Defence Spending, Institutional Environment and Economic Growth: NATO Membership*

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Abstract

This paper analyses the impact of participating in a military alliance on the nexus between defence spending and economic growth. In particular, we study how belonging to a military organization influences the defence spending of members, and consequently their economic growth. Conclusions from the theoretical model are tested empirically for countries that have some kind of relationship with the North Atlantic Treaty Organization. Results show that the institutional environment has positive effects on the growth of these countries. In addition, evidence reinforces the idea of a non-linear relationship between military expenditure and economic growth predicted by the model.

Keywords: defence spending; public spending; growth.

JEL classification: H5, O41, O47, O5.

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1 Introduction

The relationship between defence spending and economic growth has been widely studied in the literature, both from theoretical and empirical points of view (Dunne et al., 2005). Results are inconclusive and many of the traditional empirical studies find that military spending is not a significant factor in explaining economic growth (Dunne et al., 2005). The usual explanation is that the defence spending is not productive, in contrast to investment in infrastructure, research and development, or education, and does not affect output directly (Korkmaz, 2015). However, defence spending provides security against internal and external threats. Population and private property security is essential for good functioning of markets and it also promotes investment and innovation. Accordingly, conflicts and lack of security in developing countries are considered as obstacles to economic development (Töngür and Elveren, 2012).

Starting with Olson (1965) seminal paper and Olson and Zeckhauser (1966), the economic theory of alliances rests on the notion that allies jointly contribute to a defence activity that is a pure public good and analyses the allocative problem associated. They focus on burden sharing in an alliance, in which the large, rich ally shoulders the defense burden of the small, poor allies by providing the latter with a relatively free ride. During the post-Cold War era, defence alliances have increasingly turned to peacekeeping and peace enforcement conducted jointly by multiple allies, requiring a degree of integration and cooperation never experienced before. This new scenario has renewed the interest on military alliances (Sandler and Hartley, 2001) and has implications for defence burden sharing, allocative efficiency, and alliance institutional design and stability.

La Porta et al. (1997) show the important role of institutional environment and regulations on the behaviour of economic agents. Their work implies that the existence of a solid and reliable institutional environment can boost countries’s economic growth. Supranational legislation may serve as a further impulse to accelerate investment and technological development. In this line, Callado et al. (2016) show how participating in an economic and monetary union grants an institutional stimulus for additional technological development of newcomers. Moreover, in an increasingly globalised world, growth rates of individual countries do not only depend on their own characteristics, such as defence spending or infrastructure, but they seem to be critically related to the income levels and growth rates of their trading partners, usually their neighbouring countries (Klenow and Rodriguez-Clare, 2005). In this regard, Callado et al. (2013) show that developing countries may benefit from free trade agreements with developed ones by gradually adopting their more developed financial systems and consequently improve the performance of their economies. With respect to defence, supranational organizations, as for example the North Atlantic Treaty Organization (NATO), have the potential to promote common defence, development of new technologies and capabilities to adapt to the new strategic environment (Ruiz, 2014). However, the effect of the integration into a military institution on the economy has not been studied within the defence spending – economic growth relationship. This article attempts to make a contribution in this line.

Several theoretical studies investigating the link between economic growth and defence spending have been carried out. Shieh et al. (2002) examine how the government’s resource allocation between the defence and non-defence sectors impacts both economic growth and so-
cial welfare. Their consumers are concerned with defence spending because it affects security, but if higher fraction of total government spending is devoted to defence, output can be affected negatively. Aizenman and Glick (2003) reformulate the model with defence spending by including external threats. Output cost of threat can be diminished by an increase in defence spending. Similarly, Pieroni (2009) deepens the study of complementary indirect effects of defence spending through synergies between military spending and other public expenditures, and how changes in the former may affect the latter and condition economic growth.

This paper analyses how the integration into a military alliance and the influence of the military institutional agreements and the new military status can affect the relationship between the defence spending and economic growth. In order to set up a theoretical model in the context of a military institution we add the membership in a military alliance into the models of Shieh (2002) and Pieroni (2009). If a country chooses to integrate into a military alliance, common defence policy insures higher level of security. This should be beneficial for the economic stability and consequently for growth. On the other hand, membership in a military institution may affect the defence spending of all alliance components, and thereupon the output of all parties involved. This effect may have a negative impact under certain conditions. In the empirical part we study the case of the North Atlantic Treaty Organization (NATO). NATO was born at the outset of the Cold War, designed to meet three complementary objectives: deter Soviet expansionism, prevent the revival of nationalist militarism in Europe through a strong North American presence on the continent, and encourage European political integration. Its core function lay in the collective defense of Central and Western Europe against a Soviet attack. The end of the Cold War and the disintegration of the Soviet Union forced the organization and its member states to adapt to a new security environment. This evolution has affected NATO’s membership, its role in the complex system of interlocking European institutions and the developing of new partnerships with other countries. This enlargement process allows us to analyse how the process of entering a military alliance considering both the role of new institutions together with the security benefits from that integration. Our findings show a nonlinear positive effect of defence spending on economic growth.

