E C O N O M I C S B U L L E T I N

Military Expenditures, External Threats and Economic Growth

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Abstract

Do military expenditures have impact on growth? Aizenman Glick (2006) found that this impact is positive in countries with good governance, where the external threat is significant. Our article shows that their results suffer from three limitations: (i) they are not robust to the most recent main database used; (ii) small changes in the time period of some variables change their results, and (iii) the authors' econometric specification is not adequate to their hypothesis. Using a 2SLS specification we reconfirm the authors' hypothesis.

Citation: Araujo Junior, Ari Francisco de and Cláudio D. Shikida, (2008) "Military Expenditures, External Threats and Economic Growth." *Economics Bulletin*, Vol. 15, No. 16 pp. 1-7
Submitted: August 13, 2008. **Accepted:** September 16, 2008.
URL: http://economicsbulletin.vanderbilt.edu/2008/volume15/EB-08O10019A.pdf

1. Introduction[1]

The CIA World Factbook informed for the year 2006 that the Brazilian government had spent 2.5% of GDP on military expenditures. The most recent estimate (for the year 2005) for some neighbouring countries pointed to expenditures of 1.3% (Argentina) and 1.2% (Venezuela). For another country that is important in the regional political and military play, Colombia, the estimate, also for 2005, was of 3.4% of GDP, which can possibly be explained based on its internal political instability.

The situation of each of those countries in other dimensions (social, economic or institutional), if properly assessed, will reveal a certain diversity of results, which can eventually be related to the military expenditures of each country. This is one of the topics studied by the so-called *Defence Economics*, which concerns the application of Economics to problems related to the military defence of a country or group of countries. Although it is one of the most interesting research areas in the literature, it has been little explored in Brazil. Ironically, this occurs in spite of the fact that one of the first economic problems taught in undergraduate programmes – perhaps the most famous – is precisely the trade-off faced by an agent in deciding whether to produce an additional unit of butter or of cannons.

Basic questions arise from that example, on "what, how and for whom" to produce goods in an economy. However, those are only initial questions that could be answered by an engineer, as said by Alchian and Demsetz (1973). Besides those, defence economics encompasses more interesting questions, such as: (i) the types of contracts between the military and their civil suppliers, (ii) the determinant factors of alliance formation, (iii) the determinant factors of arms races, (iv) the relationship between institutional arrangements and defence economics, (v) the economics of conflict (conventional and non-conventional, such as terrorism), and (vi) the influence of the defence sector in economic growth.

This papers deals with the last of the items above, which could be summarised in the following question: *More guns, more butter*? In other words, do military expenditures have any impact on the economic growth of a country? If so, is it a positive impact? The question is of obvious relevance, since military expenditures are made by the public sector, not by the private sector.

More recently, Aizenman and Glick (2006) found a nonlinear relationship between military expenditures and growth, using national instead of regional data. The mechanism of transmission between the two variables is mediated by an "external threats" proxy. Our paper explores this causal nexus in growth models with military expenditures. We seek to know whether the results found in Aizenman and Glick (2006) are robust and, if not, we suggest a better way to deal with the problem.

2. Methodology and data

The adopted methodology and the data used in this paper follow Aizenman & Glick (2006). The authors found evidences for nonlinearity in the interaction between threats and military expenditures on economic growth in a cross-section matrix for the period 1989–98. The conjecture tested by Ainzenman and Glick (2006) affirms that the "impact of military expenditures on growth is a non-linear function of military threats suffered by a certain country from foreign countries or other external forces" (Ainzenman and Glick 2006, 130).

[1] We thank Pedro Henrique C. Sant'anna for his help and the participants of the 1st National Meeting of the Brazilian Association of Defence Studies (ABED) for their comments. We take responsibility for any errors or omissions.

In this context, *tcy* denotes real growth, *gm* the military expenditures and *am* the effective threats. The specification below represents such conjecture:

$$tcy = \alpha_1 gm + \alpha_2 (am)(gm) + \beta_1 am + \Theta X \qquad (1)$$

where Θ is the series of control variables, α_1, $\beta_1 < 0$ and $\alpha_2 > 0$. The first derivatives yield mathematically the expected effects:

$$\begin{aligned} \partial tcy / \partial gm &= \alpha_1 + \alpha_2 am \\ \partial tcy / \partial am &= \beta_1 + \alpha_2 am \end{aligned} \qquad (2)$$

That is, the direct effects of military expenditures and external threats are supposed to be negative, whereas the interactive effect is positive. We will test it econometrically:

$$tcy = \gamma + \alpha_1 gm + \alpha_2 (am)(gm) + \beta_1 am + \Theta X + \varepsilon \qquad (3)$$

in which γ is the constant and ε are the errors. Our database is slightly different from the one used in Aizenman & Glick (2006). *tcy* was built as the mean annual growth rate of real GDP per capita between the period 1988–2003 (this variable was calculated until 2000 for Haiti), the source of which is version 6.2 of the Penn World Table[2]. *gm* was calculated as the average of annual military expenditures between 1988 and 2003. The source, in this case, is the World Bank Economic Indicator[3] (2007). As a proxy for external threats (*am*), we calculated the number of years during which a country was in war with each one of its adversaries in the period between 1970 and 2003 (adding the total of its adversaries) from data of version 2.0 of the Correlates of War Project (COW) of University of Michigan. In this specific case, we used two definitions: a more restrictive one (*am1*), which considers as 'years of war' those in which at least one of the disputers suffered more than 1,000 casualties specifically related to the conflict, and a less restrictive one (*am2*), which takes into account as 'year of war' even those when war caused less than 1,000 casualties.

