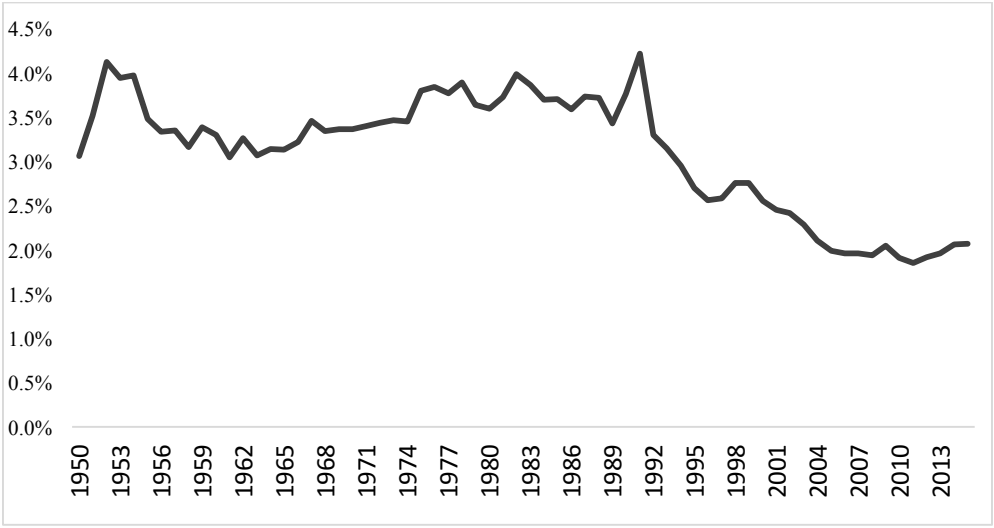
Although several factors can be hypothesized as determining the level of resources allocated to national defence, the predominant ones are almost invariably strategic in nature (*inter alia*: Bove and Brauner, 2016; Douch and Solomon, 2014; Wang, 2013; Flores, 2011; Dunne *et al*. 2008; Dunne and Perlo-Freeman, 2003). The annual defence budget is the monetary quantification of the resources allocated to national defence and denotes the costs of the inputs that go into the production of military capabilities. Expressed as a share of GDP, military expenditure reflects the defence burden of a country in terms of the inputs that the implementation of national defence policy absorbs. The presence or not of an international convergence process in terms of defence spending as a share of GDP was the theme of recent papers by Lau *et al*. (2016), Arvanitidis and Kollias (2016) and Arvanitidis *et al*. (2014). They report findings that point to the existence of such a process. However, in Lau *et al*. (2016) and Arvanitidis *et al*. (2014), the time span of the analysis is limited to the post-Cold War period due to data availability limitations. SIPRI has recently extended its military expenditure dataset that until now covered the period since 1988. The new database offers consistent estimates across countries that in a number of cases date back to 1949 (Sandler and George, 2016; Perlo-Freeman, 2017; Perlo-Freeman and Sköns, 2016). SIPRI's new dataset offers the opportunity to readdress the defence burdens convergence theme for almost the entire post World War II period and hence

for better insights and inferences. This issue is examined in the present paper, utilizing SIPRI's entire dataset for the period 1950-2015. In the section that follows brief snap-shots of the data used are presented as enticers for the empirical investigation. The methodologies used to tackle the issue at hand are also briefly discussed in this section. The findings are presented and discussed in section three while section four concludes the paper.

Data snap-shots and methodology

We start the descriptive presentation of the data used by looking at the trends exhibited by the variable concerned throughout the entire period, i.e. 1950-2015. The average defence burden is estimated for every year using all the country data available for each specific year. The world average can be visually in inspected in Figure 1. Despite the inevitable fluctuations from one year to the other, two broad periods are identifiable in terms of a prevailing trend in the series. The Cold War period during which a mild upward trend is dominant and the post-bipolar with a clear and fairly sharp downward trend dominating during this period. The latter appears to level-off from around the mid-2000s and a mild reversal seems to be present in more recent years. The prominent spike in the series just before the downward trend during the post-Cold War period is attributable to the extreme value for Kuwait in 1991. As a direct outcome of the 1990 Iraqi invasion and the Gulf War that followed, Kuwait's defence burden in 1991 soared to 117.3% of GDP (48.5% in 1990 and 31.8% in 1992). Similarly, the notable sharp increase during the first years of the period presented in Figure 1, can probably be attributed to the Korean War.

Figure 1: Average defence burden 1950-2015



During the period in question, the average defence burden value was 3.1%. Higher during the Cold War period - 3.5% during 1950-89 - and lower in the post-bipolar one, averaging 2.5% during 1990-2015. As can be seen in Table 1, during all the Cold War decades the defence burdens globally averaged over 3% of GDP, with the 1980s being the decade when the highest value is recorded (3.7%) followed by the 1970s with a 3.6% global average. A steady downward trend is the case for all the post-bipolar sub-periods presented in Table 1.