The remainder of the paper is organised as follows. In section 2 we present some information about NATO related to our research. Section 3 presents the theoretical model. Relationships obtained in the empirical exercise are discussed in section 4. Final remarks are summarised in section 5.

2 North Atlantic Treaty Organization

NATO is a political and military alliance that brings together 28 member countries from Europe and North America. These countries meet to cooperate in the field of security and defence. It is committed to protecting its members through political and military means, it contributes to preventing conflicts within and beyond the frontiers of its member countries and carry out activities in the area of civil emergency planning as well as to promote cooperation in the field of science and the environment.

The first step to become a member of NATO is to declare an interest in joining the alliance.
Countries are invited to engage in an intensified dialogue with NATO about their membership aspirations and related reforms. Aspirant countries may then be invited to participate in the Membership Action Plan (MAP) to prepare and demonstrate their ability to meet obligations and commitments of future membership. In addition to being in a position to further the principles of the 1949 Washington Treaty they are also expected to meet certain political, economic and military criteria.

Specifically countries seeking NATO membership would have to be able to demonstrate that they have fulfilled the following requirements: i) a functioning democratic political system based on a market economy, ii) the fair treatment of minority populations, iii) a commitment to the peaceful resolution of conflicts, iv) the ability and willingness to make a military contribution to NATO operations and v) a commitment to democratic civil-military relations and institutional structures. Once admitted, new members would enjoy all the rights and assume all the obligations of membership. This would include acceptance (at the time when they join) of all the principles, policies and procedures previously adopted by Alliance members (NATO, 2015a). Among them, standardization agreements play an important role (STANAG). Member states need to share a common set of standards, especially among military forces, to carry out multinational operations. In particular, NATO standardization is the development and implementation of concepts, doctrines and procedures to achieve and maintain the required levels of compatibility, interchangeability or commonality needed to achieve interoperability. Standardization affects the operational, procedural, material and administrative fields. This standardization allows for more efficient use of resources and thus enhances the Alliance’s operational effectiveness (NATO, 2015b).

NATO membership has increased since 1949 from 12 to 28 countries through six rounds of enlargement. The dismantling of the Warsaw Pact and the incorporation of some ex-Warsaw-Pact members to the alliance caused NATO’s adoption of a new strategic doctrine in 1994 that calls for crisis management and peace enforcement in places even outside of Europe whenever NATO’s vital interests are at risk.¹ Along this changing strategic and membership environment there has been a significant downsizing of defence budgets among most NATO allies with the exception of Greece and Turkey, although there is no evidence of disproportionate burden sharing (at least during the nineties), Sandler and Murdoch (2000).² As explained above, together with the enlargement process, the Alliance has developed a network of structured partnerships with countries from the Euro-Atlantic area, the Mediterranean and the Gulf region, as well as individual relationships with other partners such as Japan or Australia. Partners cooperate with NATO in a very broad range of security-related areas and can participate in over 1,000 activities offered in the Partnership Cooperation Menu. Partners contribute in many ways to shaping discussions and debates in the Alliance (NATO, 2014).

¹The fourth enlargement was the first after the end of the Cold War when Hungary, the Czech Republic, and Poland joined NATO in 1994.
²On average western European countries spent 3.1% of their Gross Domestic Product on defence between 1985 and 1989, this figure had fallen to 1.7% in 2008. Over the same period, the US has seen its defence budget fall from 6% to 4% but this last figure does not take account of expenditure on operations in Iraq and Afghanistan nor the budget for the Homeland Security Department (Liberti, 2011).
3 Theoretical Model

As stated before, we are interested in the effect that a military alliance membership has on growth. Alliance membership should come along with huge benefits of common security for everyone. A country can decide to become a member of a military alliance or not. If not a member, the total amount of military spending is determined by funds devoted by each individual country. If a country is a member of an alliance, such as NATO, military spending will be affected by the rules, procedures and structure of the alliance that will merge their resources and military know-how together with the ones provided by each country.3

Let us consider an economy populated by infinitely lived identical households. Households maximize their discounted utility function over the stream of consumption $c_t$ and security (national defence) $s_t$

$$\sum_{t=0}^{\infty} \beta^t \left[ c_t^{1-\theta} - \frac{1}{1-\theta} + \psi S(s_t) \right]$$

where $0 < \beta < 1$ is the discount factor, $\theta > 0$ is the inverse of the elasticity of intertemporal substitution, $\psi$ is the weight agents assign to national security and the function $S(\cdot)$ is increasing in security.

