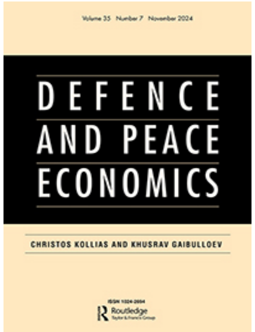

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Analysis of the Economic Effects of Defence Spending in Spain: A Re-Examination Through Dynamic ARDL Simulations and Kernel-Based Regularized Least Squares

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ABSTRACT
Spain's economic growth over the last few decades constitutes a rather distinctive case in post-World War II Europe, which has attracted international academic interest. This paper examines the relationship between Spain's military expenditure and economic growth during the period 1954-2021 to shed further light. Using the recently developed method of Dynamic Autoregressive Distributive Lag (DARDL) simulation proposed by Jordan and Philips (2018) and the Kernel-Based Regularized Least Squares (KRLS) technique which accounts for potential non-linearities, interactions, and heterogeneous effects, this paper tests the short and long – run equilibrium relationship between military expenditure and economic growth in Spain. Furthermore, with the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests, we examine the stability of the above relationship. The results show that there is a positive short and long – run relationship between military expenditure and economic growth in Spain during the period under study. However, when we stratify our sample (before and after Spain's democratization), the positive relationship is sustained only during the years of the non – democratic regime. This has further policy implications as policymakers in Spain need to carefully balance national security concerns with the need for sustained economic growth.

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Introduction

Public resources devoted to military spending (*milex* henceforth) have been one of the most important budgetary items in countries around the world throughout modern times, drawing the attention of academics and politicians alike. Since Benoit's (1973, 1978) seminal work that highlighted the contributions of *milex* to civil economies, a growing literature has examined the relationship between defence spending and economic growth. A notable methodical critique of Benoit's work, however, focused on his conclusion that"heavy defense expenditure does not … appear to have been associated with lower growth rates" (1973, 4). Objections primarily include his failure to account for both the inflow of foreign resources to understand whether economies were rather inefficient, to start with, and the variations over-time in the data series (Deger 1986, Faini et al. 1984). The existing literature, which is centred on the determinants and socio-economic consequences of *milex* in the short – and the long – run, has provided mixed evidence and findings (Dunne and Uye 2010, Emmanouilidis and Karpetis 2020): it is basically characterized by heterogeneity in the selected

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sample, the time period analysed, the countries selected and the applied methodology (Raju and Ahmed 2019). Theoretically, defence is perhaps the most typical public good, whilst practically, despite the ending of the Cold War at the beginning of the 1990s, the shares of GDP devoted to defence continue to be high.

Considering that there is no unanimity in the *milex* –economic growth literature, it is worth re – examining whether defence expenditure is indeed a budget item that adds to or subtracts from a country's economy and whether differences in policies set by the different political systems[1] affect military budgets, using Spain as a case study. Spain is an appealing case study for many reasons as it is an important player in European defence, but also due to its tumultuous modern political history (i.e. the dictatorship of Francisco Franco from 1939 to 1977, followed by the transition to democracy from 1977 to date); the amount of defence expenditure as a share of the country's GDP which has shown a downward trend since 1982, when Spain joined NATO; its significant defence industrial base[2]; its privileged and complex geostrategic position[3]; and its global security objectives.[4]

Furthermore, most studies have looked at the economic growth –*milex* nexus of Spain in multi – country analyses, especially together with the peripheral European countries, (i.e. Greece and Portugal) (e.g. Dunne, Nikolaidou, and Mylonidis 2003, Nikolaidou, 2016) or using short data periods, for example analysis from the 1960s to the 1990s (e.g. Molas –Gallart 1997, Gadea and Montañes, 2001), or early 2000s (e.g. Pérez-Forniés et al. 2014) or by examining the political determinants of *milex* (e.g. Sabaté 2016).

The present study is of particular importance, since, firstly, it is among the few studies to explore the *milex* –economic growth nexus in Spain over a longer period (1954-2021), to the best of our knowledge. Secondly, we use the novel Dynamic Autoregressive Distributive Lag (DARDL) simulation introduced by Jordan and Philips (2018), that can instantly provide visualization and graphs, by further examining the potential counterfactual shift in the targeted variable *ceteris paribus*. The traditional ARDL approach can be quite complex as the number of lags increases in the default ARDL (1,1) model, which can further lead to increased difficulties interpreting short – and long – run relationships. DARDL, through dynamic stochastic simulations and a prolific graphical interface, exhibits counterfactual changes in a particular variable while other variables selected in the model are held constant. As such, DARDL lessens the dependence on direct interpretations of model coefficients prevalent in the traditional ARDL model (Khan et al. 2021, Okere et al. 2022). This study, further, employs the Kernel-Based Regularized Least Squares (KRLS) method, an econometric machine-learning technique established in Hainmueller and Hazlett (2014). The latter is useful for our analysis as it accounts for the possible existence of non-linearities and heterogeneous effects, explores short – and long – run interactions with more accuracy, and produces strong and objective findings.[5] Hence, the novel DARDL simulations and KRLS approaches are not only advantageous for complex dynamic relationships, but also enhance time series methodologies for formulating policy.

The remainder of the paper is organized as follows. The next section provides a short overview of the military – economic growth nexus in Spain. Section 3 provides a short review of the existing literature. Section 4 contains the empirical specification and discusses the data and the methodologies employed. Section 5 includes the econometric estimates and discusses the empirical results, while the last section concludes the study.