Table 1: Average defence burden per decade

1950-59	3.5%		
1960-69	3.2%		
1970-79	3.6%	1950-2014	3.1%
1980-89	3.7%	1950-1989	3.5%
1990-99	3.1%	1990-2015	2.5%
2000-09	2.2%		
2010-15	2.0%		

Although various approaches to test for convergence have been discussed in the literature ranging from simple statistical measures, to regression analysis, time-series analysis and transitional dynamics, two are the key methodologies that have

most commonly been used. These are *β*-convergence and *σ*-convergence, which are briefly discussed next. The former, i.e. *β*-convergence, examines the relation between the initial value of the converging variable - in this case military burden - and its subsequent growth rate (i.e. its change in a specified period) for a set of countries. A negative such relation indicates a catch-up movement where low spenders increases their defence expenditures as a share of GDP, or high spenders reduce them, or both, and in the long run all converge to an equilibrium position, known as *steady state* (Arvanitidis *et al*, 2014). If however, the focus of the empirical investigation is on how the entire group of countries has behaved in the past, then *σ*-convergence is a more appropriate methodology to be adopted. It examines the dispersion of the variable under investigations for a set of countries using a number of suitable measures, such as the range, the variance, or the coefficient of variation. The convergence hypothesis is accepted if the dispersion of the cross-section levels diminishes over time. It should be noted that in *σ*-convergence analysis it is irrelevant whether a single country shows convergence to a steady state. What matters, instead, is how the entire cross-section behaves. Quah (1993, 1993a, 1997) stresses the importance of the *σ*-convergence methodology over *β*-convergence on the basis that the former implies the latter, but not vice versa, arguing that *σ*-convergence also provides an indication as to whether the distribution in the sample is becoming more equitable. Traditionally, convergence studies tended to overlook the relative size of each country, treating all observations as equal. This causes no problem to studies using convergence as a test of economic growth theories, but may lead to different outcomes and, perhaps, erroneous inferences if the objective is to assess world distribution and inequality (*inter alia*: Firebaugh, 1999; Sala-i-Martin, 2002; Artelaris *et al*, 2011), which is the case here. As such, weighted measures of *σ*-convergence have been suggested, allowing countries to have an influence to the statistical convergence measure used which is analogous to their relative size.

The most frequently used measure of *σ*-convergence is the coefficient of variation. However, other statistics and indices have also been employed, ranging from simple ratios to various entropy measures. For our purposes here, we use six such measures to explore the presence or not of convergence in terms of defence

burdens internationally. These are: the unweighted coefficient of variation (*CV*), the area-weighted coefficient of variation (CV_w):

$$CV = \frac{\sigma}{\bar{x}} \tag{1}$$

$$CV_w = \frac{\sigma_w}{\bar{x}_w} \tag{2}$$

the unweighted variance (σ^2), the area-weighted variance (σ_w^2):

$$\sigma^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2 \tag{3}$$

$$\sigma_w^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x}_w)^2}{\frac{(n-1)}{n}\sum_{i=1}^{n} w_i} \tag{4}$$

Theil's L index (T_L) and the Theil's T index (T_T)[1]:

$$T_L = \frac{1}{n}\sum_{i=1}^{n} ln\frac{\bar{x}}{x_i} \tag{5}$$

$$T_T = \frac{1}{n}\sum_{i=1}^{n}\left(\frac{x_i}{\bar{x}} \cdot ln\frac{x_i}{\bar{x}}\right) \tag{6}$$

where: x_i is the variable under scrutiny - i.e. military spending as a share of GDP - of the country *i*, *n* is the number of countries, $\bar{x}$ is the arithmetic mean, $\bar{x}_w$ is the weighted mean, and w_i are the weights, that is the surface area of each country in km^2 drawn from the World Bank's database. Finally, in order to assess whether the convergence process, if established, reflects a race to the top or to the bottom the maximum-to-minimum ratio - top 10 to bottom 10 countries – is also estimated:

$$\bar{x}_w = \frac{\sum_{i=1}^{n} w_i \cdot x_i}{\sum_{i=1}^{n} w_i} \tag{7}$$

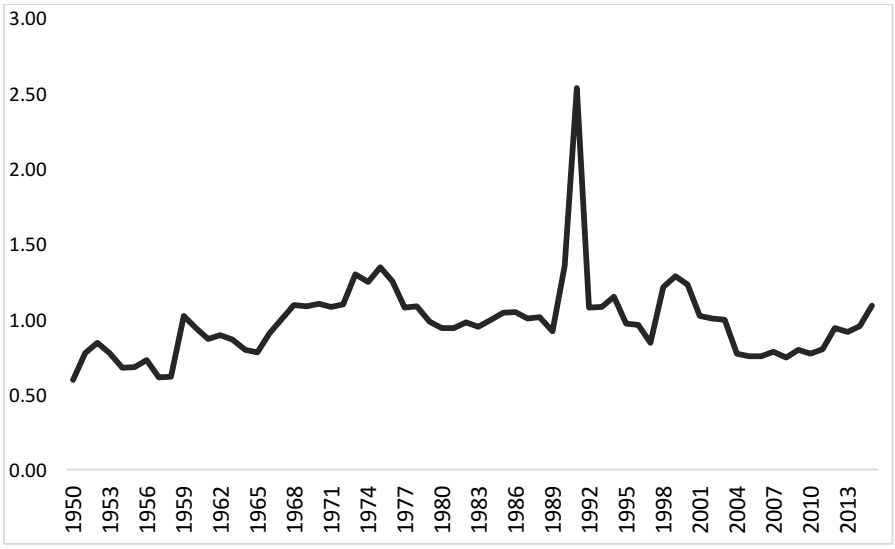
Patterns of convergence and divergence

We start the analysis with the estimation of the annual coefficient of variation (CV) for the entire dataset provided by SIPRI. The CV is estimated from all the available data-points each year, i.e. no country is excluded irrespective of whether its time-series covers the entire period or not or whether or not there are gaps in data. The database includes 167 countries for which data on their defence burden is available