Government spending $g_t$ is productive, as in Barro (1990). We assume the production function to have the Cobb-Douglass form, similar to Pieroni (2009),

$$y_t = A_t k_t^{1-\varepsilon-\sigma} n_t^{\varepsilon} \left[ m_t^{1-\sigma} (\phi_t M_t)^{\varepsilon} \right]$$

where $y_t$ is output per capita at time $t$, $A_t$ is the productivity level at time $t$, $k_t$ is the physical capital per capita, $n_t$ is non-military spending per capita, $m_t$ is military spending per capita, $M_t$ is the total military spending of the alliance per total of alliance inhabitants and $\phi_t$ is the alliance spillover parameter. The elasticities of output with respect to non-military spending and military spending are $\varepsilon$ and $\sigma$, $0 < \varepsilon < 1$, $0 < \sigma < 1$, respectively. Parameter $\kappa$, $0 < \kappa < 1$, characterizes the weight the alliance military spending has in the national production, i.e. the spillovers from the alliance membership. The strength of these spillovers is measured by $\phi_t > 0$.

Government spending $g_t$ is considered to take two forms: military spending, $m_t$ and non-military spending, $n_t$. In each period a fraction $\rho_t$ of government spending is devoted to the military spending

$$m_t = \rho_t g_t$$

and the rest to the non-military one

$$n_t = (1 - \rho_t) g_t.$$  

Military spending is necessary for providing security. Higher security increases agents’ welfare. Security is further enhanced by military alliance membership. Production of national security

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3It is considered that alliance membership would mean a standardisation of military spending to comply with the norms laid down by the alliance. For example, the NATO Connected Forces Initiative (CFI) that combines a comprehensive education, training, exercise and evaluation program with the use of cutting-edge technology to enhance the high level of interconnectedness and ensure that Allied forces remain prepared to engage cooperatively in the future.
is specified as
\[ s_t = B_t M_t \]
where \( B_t \) is the efficiency at which military spending is turned into national security and \( M_t \) is the total alliance military spending per capita in the analyzed economy.\(^4\)\(^5\) If a country becomes a member of an alliance, its military spending may be modified. The following expression reflects convergence to the ‘standard’ level of military spending
\[ m_{t+1} = (\gamma^* - 1) \left[ (1 - \pi) m_t + \pi M_t \right] + m_t \]  \hspace{1cm} (2)
where \( \gamma^* \) is the balanced growth path growth rate of our economy, \( \pi, 0 < \pi < 1 \), measures the speed of convergence. In this case the fraction of government spending which goes to military spending will be affected by the alliance membership
\[ \rho_t = \rho(m_t, M_t). \]
Government finances its spending by taxing output at a rate \( \tau_t \)
\[ g_t = \tau_t A_t k_t^{1-\varepsilon-\sigma} n_t^\varepsilon \left[ m_t^{1-\kappa} (\phi_t M_t)^\kappa \right]^\sigma. \]  \hspace{1cm} (3)
Households enter a given period with capital \( k_t \). They distribute their income between consumption \( c_t \) and investment \( i_t \). Capital depreciates at a rate \( \delta \) and investment is given by
\[ i_t = k_{t+1} - (1 - \delta)k_t. \]
Households spend their disposable income on consumption and investment, and their budget constraint can be written as
\[ c_t + k_{t+1} - (1 - \delta)k_t = (1 - \tau_t) A_t k_t^{1-\varepsilon-\sigma} n_t^\varepsilon \left[ m_t^{1-\kappa} (\phi_t M_t)^\kappa \right]^\sigma. \]  \hspace{1cm} (4)
The ratio of government spending to physical capital can be expressed from (3) as
\[ \frac{g_t}{k_t} = (\tau_t A_t) \frac{1-\varepsilon-\sigma}{1-\varepsilon-\sigma} (1 - \rho_t) \frac{1-\varepsilon-\sigma}{1-\varepsilon-\sigma} \left( \frac{\phi_t M_t}{k_t} \right)^{\frac{\varepsilon}{1-\varepsilon-\sigma}}. \]  \hspace{1cm} (5)
Maximizing the household utility (1) with respect to the budget constraint (4), using (5), we get the following expression for the growth rate of consumption
\[ \gamma_t = \frac{c_{t+1}}{c_t} = \left\{ \beta \left[ (1 - \varepsilon - \sigma) (1 - \tau_{t+1}) A_{t+1}^{\frac{\varepsilon}{1-\varepsilon-\sigma}} \right] \right\}^{\frac{1}{\sigma}} \frac{(1 - \rho_{t+1})^{1-\varepsilon-\sigma} \left( \rho_{t+1} \right)^{1-\varepsilon-\sigma} \left( \frac{\phi_t M_t}{k_t} \right)^{\frac{\varepsilon}{1-\varepsilon-\sigma}} + 1 - \delta \}^{\frac{1}{\sigma}} \]  \hspace{1cm} (6)
\(^4\)The total alliance military spending may be represented by the stock of arms available in the whole alliance. If a country has low number of inhabitants the available stock of arms will be large. This reflects the fact that a small country will benefit more from alliance membership in case of a conflict: according to one of the strategic links, NATO members will always assist each other against attacks (NATO, 2010).
\(^5\)Notice the difference between \( M_t \) (total alliance military spending per capita in the analyzed country), \( M_t \) (total alliance military spending per all alliance inhabitants) and \( m_t \) (military spending per capita in the analyzed country).
Using the households’ budget constraint (4) and the government budget constraint (3) we know that the growth rate of all variables is the same.\(^6\) If the tax rate is constant, \(\tau_t = \tau\), the fraction of government spending devoted to military spending is also constant, \(\rho_t = \rho\), and the spillover parameter \(\phi_t = \phi\), the whole model collapses to an AK model, as developed in Barro (1990). In that case the growth rate is maximized when the tax rate is set to