Spain's Turbulent Economy and *Milex* Nexus –An Overview

Most of Spain's national territory is located on the Iberian Peninsula and as such within the orbit of the Western European (WE) world. Modern Spain is made up of 17 autonomous regions and two autonomous cities.[6] The Spanish economic development took place in the midst of a turbulent political history[7] with alternating democratic and non-democratic periods (and international isolation until the mid-1950s), which was quite different from other WE countries[8] (Figure 1). De la Escosura (2000) states that Spain did not follow the structural change[9] of other WE countries, although it does not show any similarities with Less Developed countries either.[10] Rather

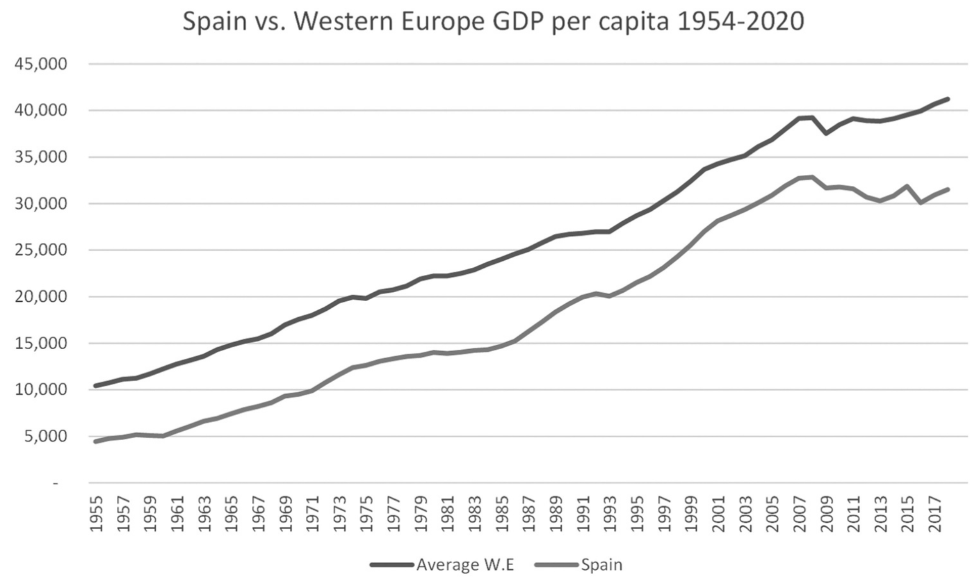


Figure 1. Spain's Comparative Real per Capita GDP (Western Europe) (2011 EKS $).
Source: Authors' computation based on World Development Indicators (2023)

the"economic performance in modern Spain tell[s] a story of failure and retardation up to the mid-twentieth century that led the way to fast growth after 1960" (De la Escosura 2007, 148). Certainly, Spain's most important difference with respect to WE emerged after World War II, when most WE countries were established democracies, whilst Spain had a dictatorship from 1939 to 1974.

However, Spain's economic growth over the last few decades constitutes a rather distinctive case in post-World War II WE which has attracted international interest because of its unique politico-economic modern history (i.e. successful transition from dictatorship to democracy); transition from a controlled market economy to a more liberal one; the acceleration in the growth of GDP per capita of the 1960s and early 1970s (from 3.5% during 1950-1960 to 6.3% during 1960-1973); a rather delayed integration in reconstruction plans and international organizations such as Marshall Aid and Bretton Woods (De la Escosura 1995, Melcarne et al. 2021); and inadequate natural resources, low human capital endowment, and inefficient institutions (Harrison 1995, De la Escosura 2007).

Before the 1950s, autarky was the rule and Spain's economic performance appears disappointing from the perspective of catching – up, since its growth rate fell short. Spain's economic history shows a sharp contrast between the nineteenth century's backwardness and economic slowdown and the twentieth century's rapid growth, even though the first half of the twentieth century was dominated by relative stagnation, whilst rapid growth was present in the second half (GDP per capita fell 0.4% between 1929 and 1935, followed by a further decline of 3.4% during 1935-1940, mainly due to the combined and persistent effects of the Great Depression, the Spanish Civil War and a post-war depression) (De la Escosura 1995). During the 1940s the economy practically stagnated in per capita terms (0.2%) because Spain was under autarchy, whilst during the period of 1954-75, the Spanish economy witnessed an impressive acceleration of 6.9% growth in GDP, almost exclusively attributable to labour productivity (Harrison 1995, Tortella 2000). Spain's economic take – off began belatedly during the 1950s and accelerated dramatically from the 1959, and the establishment of the Stabilization and Liberalization Plan, up to 1974. It is noteworthy, that during the 1960-1974 period, the Spanish economy grew in per capita terms similarly to the WE, but starting from a lower level (e.g. $5,741 per person in Spain compared to an average of $10,224 in WE.) (De la Escosura, Rosés, and Villarroya 2010, Melcarne et al. 2021) (see Figure 1). The 1959 Stabilization and

Liberalization Plan[11] marked the beginning of a new era for Spain since the country entered a process of economic liberalization and international market integration. Hence, Spain was integrated into the International Monetary Fund (1958), the World Bank (1958), the Organization for European Economic Cooperation (1959), and the General Agreement on Tariffs and Trade (1963) whilst economic interventionism was relaxed, but not suppressed, and the international isolation Spain has suffered since 1945, was relaxed. Withal, after 1975 (following Franco's death) two distinctive phases can be emphasized: one of economic slowdown (GDP fell from 3.35% from 1965-75 to 2.05% in 1975-85) and political instability during the years of transition to democracy (1975-85), which overlapped with the oil shocks; and another of return to fast growth after Spain became a member of the European Communities (EC hereafter) (1986), which ended with the recession of the early 1990s (GDP per capita increased to 2.45% during the period of 1985-1990) (Andres, Bosca, and Domenech 1994, De la Escosura 1995) (see Figure 2).

Furthermore, during the 1999-2007, the Spanish real GDP per capita increased by approximately 20%, with average real GDP growth of around 4% per year. Between 2007 and 2013 real per capita GDP fell, though, by 9% with rather persistent reduction of domestic demand, net positive contribution of the external sector, job destruction,[12] and downward trend in house prices (Ortega and Peñalosa 2013).