[1] Theil's L and Theil's T indexes belong to the family of generalized entropy, GE(a), inequality measures. Theil's L is also referred to as mean log deviation measure and is written as GE(0) whereas Theil's T as GE(1) (Haughton and Khandker, 2009).

even for a small number of years. As one would intuitively expect, the further back we move towards 1950 the fewer the countries for which estimates of their defence burden are available and vice-versa. For instance, for the start year of the period – i.e. 1950 – data is available only for 15 countries. This number increases to 57 in 1960, to 90 in 1970, to 110 in 1980, to 118 in 1990, to 146 in 2000, to 153 in 2010 and slightly fewer (143) in 2015. Hence, the plot of the CV series in Figure 2, offers a bird's eye view of how the entire population has behaved in terms of converging or diverging with respect to the defence burden.

Figure 2: Annual coefficient of variation 1950-2015



As a broad initial observation, it appears that during the Cold War era the dominant trend up to the mid-1970s was that of divergence with the inevitable yearly fluctuations. A feeble process of convergence seems to be the broad tendency up to the end of the 1980s and the end of the Cold War. The Kuwait effect, mentioned in the previous section, is clearly evident in the 1991 spike of the CV series. An initial drop of the CV value up to the late 1990s, hints a process of convergence. This is briefly interrupted before it resumes from 2000 onwards up to the end of the decade when a clear upward trend in the value of the CV series points to divergence possibly associated with the recent economic crisis and its fiscal ramifications. In a sense, the visually observed changes in the trend of the CV series from one period to the other, reflect the major phases through which the global security environment has gone

through during the period in question. For instance, the end of the Cold War and the collapse of one of the two superpowers that dominated the global political and security scene during bipolarity have affected defence spending as seen in the previous section (Figure 1 and Table 1). Defining events such as 9/11 have also greatly impacted the global security agenda. Such changes and events represent important milestones and one would expect them to leave a statistically traceable imprint. To this effect, it was decided to examine for the presence of structural breaks in the CV series. Several tests have been proposed for identifying structural changes. A traditional test for structural breaks in a series is that proposed by Chow (1960) but an important limitation of this test is that the break-date must be known a-priori and does not allow for multiple breakpoints in a time-series. The Bai and Perron (1998, 2003a, 2003b, 2006) test, overcomes this limitation allowing for the possibility of multiple structural changes in a univariate regression. We use the global minimization procedure for identifying structural changes in the CV. A preferred strategy to determine the number of breaks is to first look at the UD-max or WD-max tests to see the existence of at least one structural break (Jouini and Boutahar, 2005). The test results reported in Table 2 suggest the presence of five breakpoints. The years in which they occur are 1959, 1968, 1979, 1990 and 2001. Starting from the latter, it can evidently be associated with the 9/11 mega terrorist attacks in the USA and their aftermath i.e. the War on Terrorism and the military campaigns in Afghanistan and Iraq. Similarly, the 1990 breakpoint can be associated with the end of bipolarity and the East-West armaments race: the fall of the Berlin Wall was in 1989; the Soviet Union was dissolved in 1991. The identification of 1990 as a breakpoint point year, could also be attributed to Kuwait's extreme values in terms of defence burden around this year: 48.5% in 1990, 117.3% in 1991 and 31.8% in 1992. The 1968 breakpoint could tentatively be associated with the revised nuclear strategy of *flexible response* adopted by the western allies. In particular, the NATO Alliance formally transitioned from Mutual Assured Destruction to Flexible Response in 1967. The second Berlin crisis in 1958, the Cuban revolution in 1959 are events that could tentatively be cited in the case of the 1959 breakpoint traced by the tests. Similarly, the signing of the SALT II Treaty, the Iranian revolution and the hostage crisis later that year, the Soviet invasion of Afghanistan, the Sandinista revolution and the Contra

insurgency in Nicaragua are important events that could possibly account for the 1979 break (Table 2). Additionally, this break-year selection may be due to the qualitative changes of the early to mid-1980s in the international strategic environment that the election to the US Presidency of R. Reagan in 1980 (he took office in 1981) brought about. He was elected on a platform that opposed the concessions of détente and he adopted and spearheaded along with M. Thatcher (elected Prime Minister of the UK in 1979) a more hardline approach towards the USSR. The adoption of the Strategic Defense Initiative (SDI) of 1983 probably epitomizes his defence and foreign policy vis-à-vis the Soviet bloc.