\[
\tau^\text{max} = \varepsilon + (1 - \kappa)\sigma
\]

and the fraction of government spending destined to military spending is

\[
\rho^\text{max} = \frac{(1 - \kappa)\sigma}{\varepsilon + (1 - \kappa)\sigma}.
\]

This implies that the fraction of military spending in gross domestic product (GDP) that maximizes the growth rate is

\[
\left(\frac{m_t}{y_t}\right)^\text{max} = \tau^\text{max}\rho^\text{max} = (1 - \kappa)\sigma.
\]

If NATO members are encouraged to converge in their military spending to a given fraction \(x\) of their GDPS, we can predict the effects by taking into account their structural parameters.\(^7\)

Setting \(\kappa = 0\) we get a version of the model of Pieroni (2009), a model for a country which is not a member of an alliance. In this case the national security would be just a function of national military spending

\[
\zeta_t^{\text{non-member}} = B_t m_t.
\]

### 3.1 Equilibrium behaviour

We have two effects playing against each other in this model. The military alliance membership and the compliance increases the fraction of government spending devoted to military spending, \(\rho_t\). If \(\rho^\text{max}\) and \(\tau^\text{max}\) were employed before the country becomes a member of a military alliance, the convergence to the required standards would induce negative effect on growth. On the other hand, the military alliance membership provides higher security and stability. This positive effect on growth is expressed as a spillover in the production function.

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\(^6\)We have to impose this growth rate on \(M_t\), too. However, given the convergence equation (2), once \(m_t\) converges to \(M_t\), the spillover effect will disappear and the model collapses to Pieroni (2009).

\(^7\)Function \(\tau = T(\gamma)\), \(\rho = R(\gamma)\) are both concave, i.e.

\[
\frac{d\tau}{d\gamma} > 0 \text{ for } \tau < \tau^\text{max}, \quad \frac{d\tau}{d\gamma} < 0 \text{ for } \tau > \tau^\text{max},
\]

\[
\frac{d\rho}{d\gamma} > 0 \text{ for } \rho < \rho^\text{max}, \quad \frac{d\rho}{d\gamma} < 0 \text{ for } \rho > \rho^\text{max}.
\]
4 Empirical Analysis

4.1 Data and Methodology

We are interested in the effects of becoming a member of a military alliance in the nexus between defence spending and economic growth. The initial analysis is based on a dynamic panel data set of 55 countries over the 1955-2014 period. All the countries included are NATO members or have a kind of partnership with the alliance along the period of study. Actually, most of them have different levels of partnership during the period. Appendix collects the countries included and their relationship with the alliance. Like Compton and Paterson (2016) and Musayev (2016), we use non-overlapping five-year intervals. In this way short-run cyclical fluctuations are filtered out, so that the focus is on long-run growth effects (Aghion et al., 2009). Following equation (6) of the model, the growth rate of the economy will depend on military spending and its relationship with the rest of the public expenditure, on the fact of belonging or not to a military alliance and the effects it may have on technology and defence sector. Therefore, the baseline specification to estimate is

\[ \Delta Y_{it} = \alpha_0 + \alpha_1 \text{Gdpcap}_{it-1} + \alpha_2 \text{Nonmil}_{it} + \alpha_3 \text{Mil}_{it} + \alpha_4 \text{Alliance}_{it} + \lambda X_{it} + \eta_t + \varepsilon_{it} \]  