Moreover, during the period under study (1954-2021), the Spanish military expenditure had to accommodate itself to different political regimes (e.g. from Franco's dictatorship to democracy with an average *milex* of 2.1% of GDP), changes in the geopolitics (e.g. the Cold War, the creation of the EC, globalization, and the democratization of Eastern European countries, to name but a few) and to extensive socio-economic transformations (e.g. transition from an agrarian – based economy towards one driven by real estate, changes in the ratio of wealth to national income, rise to life expectancy, to name a few) (Sidaway 2001, Chislett 2018). Nevertheless, despite all the changes that have occurred in the last few decades, *milex* shows a rather stable pattern (maintaining an average ratio of around 2% of GDP –Figure 3) (Gadea and Montañes 2001). This stable trend lasted until the mid −1990s (an average of 1.8% of GDP from 1975-1995), with a slight increase during 1982 when Spain joined NATO[13] (2.54% of GDP), and a decrease following the end of the Cold War (the so – called *peace dividend*).

Figure 2. Spain's economic growth 1950-2021 (GDP %).
Source : Authors' computation based on De La Escosura and Roses (2021)

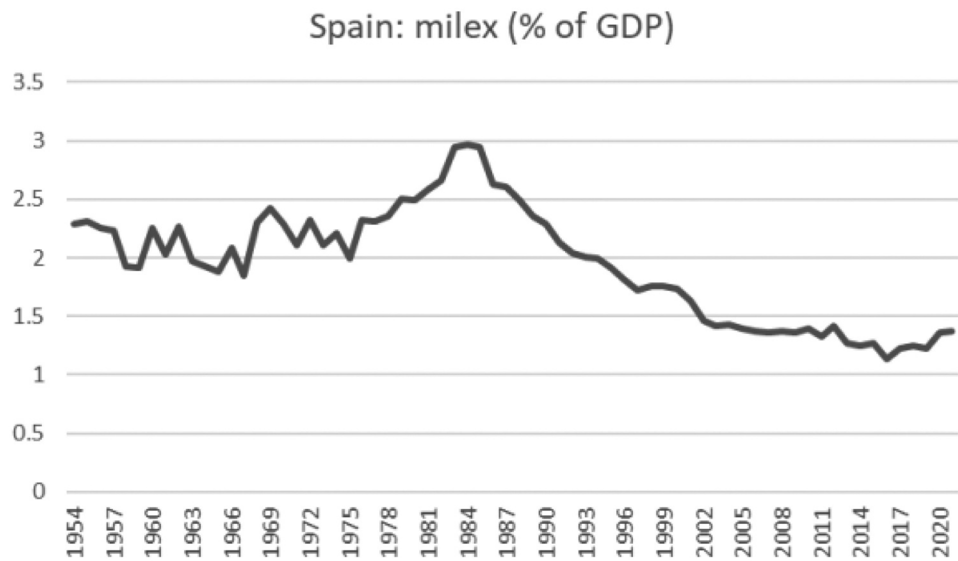


Figure 3. Spain's Military expenditure (% of GDP).
Source: Authors' computation based on data from SIPRI, 2022

However, during the democratic transition of the second half of the 1970s (after 1976 coinciding approximately with the end of Franco's dictatorship) until the beginning of the 2000s, a profound transformation of the military policies occurred.[14] It can be noted that a significant defence policy was the limited 2004 Spanish military attempt to modernize military transformation for harmonization purposes.[15] Spain sought to adapt its defence structures to meet current and future external threats. Interestingly though, in Spain the military transformation was limited only to its military sphere (compared to other NATO countries) and"[not] the whole defence architecture (strategic conception, political options, military power, defence economy, industrial cooperation, strategic culture and the management of civilian and military manpower)[16]" (Piella 2016, 2), which in turn had a narrow impact on the country's defence policy. Piella (2016) states that the above limitation was due to unrealistic defence and financial planning,[17] limited political commitment, and a lack of institutional continuity and experts to guide the transformation. The transformation process of the Spanish defence has yet to be fully realized, following the economic downturn from 2008 to 2014.

Prior Literature

Milex's role in countries' economies, is a complex one (more complex than simply depending on the level of development of a country) (Bove and Brauner 2016). Ever since the seminal works of Benoit (1973, 1978), the relationship between *milex* and economic growth has been extensively studied, different economic models have been developed, and different countries have been analysed, yet the empirical findings are rather mixed (Raju and Ahmed 2019). The general consensus, though, is that there is a trade – off between *milex* and other major government budgetary components (e.g. education and health). If resources are invested in defence, then capital, labour and technology may become unavailable for civilian use[18] (Lin, Ali, and Lu 2015, Dunne and Tian 2015).

To begin with, *milex* improves the socio – political conditions that drive an economy to prosper (e.g. maintenance of internal and external security), which in turn signals a safe environment for conducting business, attracting investment, and driving trade, thence contributing to economic growth (Sandler and Hartley 1995). Hence, *milex* provides positive externalities to the civilian sector, by supporting the development of economic infrastructure (Adams and Gold 1987, Gold and Adams 1990, Lee and Chen 2007), and by further introducing modern skills and attitudes to the labour force (Dunne et al. 2002, Yildirim, Sezgin, and Öcal 2005). Yet, *milex* might create mild inflation by encouraging an increase in production (Chan and Mintz 1992). As such, any increase in *milex* can result in increased capacity utilization and profits, which might lead to increased investment and ultimately economic growth (Faini et al. 1984, Dunne 1996). Similar results were reported by Nikolaidou (2016) for Greece, Spain and Portugal and for the period 1960-2014. Withal, oftentimes these positive economic effects might only have a temporary, or a *lagged* effect[19] (Babin 1989, Dunne et al. 2003). However, Kinsella (1990) finds no lagged effects on output, and no substantial relationship in either causal linear direction, between *milex* and inflation, unemployment rate, or interest rates.

Nonetheless, negative spillovers from the military to the civilian sector may occur when the crowding – out of investment and consumption leads to increased inflationary pressures and as such hinder economic growth (Deger and Sen 1983, Yakovlev 2007). Moreover, *milex* might delay economic growth in an indirect way by decreasing investment in other types of expenditure. For example, a decrease in investment might lead, further, to cuts in other public spending (e.g. education and health) which, in turn, might lead to increased taxes, government borrowing, and unemployment (Dunne, Smith, and Willenbockel 2005, Chletsos and Roupakias 2017). Increased *milex* often diverts resources and employment from productive parts of the economy and, consequently, exports and trade competitiveness will be negatively impacted (Chan 1988). This, in turn, might lead to a weaker currency and structural unemployment (Dumas 1977). Similar results were reported by Chletsos and Roupakias (2017) for Spain during 1960-2015.