Table 2: Results from the Bai-Perron test for multiple structural breaks

UDmax stat	*WDmax stat*	*Break Years*
17.18	25.92	1959
		1968
		1979
		1990
		2001

Notes: Test statistics employ HAC covariances and allow error distributions to differ across breaks. Trimming E is set at 15% and the maximum permitted number of breaks is 5.The critical values of Bai-Perron test are 12.37 and 13.83 for UDmax and WDmax respectively at the 1% level of significance.

As a next step in the analysis and in order to partially moderate the effects exerted by extreme values such as the one by Kuwait that are due to year specific economic, political or security circumstances that a country might have faced, we decided to proceed using 3-year averages as snapshots. On the one hand, the 3-year snapshots adequately reflect and encapsulate changes in states' defence burdens during the period in question and on the other they partially mitigate the effects by year specific extreme values. Hence, the dominant trends are better revealed. The plots from estimating (1), (2), (3) and (4) are shown in Figure 3 where both the unweighted and weighted coefficient of variation and variance are presented. Theil's L index (T_L) and the Theil's T index (T_T) are also included in the figure.

Figure 3: Graphs of the 3-year averages of the *CV* and σ^2 series 1950-2015

The general picture that emerges from the plots in Figure 3 is one that suggests three main periods with different patterns in terms of convergence/divergence. Broadly speaking, during most of the Cold War era the dominant trend is that of divergence as the values of the indices used are generally increasing. This period presents a greater variation in terms of the convergence/divergence patterns that one can visually identify in the plots of both the weighted and unweighted indices vis-à-vis the post-bipolar one. Perhaps with the exception of the σ_w^2 graph, the rest – i.e. the plots of the CV, CV_w, σ^2 and T_T - more or less paint a pretty similar picture of

divergence during the Cold War. So does T_L but it indicates a reversal in the divergence trend appreciably earlier that the other indices. With this exception, the divergence trend of the Cold War period is reversed towards the end of bipolarity when a process of convergence sets-in. A finding that broadly accords with those reported by Lau *et al.* (2016) and Arvanitidis *et al*. (2014) for the post-bipolar period. Depending on the index and whether the unweighted or the weighted estimate is examined, this convergence trend appears to commence towards the mid-1980s or from 1990 onwards. In particular, both the CV_w and the σ_w^2 suggest a convergence process starting around the mid-1980s, whereas the unweighted CV and σ^2 from the 1990s onwards. So does Theil's T index (T_T).

As noted earlier, convergence does not imply that countries are converging towards lower values of defence burdens. They could very well be converging but at higher levels of defence spending as a share of GDP. In order to assess whether the convergence process of the post-Cold War period reflects a race to the top or to the bottom (7) was estimated i.e. the maximum-to-minimum ratio - top 10 to bottom 10 countries. As can be observed from the plot in Figure 4, the post-bipolar convergence process is a race to the bottom with the mild reversal present towards more recent years as already identified in the previous step of the analysis. Figure 5 offers the opportunity of further visual scrutiny and verification of this international trend as a gradually increasing number of countries cluster at lower levels of defence burden.

Figure 4: Ratio of top 10 to bottom 10 defence burdens

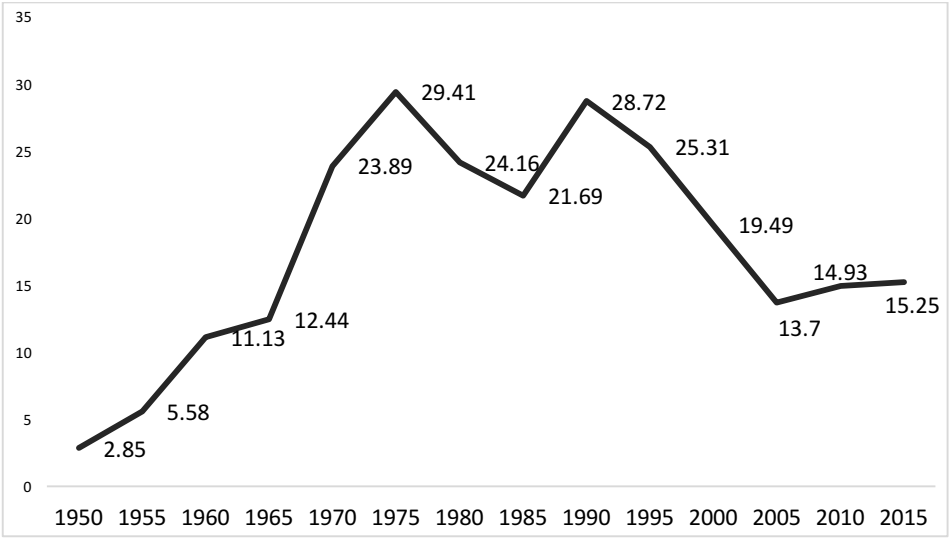
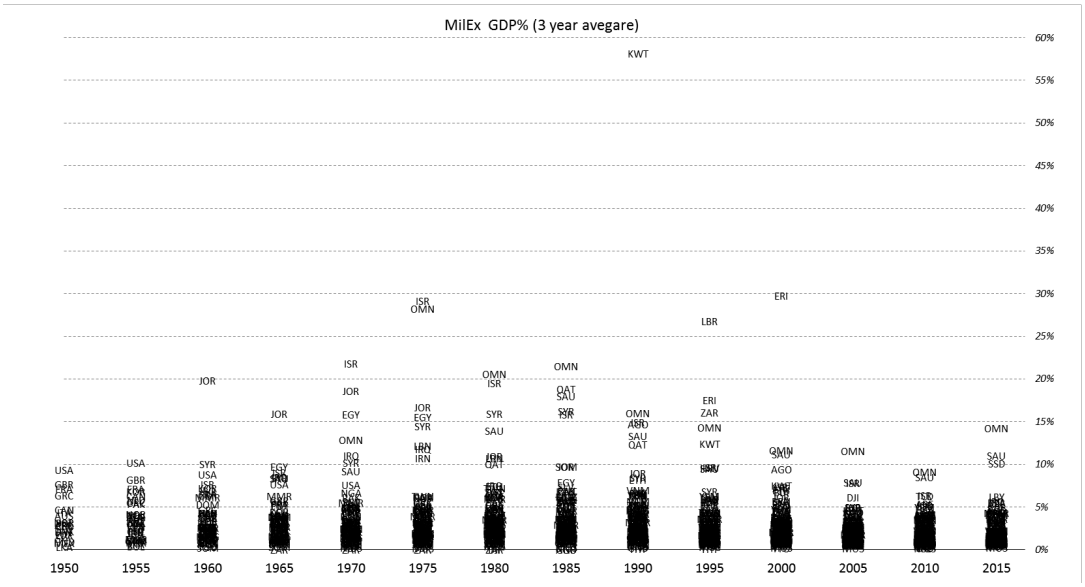