(7)

where for country \( i \) and period \( t \), \( \Delta Y_{it} \) is the five-year average log difference of real GDP, \( \text{Gdpcap}_{it-1} \) is the logarithm of real GDP per capita at the beginning of the period, \( \text{Nonmil}_{it} \) is the logarithm of non-military spending (government consumption and investment) to GDP. These variables are constructed using data from the Penn World Tables (PWT 9.0). Variable \( \text{Mil}_{it} \) accounts for military expenditure and is computed as the five-year average of the log of military spending to GDP using data from SIPRI (Stockholm International Peace Research Institute). Variable \( \text{Alliance}_{it} \) accounts for the effects associated to the relationship with the military alliance. In particular, we include two different variables: \( \text{NATO} \) and \( \text{NatoBenefit} \). Variable \( \text{NATO} \) is defined to capture different stages in the individual country partnership, or evolution to become a NATO member. It is increasing as the relationship with NATO reinforces. Accordingly, \( \text{NATO} \) variable has the lowest values with partnership relations and higher values during integration process (as it is assumed to be an intensified partnership) and the largest value when membership is granted (see Appendix). It represents the institutional arrangements accepted in the relation with the alliance. Variable \( \text{NatoBenefit} \) instead is a proxy for the security benefits associated to common defence spending. For country \( i \), we compute the difference between the NATO per capita defence spending (excluding country \( i \)) and the national per capita defence spending. Large values indicates that country \( i \) is far from the alliance expenditure. Low values suggest that country \( i \) is converging to the NATO expenditure. Negative values would suggest excessive military burden. Control variables are accounted for in \( X_{it} \). We include standard control variables used in the empirical growth literature. In particular, schooling (logarithm of the average years of schooling attained by females and males aged 15 and over obtained from Barro and Lee (2013); and the population growth rate (data from PWT 9.0). Table 1 collects summary statistics of the data used.
Table 1: Summary Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Std.Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth of GDP per capita</td>
<td>466</td>
<td>0.0230</td>
<td>0.0751</td>
<td>-1.0980</td>
<td>0.2995</td>
</tr>
<tr>
<td>GDP per capita (log)</td>
<td>467</td>
<td>9.3510</td>
<td>0.9093</td>
<td>5.6759</td>
<td>11.2312</td>
</tr>
<tr>
<td>Gov. consumption/GDP</td>
<td>468</td>
<td>0.1949</td>
<td>0.0862</td>
<td>0.0527</td>
<td>0.6448</td>
</tr>
<tr>
<td>Investment/GDP</td>
<td>468</td>
<td>0.2376</td>
<td>0.0705</td>
<td>0.0315</td>
<td>0.4695</td>
</tr>
<tr>
<td>MIL (Military spending/GDP)</td>
<td>468</td>
<td>0.0263</td>
<td>0.0222</td>
<td>0.0000</td>
<td>0.3612</td>
</tr>
<tr>
<td>NATO</td>
<td>653</td>
<td>0.3893</td>
<td>0.4521</td>
<td>0.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>NATO Benefit</td>
<td>699</td>
<td>3.7015</td>
<td>18.0212</td>
<td>-0.8862</td>
<td>262.7467</td>
</tr>
<tr>
<td>Population Growth</td>
<td>466</td>
<td>0.0055</td>
<td>0.0087</td>
<td>-0.0373</td>
<td>0.0315</td>
</tr>
<tr>
<td>Schooling (log)</td>
<td>585</td>
<td>2.0288</td>
<td>0.3842</td>
<td>0.1051</td>
<td>2.5789</td>
</tr>
</tbody>
</table>

We estimate equation (7) using system Generalized Method of Moments (GMM) dynamic panel data estimator. Traditionally GMM uses first-difference transformation. However, this technique has a weakness. It magnifies gaps in unbalanced panels (Roodman, 2009). Arellano and Bover (1995) propose a second transformation 'orthogonal deviations' that minimizes data loss and since lagged observations do not enter the formula, they are valid as instruments. Since the sample is small, we decide to use this transformation in order to preserve sample size. Further, to avoid over-fitting, we collapse the instrument matrix.8

Focusing first on the diagnostic tests, Hansen’s J-statistics for all specifications are too small to reject the null hypothesis that the instruments are valid. Therefore the excluded instruments are correctly omitted from the estimated equation. Further, AR(1) and AR(2) test statistics for the first and second order serial correlation in the first-differenced residuals indicate, as required, that while we can sometimes have evidence of first order autocorrelation, we always accept the null hypothesis of no second order autocorrelation.

4.2 Empirical Results

Tables 2 and 3 collect the estimation results for the impact of military expenditure conditional to participating in a military alliance. Table 2 includes the results for the whole sample. Column 1 stands for the baseline specification where economic growth is supposed to be affected by different kinds of public expenditure and some other control variables. The rest of the columns introduce the NATO variables of interest and some interaction effects. Estimation is done with robust standard errors to account for heteroskedasticity and autocorrelation. To control for instrument proliferation, instruments are collapsed. Below each column Hansen J-tests and AR(1) and AR(2) are reported.