Additionally, modernization of the military is also linked to high *milex*; for example, in countries with already advanced military technology, the defence sector is more productive than the civilian one, and as such, *milex* promotes economic growth (Yildirim et al. 2005, Azam 2020). Yet, many countries simply cannot afford military spending but, in support of internal and external security, many governments resort to running deficits to finance *milex*, like in Spain[20] (Dakurah, Davies, and Sampath 2001, Azam 2020).

As indicated above, the literature has not provided a consensus on the relationship between *milex* and economic growth, whilst any effects can only be experienced for a period of time and often are not consistent (neutral effects). In this regard, that has a dual meaning: either that *milex* has no impact on economic growth or that any positive or negative effects might cancel each other out (Heo and DeRouen 1998).

Furthermore, the direct impact of defence spending on economic performance is often seen as an opportunity cost that might deny resources and human capital to some dynamic sectors of the economy, such as exports. For example, Chan (1988) reported no clear evidence (either positive or negative) of an impact of *milex* on export expansion in Taiwan. Heo (2010) reported similar results for the U.S.A. for the period 1954-2005. Also, Gold and Adams (1990) reported inconclusive results as to whether defence spending was the primary cause of the decline in the U.S.A.'s international competitiveness, or whether it is investment's determinant. Similarly, Dunne and Nikolaidou (2005), were unable to report a general empirical conclusion on *milex*'s effect in Greece, Spain and Portugal over the period 1960-2002. An explanation (specifically for Spain) was the lack of information in the data due to the lack of exogenous shocks.

The political character of states is another force that might influence *milex* (Freedman, 1998, Fonfría, 2013). Most of the prior empirical evidence on Spain, indicated that the ideology of the elected government has not influenced defence spending significantly since 1850 (Molas –Gallart, 1997, Gadea and Montañes, 2001, Pérez-Forniés et al. 2014). For example, while Spanish *milex* may have been relatively low over the last few decades (e.g. an average of 1.06% of GDP compared to an average of 2.78% of NATO), there have been current periods of increased spending, for example, the Ministry of Defence -Spain (2017) reported that in 2016 *milex* accounted for approximately 15% of

Spain's total public spending. Similarly, Ortega et al. (2017) stated that in 2017 the Spanish *milex* increased significantly compared to 2016, i.e. from 6,899.22 to 8,716.47 million of euros.

Conversely, Sabaté's (2016) findings show that for the period 1850-2009, the Spanish dictatorships had a positive influence on military spending, even though the army was rather underdeveloped (Molas –Gallart, 1997). During the posterior democratic period, there has been a push to reduce *milex*, which was partially compensated by the restructuration and modernization of the Spanish army during the transitional period in the late 1970s and early 1980s (Sabaté 2016). Furthermore, armaments' production in Spain was further advanced due to three production programs (the General Directorate for Armament and Material (DGAM) in 1979; the 'state-of-the-art technologies' in 1987; and the International Defence R&D outlays during the 1990s) which supported the almost dying firms.[21] By 1987, Spain was among the world's biggest armaments exporters, which supported economic growth, but after 1988, Spain established embargoes against countries accused of human rights violations, (e.g. South Africa, Chile, Paraguay), and Warsaw Pact and other communist countries as well as active belligerents such as Iran and Iraq (Molas –Gallart, 1997). The development of a strong defence industry can lead to a positive bi – directional relationship between *milex* and economic growth, (whereby *milex* reinforces economic growth and GDP growth leads to an increase in *milex*) as reported by Gomez –Trueba et al. (2020) for 1961-2018 in Spain.

Finally, whether the effects of *milex* on economic growth are direct or indirect, positive, negative or inconclusive, or consequent to endogenous or exogenous shocks, oftentimes the greatest difficulty seems to be considering *milex* as a key driver of economic growth.

Model Specification, Data and Methodology

Our model follows the Barro-style[22] model of economic growth developed by modifying the Barro (1990) model, which has gained growing interest in recent years (e.g. Dimitraki and Menla Ali 2015; Compton and Paterson 2016; D'Agostino, Dunne, and Pieroni 2019; Utrero-González et al. 2019; D'Agostino et al. 2020; Dimitraki and Win 2021; to name just a few). The Barro-style specification, controls for variation in the size of central government (*milex* and other government/civilian spending) as an explanatory variable for economic growth. Other control variables are: governmental investment, openness to trade and labour.[23] Specifically, the present paper employs a formulation of the following type:

$$Y_t = b_0 + b_1 milex_t + b_2 civ_t + b_3 tr\_openness_t + b_4 pop_t + b_5 inv_t + e_t \tag{1}$$

where Y_t is the natural logarithm of GDP, $milex_t$ and civ_t represent the military and non -defence expenditure as a percentage of GDP, $tr\_openness_t$ is the sum of the Spanish exports and imports as a share of the country's GDP, pop_t stands for the population growth (proxy for labour), and inv_t that is represented by gross capital formation as a share of real GDP (expressed in constant international 2017 prices).

This study uses annual time-series data covering a 67–year period from 1954 to 2021, reflecting data availability. The data for Spain's GDP (in constant 2017 international dollars) were sourced from the Central Bank of Spain; the military expenditure data were sourced from SIPRI; civilian spending was sourced from the World Bank's Development Indicators. Population, openness to trade and gross capital formation data were sourced from the Penn World Tables. Descriptive statistics are listed in Table 1.

Table 1 reports the descriptive statistics of our variables: *GDP*, *milex*, *civilian spending, population, openness to trade and investment*. The annual means of all the variables are positive. With regard to volatility, *GDP, civ, tr_openess* and *inv* exhibit higher volatility than military spending whilst *pop* shows lower volatility. Furthermore, all the variables exhibit strong kurtosis and skewness. The Jarque – Bera (JB) test statistics show that normality is rejected at the 1% level for *GDP, tr_openess, and inv*.