Figure 5: The trend towards lower defence burdens



As a final step, it was decided to briefly look at the convergence issue at the regional level. Following SIPRI's regional groupings of countries we applied the σ-convergence methodology for Africa, the Americas, Asia and Oceania, Europe and the Middle East since it is a geopolitical region with particular interest and presence in world affairs. For each region the coefficient of variation (CV) was estimated[2]. Given the data availability constraints, the time-period selected for each region was a compromise between N and T: for Africa and the Middle East the time period is 1960-2015, for the Americas and Europe 1950-2015, for Asia and Oceania 1957-2015. The estimated CVs are presented in Figure 6. Just as before, we also applied the Bai and Perron (1998, 2003a, 2003b, 2006) test to examine for structural breaks in the series. The summary results are also included in Figure 2. As one would intuitively expect, the regions present a fairly varied picture in terms of defence burden convergence. This should come as no surprise since the allocation of resources to defence is not influenced by the global security and strategic environment but also by region and country specific factors. In all five regions for which the tests were conducted periods of convergence and divergence are visually traceable with no all-encompassing

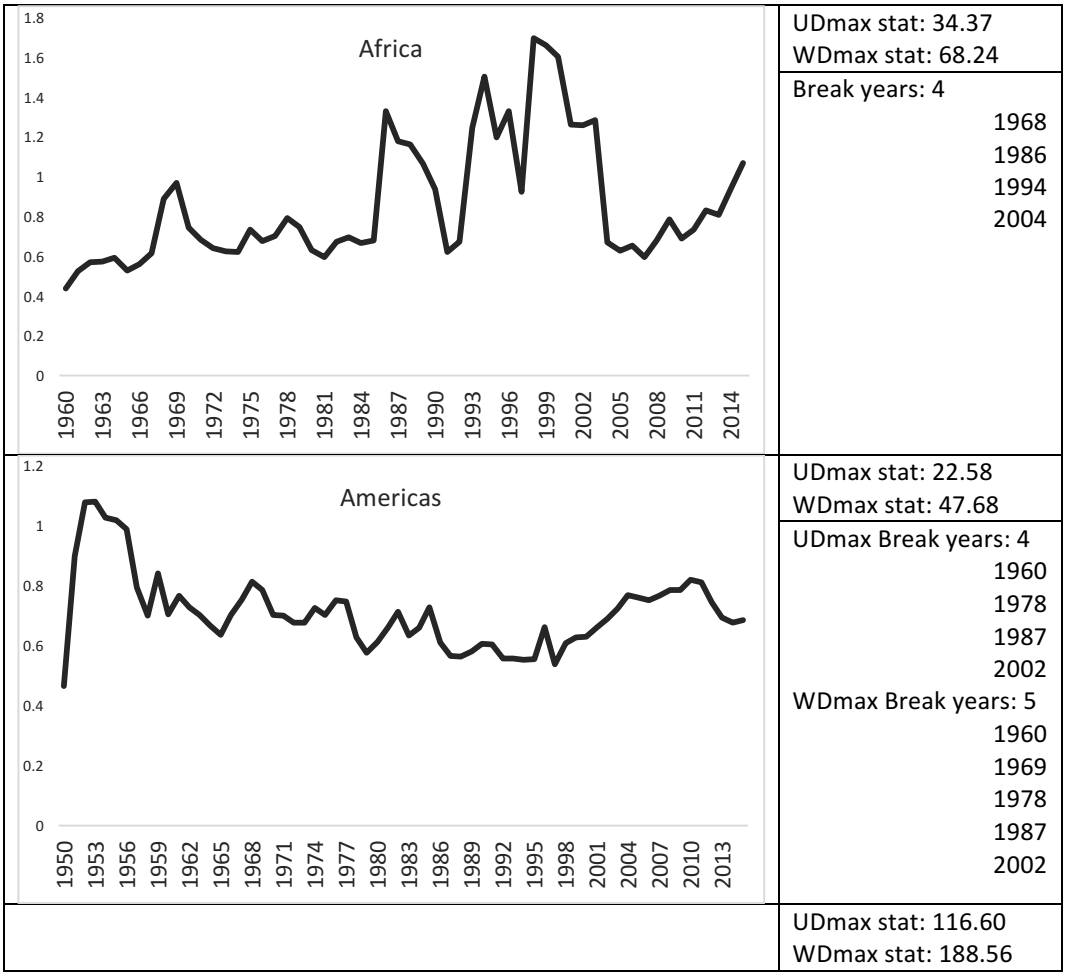
[2] For reasons of brevity we do not present the other measures of convergence outlined in the methodology section.