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8 We have chosen not to run two-step GMM due to well-known finite sample problems associated with the standard errors of two-step estimates. Indeed, two-step estimates of the model (not reported) suggest significant downward bias in the standard errors, even after using the Windmeijer (2005) correction.
## Table 2: Military Spending, NATO and growth

<table>
<thead>
<tr>
<th>Dependent var: GDP per Cap (log)</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDPCAP (initial GDP (per capita))</td>
<td>-0.0347***</td>
<td>-0.0389***</td>
<td>-0.015*</td>
<td>-0.0181**</td>
<td>-0.0197**</td>
</tr>
<tr>
<td></td>
<td>(0.0065)</td>
<td>(0.0065)</td>
<td>(0.0081)</td>
<td>(0.0086)</td>
<td>(0.0092)</td>
</tr>
<tr>
<td>Investment/GDP</td>
<td>0.2547**</td>
<td>0.1777*</td>
<td>0.0801</td>
<td>0.3895**</td>
<td>0.3298**</td>
</tr>
<tr>
<td></td>
<td>(0.1236)</td>
<td>(0.1010)</td>
<td>(0.1091)</td>
<td>(0.1817)</td>
<td>(0.1615)</td>
</tr>
<tr>
<td>Gov. consumption/GDP</td>
<td>-0.3182</td>
<td>-0.1919</td>
<td>-0.3318**</td>
<td>-0.3735**</td>
<td>-0.4497***</td>
</tr>
<tr>
<td></td>
<td>(0.203)</td>
<td>(0.2180)</td>
<td>(0.1539)</td>
<td>(0.1492)</td>
<td>(0.1383)</td>
</tr>
<tr>
<td>Mil (military spending/GDP)</td>
<td>1.069</td>
<td>0.5406</td>
<td>0.5396</td>
<td>1.6216*</td>
<td>1.6762*</td>
</tr>
<tr>
<td></td>
<td>(0.9154)</td>
<td>(0.7171)</td>
<td>(0.5839)</td>
<td>(0.9403)</td>
<td>(1.0061)</td>
</tr>
<tr>
<td>NATO</td>
<td>0.0482*</td>
<td>0.3794**</td>
<td>-0.0586**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0270)</td>
<td>(0.1646)</td>
<td>(0.0256)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NATO Benefit</td>
<td>0.0253*</td>
<td>0.0109</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0162)</td>
<td>(0.0138)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NATO Benefit x Mil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.6254</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.6418)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population growth</td>
<td>2.2766</td>
<td>3.1781</td>
<td>4.0711</td>
<td>2.3840</td>
<td>2.8742</td>
</tr>
<tr>
<td></td>
<td>(3.7507)</td>
<td>(3.5772)</td>
<td>(3.7099)</td>
<td>(3.2497)</td>
<td>(3.5700)</td>
</tr>
<tr>
<td>Schooling (log)</td>
<td>0.0606**</td>
<td>0.0764**</td>
<td>0.1095**</td>
<td>0.0767*</td>
<td>0.0825*</td>
</tr>
<tr>
<td></td>
<td>(0.0309)</td>
<td>(0.0347)</td>
<td>(0.0553)</td>
<td>(0.0440)</td>
<td>(0.0479)</td>
</tr>
<tr>
<td>constant</td>
<td>0.1276</td>
<td>0.1321</td>
<td>-0.0741</td>
<td>-0.1104</td>
<td>-0.0849</td>
</tr>
<tr>
<td></td>
<td>(0.1913)</td>
<td>(0.1617)</td>
<td>(0.1675)</td>
<td>(0.2378)</td>
<td>(0.2441)</td>
</tr>
<tr>
<td>Obs</td>
<td>431</td>
<td>431</td>
<td>431</td>
<td>431</td>
<td>431</td>
</tr>
</tbody>
</table>

| Specification tests (p-values)   |         |         |         |         |         |
| AR(1)                            | 0.05     | 0.04     | 0.01     | 0.19     | 0.22     |
| AR(2)                            | 0.39     | 0.77     | 0.38     | 0.11     | 0.1      |
| Hansen tests                      |          |          |          |          |          |
| overidentification               | 0.999    | 0.999    | 0.999    | 1        | 0.999    |
| exogeneity                       | 0.904    | 0.993    | 0.671    | 0.902    | 0.966    |