The variables that are contained in *X* are traditional, such as in Barro and Sala-i-Martin (1995). In order to control conditional convergence, we used the Neperian logarithm of real GDP per capita of 1998 (*yi*). The hypothesis is that, controlling for other growth determinants, richer countries tend to grow at lower rates than those observed in poorer countries. The population growth rate (*tcpop*) and the average investment rate as a proportion of the GDP (*inv*) between 1988 and 2003 are control variables that were also used. *tcpop* shows the expected negative effect and *inv* should capture the positive effect of physical capital on growth. Finally, to capture the potential positive effect on human capital growth, we used the Neperian logarithm of the average schooling years of the population older than 25 years in 1990 (*educ*). The variables *yi*, *tcpop* and *inv* stem from the Penn World Table whereas *educ* comes from Barro-Lee's[4] database. Descriptive statistics and correlations of the variables are reported in the Annex to the paper.

The main differences between the databases used in this work and those used by Aizenman and Glick (2006) are: *tcy* calculated in Aizenman & Glick (2006) uses the period between 1989 and 1998; the year 1975 is used for *yi* and *educ*; *inv* is used in the period between 1984 and 1988; and the proxy for *educ* is restricted to men at high school level or above. That is, our main criticism is centred in the lack of homogeneity regarding the periods defined for each variable. It is necessary

[2] <http://pwt.econ.upenn.edu>
[3] <http://publications.worldbank.org/WDI>
[4] <www2.cid.harvard.edu/ciddata/barrolee>

to verify, therefore, whether the results are maintained when using a database that is more homogeneous in time.

It is worth remembering that, as in Aizenman and Glick (2006) as in this paper, only the variable *am* starts in 1970, that is, below the lower limit of *tcy*, which is 1988. In this case the justification resides, for both papers, in the reduced number of observations that could be used in case the definition of the time interval was more restricted.

If the nonlinear relation between military expenditures and growth is robust to the extent that it could be considered an important benchmark for economic policy-making, it is expected that up-to-date versions of the databases used, if subjected to the same econometric treatment, would generate similar results. As mentioned above, this paper uses more recent versions of the Penn World Table (6.2) and of the COW (2.0). The authors used, respectively, versions 6.1 and 1.1 of those databases. The robustness test estimates of Aizenman and Glick (2006) were done by Ordinary Least Squares by means of the White estimator (the same used by the authors).

3. Is there any relationship between military expenditures and economic growth? Revisiting Aizenman and Glick (2006)

Table 1 below shows the results for the tests *a la* Aizenman and Glick (2006) from a cross-section matrix for a longer period (1988–2003). The sign and, in most cases, the statistical significance of the control variables correspond to the expected, according to the neoclassical model of economic growth (except for education). The education proxy coefficient is positive, as expected, but not significant. Countries the population of which grow at high rates have lower economic growth. The investment in physical capital increases the economic growth in the countries of the sample. The initial income per capita is negative and significant, that is, controlling for other determinants of economic growth, it statistically captures conditional convergence.

Table 1 – Determinants of Growth [robustness Aizenman & Glick (2006)]*

	(1)	(2)
gm	0.04 (0.40)	0.33 (0.45)
gm_am1	-0.10 (0.44)	---
gm_am2	---	**-0.10** **(0.04)**
am1	0.55 (0.32)	**---**
am2	**---**	**0.54** **(0.00)**
yi	**-0.83** **(0.03)**	**-0.68** **(0.00)**
educ	0.12 (0.82)	0.01 (0.99)
tcpop	**-1.02** **(0.00)**	**-0.97** **(0.00)**
inv	**0.11** **(0.00)**	**0.11** **(0.00)**
constant	**7.87** **(0.00)**	**6.60** **(0.02)**
N	88	88
R^2	0.36	0.39

* P-value in round brackets, below each estimated coefficient.

Military expenditures and external threats increase growth. Moreover, we note that, both for *am1* and for *am2*, the linear interaction between military expenditures and external threats does not present the expected positive sign (and it is not significant at 10% when *am1* is used as a proxy for external threats). This implies that the results by Aizenman and Glick (2006) are not maintained when minor changes are made in the database, in the temporal definition of some variables and in the use of updated or fixed versions of some of their databases. However, there can be other problems, as showed below.