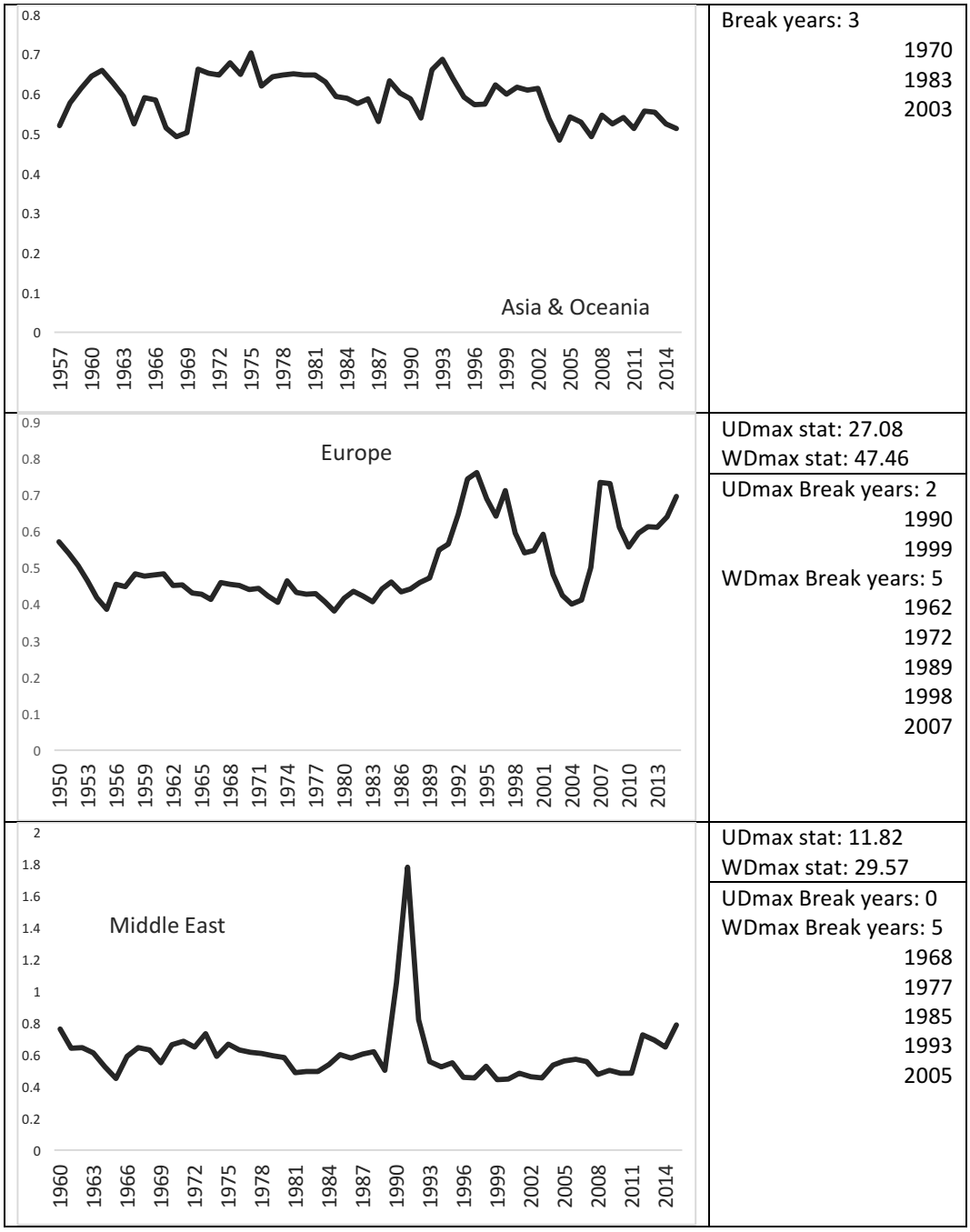
pattern emerging. Although detailed regional scrutiny is beyond our aims here since it requires an in depth regional specific discussion and analysis of how the security environment and agenda evolved in each region during the time period examined, it is nevertheless worth pointing out some similarities that appear to emerge from the structural break tests conducted. At this point it should be recalled that the break years identified in the world CV series were 1959, 1968, 1979, 1990 and 2001 (Table 2). For instance, the world CV break in 1959 was associated with second Berlin crisis in 1958 and the Cuban revolution in 1959. A break in 1960 and 1962 is statistically traced in the case of the Americas (that includes the USA and Canada) and Europe respectively. All break points seem to cluster closely together and can tentatively be linked with important Cold War events. For example, the Berlin Wall was built in 1961 and the Cuban missile crisis took place in 1962. A similar clustering of break years is also present around the end of the Cold War: 1990 for the world CV as well as for Europe[3]. An earlier year, 1987, in the case of the Americas. The Intermediate-Range Nuclear Forces Treaty was signed this year and ratified in 1988. The latter, also marks the beginning of the Soviet withdrawal from Afghanistan. Clearly, both the estimated regional CVs as well as the break years identified are affected by the samples' characteristics and the number of countries for which data is available for each year and period. Hence, inferences drawn must be viewed under the light of such data constraints. A methodological issue that also arises is whether grouping the countries in major geographic categories – Africa, Americas, Asia and Oceania, Europe - allows for the full picture to emerge. More homogenous geopolitical groupings may offer better insights. For instance the Middle East. The effect exerted by Kuwait's high defence burden as a result of the Iraqi invasion and the Gulf War that followed is clearly visible in 1991. The five break years[4] identified by the relevant tests can also be linked to significant events in this conflict afflicted region. For instance the break in 1968 may be associated with the effects of the 1967 Six Day War and Israel occupying the Golan Heights, Sinai, West Bank and Gaza. The 1977 one could be associated with the 1976 Syrian invasion of Lebanon and the Camp David Accords signed in 1978. A more cautious association could be made in the case of the 1985 break with events