Initial GDP per capita, GDPCAP, presents a negative and significant coefficient in all runs. Investment enhances growth significantly and government consumption shows a negative coefficient, but it is not always significant. The proxy for education affects positively economic growth as well. These results are in line with previous evidence such as Pieroni (2009) and Musayev (2016). NATO variable, which accounts for the kind of relationship with the alliance (higher values imply closer relationship and the value becomes 1 when the country is a full member of the alliance), is included in column 2. Its coefficient is positive and significant. The prospect of becoming a NATO partner (or member) has a positive effect on economic growth. It can be considered as a positive shock for the national defence and security sector. Initial GDP per capita, investment and education maintain sign and significance of the baseline. In column
3, we introduce the interaction term between military expenditure and NATO variable. Both NATO and its interaction are significant. However, the coefficient of the interaction is negative. Therefore, the positive effect on economic growth of NATO is greater for those countries with lower military expenditure over GDP. Variable NATO Benefit is the proxy for the security increase associated to the relationship with the alliance. It is introduced in column 4. It shows a positive and significant estimated coefficient. The incremental security associated to additional military expenditure enhances economic growth. Results for national military expenditure are positive although its significance depends on the variable set introduced. Interestingly, the introduction of NATO Benefit makes national military expenditure affect growth positively and significantly (column 4 and 5) reinforcing the positive effects of enhanced security and stability.

Table 3.A: Military Spending, NATO and growth. Subsamples.

<table>
<thead>
<tr>
<th>Dependent var: GDP per Cap (log)</th>
<th>Large defence spending</th>
<th>Low defence spending</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDPCAP initial GDP (per capita)</td>
<td>-0.0314*** -0.0329*** -0.0293*</td>
<td>0.0176 0.0145 0.0191</td>
</tr>
<tr>
<td></td>
<td>(0.0071) (0.0071) (0.0163)</td>
<td>(0.0258) (0.0248) (0.0225)</td>
</tr>
<tr>
<td>Investment/GDP</td>
<td>0.0175 -0.0343 -0.0423</td>
<td>-0.2167 -0.2962 -0.3193</td>
</tr>
<tr>
<td></td>
<td>(0.0719) (0.0635) (0.0725)</td>
<td>(0.2758) (0.3115) (0.3155)</td>
</tr>
<tr>
<td>Gov. consumption/GDP</td>
<td>-0.5075*** -0.4949*** -0.4917***</td>
<td>-0.4296** -0.466** -0.4967**</td>
</tr>
<tr>
<td></td>
<td>(0.1042) (0.1095) (0.1043)</td>
<td>(0.1941) (0.2174) (0.2087)</td>
</tr>
<tr>
<td>MIL (military spending/GDP)</td>
<td>-0.3583* -0.3503** -0.2929</td>
<td>1.7906** 1.5960** 1.8699***</td>
</tr>
<tr>
<td></td>
<td>(0.1983) (0.1734) (0.2569)</td>
<td>(0.7350) (0.6775) (0.6816)</td>
</tr>
<tr>
<td>NATO</td>
<td>0.0089 0.0394 0.0498*</td>
<td>0.3059* 0.0260 (0.1804)</td>
</tr>
<tr>
<td>NATO×MIL</td>
<td>(0.02066) (0.1012)</td>
<td>(0.0260)</td>
</tr>
<tr>
<td>Population growth</td>
<td>-1.840** -1.0328 -0.8771</td>
<td>1.9599 2.2131 2.8273</td>
</tr>
<tr>
<td></td>
<td>(0.9012) (0.8035) (0.8146)</td>
<td>(3.5213) (3.4516) (3.7339)</td>
</tr>
<tr>
<td>Schooling (log)</td>
<td>0.0302 0.0322* 0.0357</td>
<td>-0.0030 0.0283 0.0360</td>
</tr>
<tr>
<td></td>
<td>(0.0194) (0.0188) (0.0232)</td>
<td>(0.0763) (0.0755) (0.0681)</td>
</tr>
<tr>
<td>constant</td>
<td>0.3655*** 0.3696*** 0.3303**</td>
<td>-0.1143 -0.1232 -0.1887</td>
</tr>
<tr>
<td></td>
<td>(0.0557) (0.0467) (0.1465)</td>
<td>(0.1533) (0.1482) (0.1514)</td>
</tr>
<tr>
<td>Obs</td>
<td>230 230 230 201 201 201</td>
<td></td>
</tr>
</tbody>
</table>

Specification tests (p-values)

| AR(1) | 0.02 | 0.02 | 0.02 | 0.02 | 0.03 | 0.045 |
| AR(2) | 0.09 | 0.16 | 0.14 | 0.05 | 0.03 | 0.016 |
| Hansen tests |

overidentification | 0.996 | 0.998 | 1 | 1 | 1 | 1 |
exogeneity       | 0.999 | 0.988 | 0.983 | 0.483 | 1 | 1 |
The model predicts that, in equilibrium, the effects associated to military spending and alliance incorporation depend on the national military expenditure level before entering the alliance (similarly for the case of developing a partnership agreement). Accordingly, we analyse separately countries with high and low military expenditure. Results are collected in Table 3. Panel A and B present the evidence for the institutional NATO and NATOBenefit variables, respectively. Results show non-linearity in the military expenditure-growth nexus. National military burden has a negative impact on growth in countries with high levels of military spending whereas in countries with low levels of military expenditure the coefficient is positive and significant, even when the NATO variable and its interaction is introduced.\(^9\) NATO institutional variable affects growth positively only in countries with lower military expenditure. This evidence suggests that those countries with higher military expenditures may have already employed \(\rho_{\text{max}}\) before the country becomes a member of a military alliance. Therefore, the