Table 1. Descriptive statistics.

Variables	Median	Mean	St. dev.	Min	Max	Skewness	Kurtosis	JB
GDP_t	13.7604	13.6528	0.6620	12.1784	14.4554	0.0949	2.4301	6.4318***
$milex_t$	2.000	1.9500	0.4868	1.1400	2.9700	0.0599	2.0564	2.5634
civ_t	25.5302	25.6014	3.9753	17.4333	36.7707	0.1819	3.4276	0.8931
$tr\_openness_t$	25.3117	32.5945	21.5477	3.6405	68.3300	0.3122	1.5456	7.0977***
pop_t	0.8648	0.7170	0.5082	−0.3252	1.6712	−0.0994	2.1633	2.0955
inv_t	37.8986	38.8153	23.8624	7.8105	78.9547	0.0496	1.5141	6.2832**

Notes: p-values in [.]. *GDP* is expressed in natural logarithm, *milex*, *civ*, *tr_openness* and *inv* are ratios to GDP, and *pop* is expressed in growth rates.
JB is the Jarque- Bera test for normality. ***denotes significance at 1%.

Moreover, a necessary preliminary check involves the investigation of the series' stochastic properties to examine whether the bounds testing approach can be applied. Particularly, the application of that approach requires a dependent variable integrated of order one, $I(1)$, while all regressors entering the model should be either stationary at their levels or first-difference stationary, that is $I(0)$ or $I(1)$. For that purpose, the DF-GLS test, proposed by Elliott et al. (1996), is utilized along with the unit root test of Zivot and Andrews (1992) (ZA hereafter). Despite being more powerful than the conventional Augmented Dickey Fuller (ADF henceforth) test, the implementation of the former can be rendered problematic when exogenous shocks affect series' data generating process (Perron 1989). On the contrary, the ZA test overcomes that issue by accounting for structural shifts in levels (Model A), trend (Model B), or both (Model C).

As noted earlier, the existence of a long – run relationship, between the variables under consideration, is examined through the bounds testing approach of Pesaran, Shin, and Smith (2001), which relies on the estimation of an Unrestricted Error Correction Model (UECM). In the context of the present study, the UECM is formed as follows:

$$\Delta Y_t = a_0 + \sum_{i=1}^{p} a_{1i}\Delta Y_{t-i} + \sum_{j=0}^{q_1} a_{2j}\Delta milex_{t-j} + \sum_{j=0}^{q_2} a_{3j}\Delta civ_{t-j} + \sum_{j=0}^{q_3} a_{4j}\Delta tr\_openness_{t-j} + \sum_{j=0}^{q_4} a_{5j}\Delta pop_{t-j}$$
$$+ \sum_{j=0}^{q_5} a_{6j}\Delta inv_{t-j} + \rho_1 Y_{t-1} + \rho_2 milex_{t-1} + \rho_3 civ_{t-1} + \rho_4 tr\_openness_{t-1} + \rho_5 pop_{t-1} + \rho_6 inv_{t-1} + e_t (2)$$

where $\rho_i \text{for} i = 1, \ldots, 6$ represents the long-run multipliers, $a_i \text{for} i = 1, \ldots, 6$ stands for the short-run coefficients of the underlying ARDL model, while p and $q_i \text{for} i = 1, \ldots, 5$ symbolize the number of lags of the specified model. At this point, it should be noted that the optimal lag length has been defined through the Akaike information criterion (AIC), setting the maximum lag order equal to 4.

According to Pesaran, Shin, and Smith (2001), the investigation regarding the existence of cointegration can be done by applying F or Wald testing which checks the hypothesis of no cointegration $H_0 : \rho_1 = \rho_2 = \rho_3 = \rho_4 = \rho_5 = \rho_6 = 0$, against the alternative of cointegration $H_a : \rho_1 \neq \rho_2 \neq \rho_3 \neq \rho_4 \neq \rho_5 \neq \rho_6 \neq 0$. For the hypothesis testing the critical values used here are based on Pesaran, Shin, and Smith (2001) table CI (III).

Furthermore, and although ARDL modelling makes the estimation of short – and long – run dynamics feasible, the interpretation of the estimated coefficients can sometimes be difficult, especially when the ARDL model is described by a more complex structure with several lags, first differences, and lagged first differences of the independent and dependent variables (Pata and Isik 2021). To alleviate the complexity of ARDL modeling, Jordan and Philips (2018) introduced the DARDL which uses stochastic simulation to derive the effects of a positive or negative change in one of the regressors on the dependent variable. In other words, the method creates predicted values of the dependent variable, along with the associated confidence intervals, which can be plotted to show the response of the dependent variable to changes of one regressor over time. As such, the implementation of that method assumes the existence of cointegration, if an error-correction model

Table 2. Unit root test results.

Variable	DF-GLS (t-statistics) Intercept	DF-GLS (t-statistics) Trend & Intercept	ZA (t-statistics) Intercept Model A	ZA (t-statistics) Trend Model B	ZA (t-statistics) Trend & Intercept Model C	Break
	Levels			**Levels**		
GDP_t	0.1119	−0.9029	−2.6310	−2.7160	−2.4350	1968
$milex_t$	−0.6992	−1.5627	−2.9380	−3.1720	−3.4510	1976
civ_t	−0.9272	−3.0560	−4.9120**	−4.1680*	−4.6790	2011
$tr\_openness_t$	2.0789	−1.6967	−4.7040*	−2.5310	−4.3190	1994
pop_t	−3.3689***	−3.6354**	−3.6700	−2.9440	−4.3960	1998
inv_t	−0.1824	−1.9886	−3.1340	−3.4810	−3.8920	2005
	First Differences			**First Differences**		
ΔGDP_t	−2.2424**	−5.9608***	−6.5220***	−6.1360***	−6.4680***	1975
$\Delta tmilex_t$	−5.2099***	−1.0377	−12.7260***	−10.4340***	−12.6280***	1986
Δciv_t	−5.3938***	−5.1742***	-	−5.5800***	−6.5400***	2008
$\Delta tr\_openness_t$	−8.0082***	−0.1559	−8.7700***	−8.3300***	−8.6460***	1994
Δpop_t	-	-	−4.1440	−3.7310	−5.2670**	2008
Δinv_t	−6.8696***	−6.9231***	−7.4030***	−7.1130***	−7.4410***	2011