4. Rethinking the causal nexus between threat and military expenditures: the problem of simultaneity

The results presented above raise doubts about the nonlinear relationship proposed by Aizenman and Glick (2006). The problem is that the authors not only suppose that military expenditures influence the growth rate of GDP per capita, but also that such expenditures are a function of another variable, the 'threat'. There clearly is a theoretical problem of simultaneity between the variables, which was neglected by the authors. In this case, it seems to be a mistake to make estimates using Ordinary Least Squares (OLS). The most adequate is, in this sense, to estimate the exercise by means of an equations system using specifically the Two-Stage Least Squares method (2SLS). The threats proxies that we used follow those authors' methodology. Even so, the use of 2SLS can be justified by a supposed theoretical relationship: if threats affect military expenditures, this effect occurs with some time lag. This way, one of the possible improvements for econometric tests of this nature concerns the creation of other proxies for threats.

Therefore, the external threat proxies that were used (*am1* and *am2*) will serve as instruments for military expenditures (*gm*) in the following specification:

$$\begin{aligned} tcy &= \gamma + \alpha_1 gm + \alpha_2 (am)(gm) + \Theta X + \varepsilon_1 \\ gm &= \phi + \alpha_3 am + \varepsilon_2 \end{aligned} \qquad (4)$$

Table 2 presents the results obtained using 2SLS. It can be seen that the convergence hypothesis is not rejected in either equation. The impact of investment on growth is positive, as expected. The population growth rate has a negative impact on growth, although it is significant in only one of the equations. Education has a positive sign but does not present adequate statistical significance.

Table 2 – Determinants of Growth [2SLS]*

	(1)	(2)
gm	-0.40 (0.42)	**-0.88** **(0.11)**
gm_am1	0.06 (0.19)	---
gm_am2	---	**0.10** **(0.04)**
yi	**-0.86** **(0.04)**	**-0.70** **(0.11)**
educ	0.20 (0.75)	0.37 (0.58)
tcpop	**-0.79** **(0.06)**	-0.37 (0.53)
inv	**0.14** **(0.00)**	**0.18** **(0.00)**

constant	**8.15** **(0.01)**	**6.16** **(0.09)**
N	88	88

* P-value in round brackets under each estimated coefficient.

As to the military expenditures, its impact on growth is negative, but the existence of external threats produces a positive impact, as shown by Aizenman and Glick (2006). Therefore, our results suggest that the estimation strategy and, consequently, the methodology used by the authors are inadequate.

5. Conclusions

Since the 1970s, researchers question themselves about the impact of military expenditures on economic growth. This relationship is still an open research agenda in economic literature and is relevant for the formulation of long-term political and economic strategies (the weight of the military expenditures of each member of a military alliance, for example, can be reestimated according to the interests of each government, which certainly brings implications to the alliance itself).

This article shows that even recent contributions can present little robust results, for example, because of the inadequacy of the econometric methodology. The simple consideration of a methodology that is in our view more adequate to the authors' theory shows that their hypothesis on the asymmetric effects of military expenditures on growth can be maintained.

Nonetheless, there are other important problems to be dealt with. Although interesting, the causal nexus between 'threats' (or 'political instabilities') and 'military expenditures' deserves a more devoted study, not only in the definition of an external threat in terms of the number of casualties involved, but also in the theoretical scope of the concept: it is possible that many countries do not present external problems, such as wars against neighbouring countries, but do present changes in military expenditures levels because of internal threats, like in Latin America during the 1970s.

Finally, the institutional matter (the role of the electorate in the political cycle and/or in the determination of the amount of military expenditures) and its influence on economic growth, in the context of the discussion on external threats and military expenditures, is another problem that needs to be further detailed in future research.

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Annex - descriptive statistics and correlations

Variable	Obs	Mean	Std.dev.	Min	Max
tcy	89	1.405272	2.039198	-5.033431	8.047589
gm	90	2.425193	2.884743	0	23.46522
am1	90	.4111111	1.542612	0	10
am2	90	.8444444	2.476456	0	11
yi	89	8.461234	1.072993	6.469622	10.17639
educ	89	1.472677	.6730783	-.597837	2.484907
tcpop	90	1.624543	.9511871	-.5453808	4.180737
inv	90	16.77483	8.517214	3.135333	41.816

	tcy	gm	am1	am2	yi	educ	tcpop
tcy	1.0000						
gm	0.0719	1.0000					
am1	0.1486	0.1928	1.0000				
am2	0.1565	0.2776	0.6669	1.0000			
yi	0.2448	0.0663	0.1076	-0.0853	1.0000		
educ	0.2905	0.0524	0.1011	-0.0866	0.8294	1.0000	
tcpop	-0.4282	0.1101	-0.0095	0.0899	-0.6813	-0.6451	1.0000
inv	0.4693	0.1485	0.1156	-0.0584	0.6586	0.6242	-0.4817