\(^9\)Results for the low defence military expenditure show poor diagnostic statistics, in particular AR(2), therefore results should be interpreted with caution.
convergence to the required standards would induce negative effect on growth. Besides, the convergence has a positive and significant effect on growth of low military expenditure countries. Similar results, although significantly weaker, are obtained in Pieroni (2009). This effect is complemented by the positive and significant impact of the NATO institutional variable. Results associated to the NATO Benefit variable are coherent with the above evidence confirming the non-linear relationship between military expenditure and economic growth predicted by the model. Furthermore, NATO presents a non-linear relationship as well, showing that NATO involves a relevant institutional setting and security enhancing scenario for economic growth for those countries with lower military expenditure.

4.3 Robustness Analysis

This analysis may be affected by the period considered and the member commitment to the alliance. In particular, NATO enlargement takes place in the last twenty years. After Spanish accession NATO composition has not been altered. As we are especially interested in the effects of participating in the NATO alliance, we replicate the estimations for the 1990-2014 subperiod. Results confirm the positive effect of the NATO institutional framework on economic growth. Yet the security benefits have a positive but not significant coefficient.

Sharing fairly the burden of defending the North Atlantic community is very important for NATO allies. As the Cold War ended, European NATO member states committed themselves to spending at least the equivalent of 2 percent of their GDP on defense. For its part, the United States agreed to devote an amount equal to at least 3 percent of its GDP to defense. However, most NATO allies spend less than 2%. Therefore, USA military burden is shouldering small allies, being an outstanding contributor. Results maintain when we exclude USA from the analysis for NATO institutional effects and it is weaker for security benefits, NATO Benefit.

5 Conclusions

This work studies the impact of being part of a military alliance and the integration into new military institutions on the relationship between defence spending and economic growth. Theoretical setup of Pieroni (2009) is extended for an alliance membership. The empirical analysis is carried out for the particular case of NATO (54 countries) for the period 1955-2014. Results confirm that the prospect of becoming a NATO partner (or member) has a positive effect on economic growth. Belonging to this institutional environment can be considered as a positive shock for the national defence and security sector. However, results show non-linearity in the military expenditure-growth nexus. National military burden has a negative impact on growth in countries with high levels of military spending whereas in countries with low levels of military expenditure the coefficient is positive and significant. Therefore, the importance of nonlinear effects on economic growth is evident.

Future research on public spending in general and on defence spending in particular should take into account these effects. Besides, in the particular case of international alliances, syner-

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\[\text{Estimations are available upon request.}\]
gies between technological development of the country and the use of military technology can be explored through such non-linear effects.

References


Appendix

**NATO Partnership and Membership**

The Partnership for Peace (PfP) is a programme of practical bilateral cooperation between individual countries and NATO. Based on a commitment to the democratic principles that underpin the Alliance itself, the purpose of the Partnership for Peace is to increase stability, diminish threats to peace and build strengthened security relationships.

The PfP Planning and Review Process (PARP) aims to promote the development of forces and capabilities by partners that are best able to cooperate alongside NATO Allies in crisis response operations and other activities to promote security and stability. It provides a structured approach for enhancing interoperability and capabilities of partner forces that could be made available to the Alliance for multinational training, exercises and operations. The PARP also serves as a planning tool to guide and measure progress in defence and military transformation and modernisation efforts. Countries that wish to join NATO must participate in the PARP.

Individual Partnership Action Plans (IPAPs) are open to countries that have the political will and ability to deepen their relationship with NATO. They are designed to bring together various cooperation mechanisms through which a partner country interacts with the Alliance, sharpening the focus of activities to better support their domestic reform efforts.

Intensified political Dialogue (ID) on relevant issues goes along the IPAP process.

Membership Action Plan (MAP) provides advice, assistance and practical support tailored to the individual needs of countries wishing to join the Alliance.

NATO cooperates on an individual basis with a number of countries which are not actually part of this partnership framework. These include Australia, Japan, the Republic of Korea, Mongolia and New Zealand. The different degree of cooperation and global partnership has been assimilated to the aforementioned framework for comparison purposes.
Figure A.1: NATO partnership and membership. Previous Countries: Belgium, Canada, Denmark, United States, France, Iceland, Italy, Luxembourg, Norway, Netherlands, Portugal, United Kingdom, Greece, Turkey, Germany, Spain.