Notes: The optimal lag selection was determined using the Akaike information criterion. The ZA critical values at the usual levels of significance for the Models A, B and C are respectively: 1%: 5.34, 5%: 4.80, 10%: 4.58, & 1%: 4.93, 5%: 4.42, 10%: 4.11 & 1%: 5.57, 5%: 5.08, 10%: 4.82. The suggested break dates correspond to the estimated models with intercept and trend. Finally, break denotes the time of structure change.
*,**,***denote significance at 10%, 5% and 1%, respectively.

is fitted, and requires the application of the necessary residual diagnostics on the underlying ARDL specification (Jordan and Philips 2018).

Furthermore, our paper also exploits the KRLS method, a machine learning technique proposed by Hainmueller and Hazlett (2014) that fits multidimensional functions for regressions without relying on parametric assumptions, that is linearity or additivity assumptions. Through the KRLS method, it is possible to account for nonlinearities, interactions, and heterogeneous effects (Choi and Lee 2020). Particularly, the KRLS method employs a regularization problem[24] to find the best-fitting function and provides pointwise estimates of partial derivatives that represent the marginal effects of the independent variables at each data point (Hainmueller and Hazlett 2014). The derived KRLS estimator has all the desired statistical properties since it is unbiased and consistent, and follows asymptotically the normal distribution under mild regularity conditions, while it is not much less efficient than the OLS estimator even when the data follow a linear pattern (Ferwerda, Hainmueller, and Hazlett 2017).

Discussion and Interpretation of the Empirical Estimates

Overall, all model variables are non-stationary in levels. The only exception is the variable of population growth which appears to be stationary, but only in the DF – GLS test. At the same time, there is an indication of level stationarity for civilian spending in Model A of the ZA test since in that case the unit root hypothesis is rejected at a 5% level of statistical significance. In contrast, when the first differences are taken, all variables become stationary in at least one of the estimated models at a 5% level of statistical significance. This, of course, implies that the order of integration of the employed variables lies between I(0) and I(1), and as such the bounds cointegration test can be further utilized. The results of the unit root test are presented in Table 2.

Accounting for normality, homoscedasticity, and no autocorrelation in the residuals of the estimated model as well as coefficient stability, the ARDL model that is finally selected when using the AIC, is the ARDL (2,2,2,1,4,3) model. A comparison between the derived F-statistic and the critical values of Pesaran, Shin, and Smith (2001), reveals the existence of a stable long – run relationship between GDP and the regressors since the value of the former exceeds the upper limit of the critical

Table 3. ARDL Bounds Test.

Selected Model	ARDL(2,2,2,1,4,3)	
F-Statistic	4.0520**	
	Critical Values from Pesaran, Shin and Smith (2001) - table CI (III)	
Level of Significance	I(0)	I(1)
10%	2.45	3.52
5%	2.86	4.01
1%	3.74	5.06

Note: **denotes significance at 5%. I(0) and I(1) stand for lower and upper bounds respectively.

value at a 5% significance level, thus implying the rejection of the null hypothesis of no cointegration at that significance level. The results of the cointegration test are shown in Table 3.

The behaviour of the model's estimated residuals, is of particular interest, though, given that the validity of the bounds test relies on the normal distribution of the errors, which should also be homoscedastic and not autocorrelated. At the same time, the estimated coefficients of the ARDL model should be dynamically stable in order to avoid any effects of structural changes on them. Table 4 and Figures 4, 5,6 present the results of the relevant diagnostics.

More specifically, the extracted output related to Breusch – Godfrey test with four lags (Panel a) fails to reject the null hypothesis of no serial correlation at all levels of significance, whereas Cameron and Trivedi (1990) decomposition of information matrix (IM) test (Panel b) shows that the residuals are homoscedastic since the null hypothesis of homoscedasticity cannot be rejected at any of the usual significance levels. In addition, the lower part of Table 3 (Panel c) shows the skewness and kurtosis tests for normality. The resulting p – values of the two statistics confirm the normal distribution of the residuals.

The conclusion concerning the residuals' normal distribution is further supported by both plots of standardized normal probability (Figure 4) and quantiles of residuals against quantiles of normal distribution. Finally, it seems that the existence of structural breaks did not affect the estimated coefficients, given that the derived CUSUM and CUSUMSQ statistics lie within the 95% confidence band. Therefore, all diagnostic tests concerning the underlying ARDL model have the desired properties and attest to the validity of the dynamic estimates.

As a consequence, the next step involves the estimation of the DARDL[25] based on 5,000 simulations. The short – and long – run coefficient estimates of the simulated model are presented in Table 5.

To begin with, and regarding the civilian government expenditures, there is an indication of a positive and statistically significant economic effect in both the short – and long – run. The short –

Table 4. Model Diagnostics.

(a) Breusch-Godfrey Autocorrelation Test			
Lags (p)	F-statistic		df
1	1.1300 [0.2937]		(1, 43)
2	0.9530 [0.3938]		(2, 42)
3	0.6550 [0.5847]		(3, 41)
4	1.0080 [0.4150]		(4, 40)
(b) Cameron & Trivedi's decomposition of IM-test			
Source	Chi-square		df
Heteroskedasticity	64.0000 [0.4412]		63
Skewness	25.6100 [0.1413]		15
Kurtosis	1.6800 [0.1944]		1
Total	91.3000 [0.2498]		79
(c) Skewness/Kurtosis tests for Normality			
Variable	Pr(Skewness)	Pr(Kurtosis)	Joint adj. chi-square
Residuals	0.3353	0.2562	2.3100 [0.3148]

Note: p-values in [.].