[3] 1989 according to the WDmax stat, 1990 on the basis of the UDmax stat.
[4] On the basis of the WDmax stat.

around that year. In 1982 Israel invaded Lebanon and partially withdrew by 1985 whereas the First Intifada started in 1987. The 1993 break can be related to the 1991 Gulf War and the Oslo Accords of 1993 between Israel and the PLO. The withdraw of Syrian troops from Lebanon in 2005 or the 2003 Iraq War could be cited as significant events that tentatively explain the final break identified by the relevant tests in the Middle Eat CV series (Figure 6).

Figure 6: Regional CVs and break years





Notes: Test statistics employ HAC covariances and allow error distributions to differ across breaks. Trimming E is set at 15% and the maximum permitted number of breaks is 5. The critical values of Bai-Perron test are 12.37 and 13.83 for UDmax and WDmax respectively at the 1% level of significance.

Concluding remarks

Using SIPRI's new consistent database, this paper set out to examine the presence or not of a convergence process in terms of defence burdens. Compared to previous studies addressing this issue (Lau *et al*. 2016; Arvanitidis *et al*. 2014, Arvanitidis and Kollias, 2016) the new dataset offers the opportunity to examine an

appreciably larger time-period that includes both the Cold War as well as the post-bipolarity period. The empirical investigation conducted herein focused on the patterns of convergence and divergence exhibited by the entire population of countries that are included in SIPRI's database. As a broad generalization of the findings reported herein, it would appear that three main trends characterized the period under examination i.e. 1950-2015. During most of the Cold War era the dominant trend was that of divergence in terms of defence burdens. Following the collapse of bipolarity, a process of convergence in appears to be the dominant international trend. Tentatively, this could be interpreted as suggesting a process of policy convergence in terms of inputs used in the production of national defence and security. As it has been pointed (*inter alia*: Cao, 2012; Islam, 2003; Drezner, 2001, 2005; Dolowitz and Marsh, 2000), a number of factors may be driving such a policy convergence process including copying of best practices as well as independent but similar national responses to common security challenges and problems emanating from the international system[5]. In other words, this convergence pattern in terms of defence burdens that dominated most of the post-bipolar period, may be reflecting convergence in the security challenges that countries face including the threat posed by transnational terrorism. Convergence towards an "optimum" defence burden could also be a plausible explanation that nevertheless warrants further investigation. Indeed, the analysis also revealed a race to the bottom, i.e. convergence towards lower levels of military spending as a share of GDP. However, this global convergence trend exhibits signs of reversal/divergence in recent years. Clearly, this empirical investigation represents a first, initial step and more detailed scrutiny is necessary.

[5] For instance see Amara (2008) in the case of NATO

References

Amara, J. (2008) NATO defence expenditures: common goals or diverging interests? A structural analysis. Defence and Peace Economics, 19(6): 449-469

Artelaris, P., Arvanitidis, P. and Petrakos, G., (2011) Convergence Patterns in the World Economy: Exploring the Non-Linearity Hypothesis. Journal of Economic Studies, 38(3): 236–252.

Arvanitidis, P., C. Kollias and K. Anastasopoulos (2014) Is there an international convergence in defence burdens? Some initial findings, Peace Economics, Peace Science and Public Policy, 20(4): 611-620

Arvanitidis, P. and C. Kollias (2016) Converging Defence Burdens? Some Further Findings, Peace Economics, Peace Science and Public Policy, 22(4): 365–375

Bai, J., and Perron, P. (1998). Estimating and testing linear models with multiple structural changes. Econometrica 66, 47-78.

Bai, J. and Perron, P. (2003a) Computation and analysis of multiple structural change models. Journal of Applied Econometrics 18, 1-22.

Bai, J. and Perron, P. (2003b) Critical values for multiple structural change tests. Econometrics Journal 6, 72-78.

Bai, J. and Perron, P. (2006). Multiple structural change models: A simulation analysis in Econometric Theory and Practice: Frontiers of Analysis and Applied Research, D. Corbea, S. Durlauf and B. E. Hansen (eds.), Cambridge University Press, 212-237.

Barro R. (1991), Economic growth in a cross-section of countries, Quarterly Journal of Economics, 106: 407-443.

Barro R. and X. Sala-i-Martin (1992), Convergence, Journal of Political Economy, 100(2): 223-251.

Bennett, C. (1991) What is policy convergence and what causes it? British Journal of Political Science, 21(2): 215–33

Bove, V. and J. Brauner (2016): The demand for military expenditure in authoritarian regimes, Defence and Peace Economics, 27(5), 609-625

Busch, P. and H. Jorgens (2005) The international sources of policy convergence: explaining the spread of environmental policy innovations, Journal of European Public Policy, 12(5): 860-884

Cao, X. (2012) Global networks and domestic policy convergence: A network explanation of policy changes, World Politics, 64(3): 375-425.

Chow, G. (1960) Tests of equality between sets of coefficients in two linear regressions. Econometrica 28, 591-605.

De, K. (2014) Globalization and cointegration among the states and convergence across the continents: a panel data analysis, Economic Analysis and Policy 44, 107–121

Dolowitz D. and D. Marsh (2000), Learning from abroad: The role of policy transfer in contemporary policy making, Governance, 13: 5-24.

Douch, M. and B. Solomon (2014) Middle powers and the demand for military expenditures, Defence and Peace Economics, 25:6, 605-618

Dunne, J. P. and S. Perlo-Freeman (2003) The demand for military spending in developing countries: A dynamic panel analysis , Defence and Peace Economics, 14:6, 461-474

Dunne, P., S. Perlo-Freeman and R. Smith (2008) The demand for military expenditure in developing countries: hostility vs capability, Defence and Peace Economics, 19:4, 293-302

Drezner, D. (2001) Globalization and Policy Convergence, The International Studies Review, 3(1), 53-78

Drezner, D. (2005) Globalization, harmonization, and competition: the different pathways to policy convergence, Journal of European Public Policy, 12(5): 841-859

Firebaugh, G. (1999) Empirics of World Income Inequality. American Journal of Sociology, 104(6): 1597–630.

Flores, A. (2011) Alliances as contiguity in spatial models of military expenditures, Conflict Management and Peace Science, 28(4): 402–418

Haughton, J. and Khandker S. R. (2009) Handbook on Poverty and Inequality, World Bank, Washington D.C., available at World Bank's Web Site on Measuring and Analysing Poverty, at http://go.worldbank.org/7JGPK76TM0

Islam, N. (2003) What have we learnt from the convergence debate? Journal of Economic Surveys 17(3): 309-354

Jordan, A. (2005), Policy convergence: A passing fad or a new integrating focus in European Union studies? Journal of European Public Policy, 12(5): 944-953.

Jouini, J., and M. Boutahar (2005). Evidence on structural changes in U.S. time series. Economic Modelling 22, 391-422.

Lau, C., K. Marco, E. Demir and M. Bilgin (2016) A Nonlinear Model of Military Expenditure Convergence: evidence from E-star Nonlinear Unit Root Test, Defence and Peace Economics, 27(3): 392-403

Perlo-Freeman S (2017) SIPRI's new long data-set on military expenditure: the successes and methodological pitfalls. Defence and Peace Economics 28: 404-421

Perlo-Freeman S, Sköns E (2016) Snakes and ladders: the development and multiple reconstructions of the Stockholm International Peace Research Institute's military expenditure data. Economics of Peace and Security Journal 11: 5-13

Quah, D. (1997). Empirics for growth and distribution, stratification, polarization and convergence clubs. Journal of Economic Growth 2, 27-59.

Quah, D. (1993). Empirical cross section dynamics in economic growth. European Economic Review 37, 1353-1375.

Quah, D.T. (1993a) Galton's fallacy and tests of the convergence hypothesis. Scandinavian Journal of Economics, 95(4): 427–443.

Sala-i-Martin, X. (2002) The Disturbing "Rise" of Global Income Inequality. NBER working paper no 8904.

Sandler, T. and J. George (2016). Military expenditure trends for 1960–2014 and what they reveal, Global Policy 7(2), 174–184

Wang, Y. (2013) Determinants of Southeast Asian military spending in the post-cold war era: a dynamic panel analysis, Defence and Peace Economics, 24:1, 73-87,