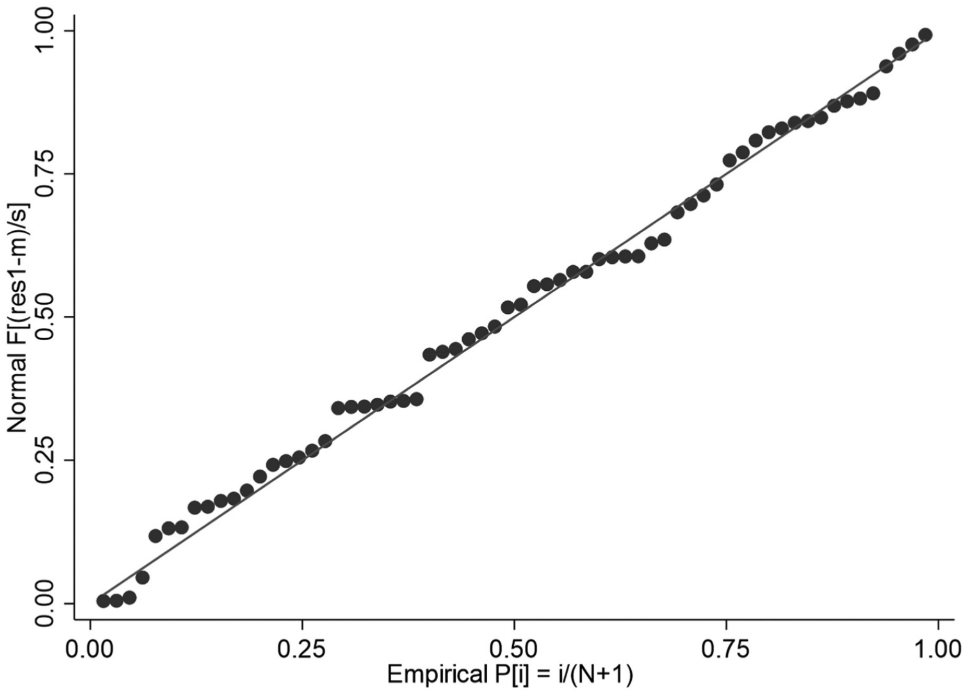


Figure 4. Standardized normal probability plot.

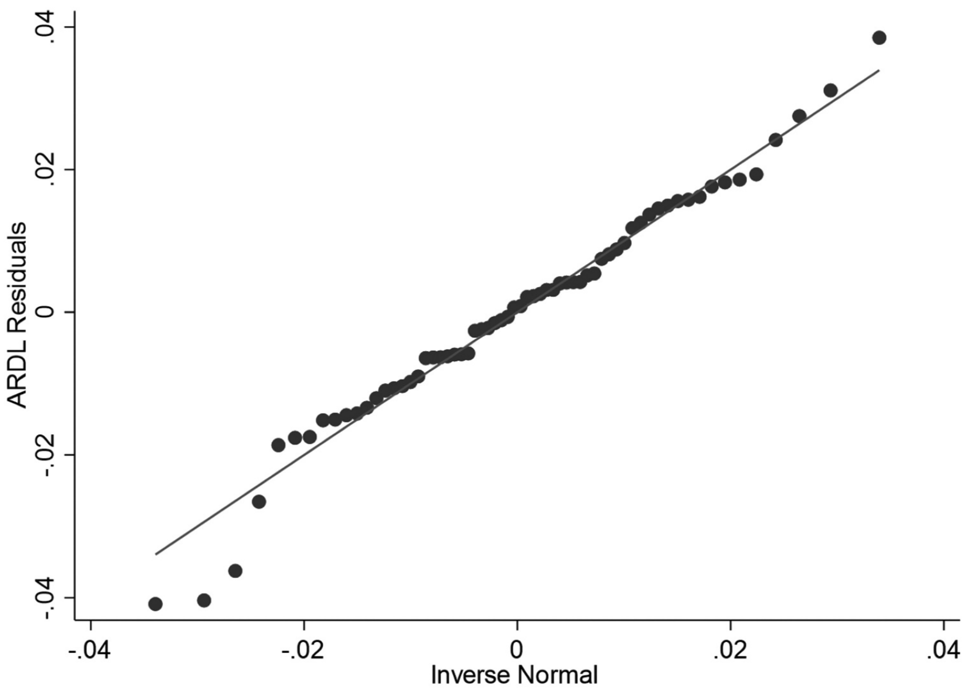
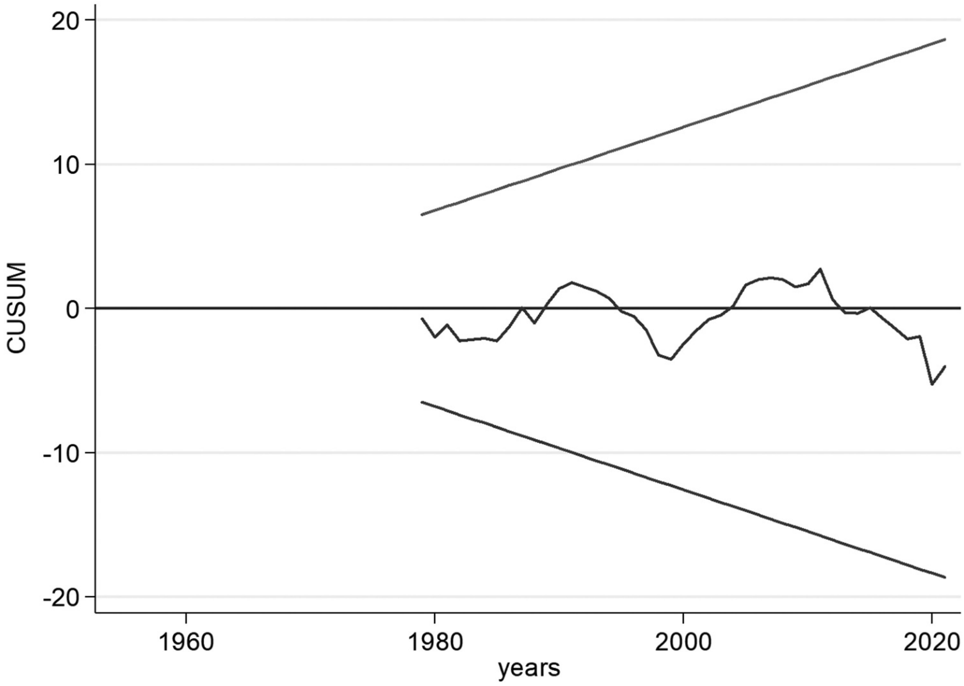


Figure 5. Quantiles of residuals against quantiles of normal distribution.



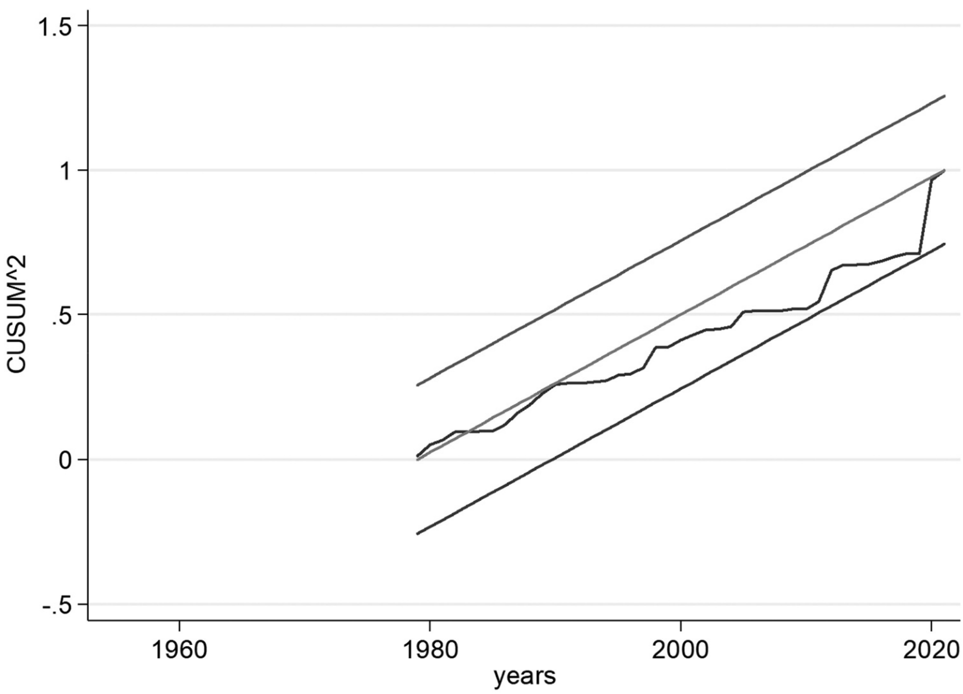


Figure 6. Cumulative sum (CUSUM) and cumulative sum (CUSUMSQ) of square statistics.

Table 5. Coefficient Estimates from Dynamic ARDL Simulation.

Variables	ARDL (2,2,2,1,4,3)
$ECT(-1)$	−0.0791*** (0.0264)
$milex_{t-1}$	0.0263 (0.0168)
civ_{t-1}	0.0042** (0.0021)
$tr\_openness_{t-1}$	0.0018 (0.0011)
pop_{t-1}	0.0069 (0.0083)
inv_{t-1}	−0.0001 (0.0005)
Short-run	
ΔGDP_{t-1}	0.3339*** (0.1191)
$\Delta milex_t$	0.0472** (0.0219)
$\Delta milex_{t-1}$	0.0447** (0.0208)
Δciv_t	0.0106*** (0.0022)
Δciv_{t-1}	−0.0039 (0.0026)
$\Delta tr\_openness_t$	0.0066*** (0.0017)
Δpop_t	0.0444 (0.0507)
Δpop_{t-1}	0.0212 (0.0724)
Δpop_{t-2}	0.0066 (0.0687)
Δpop_{t-3}	−0.0658 (0.0441)
Δinv_t	0.0001 (0.0006)
Δinv_{t-1}	−0.0003 (0.0006)
Δinv_{t-2}	−0.0012 (0.0007)
Long-run	
$milex_t$	0.3331** (0.1401)
civ_t	0.0537** (0.0173)
$tr\_openness_t$	0.0236*** (0.0084)
pop_t	0.0879 (0.1177)
inv_t	−0.0018 (0.0065)
C	0.8780*** (0.2733)
AdjR − squared	0.7225

Notes: standard errors in (.).
*,**,***denote significance at 10%, 5% and 1%, respectively.

run positive association is corroborated by the findings of de Castro (2006), who concluded that increases in government spending promoted Spain's output in the short – run, (especially in the fourth quarter following the shock). Obviously, from a theoretical point of view, the argument of short – run multiplier effects could also hold in the case of civilian spending as an integral component of aggregate demand. In the long – run, government spending could be beneficial to income by providing infrastructure and enforcing property rights, as well as improving labour force productivity and trade balance through subsidies provided to export-oriented industries (Lin 1994). Besides, public capital spending could be considered a stimulative factor for private investment (Laopodis 2001). Nevertheless, empirical evidence for the Spanish economy has shown that positive changes in government spending are associated with lower output in the long – run due to increases in budget deficits and rises in interest rates and inflation (de Castro and de Cos 2008).

Furthermore, trade openness is found to be positive and statistically significant at both time horizons, suggesting that trade liberalization policies can promote growth. The gains of trade openness are well documented in the literature (Chang, Kaltani, and Loayza 2009, Frankel and Romer 2017, Sachs and Warner 1995) and may be associated with greater capacity utilization, efficient resource allocation productivity growth and/or technology transfer, among others (Awokuse 2008). Additionally, the empirical evidence reveals no systematic relationship between economic output and population growth in either the short – or the long – run, which is consistent with Kuznets (1967) and Kelley and Schmidt (1995) mainly due to demographic and socio – economic changes that took place in Spain during the period of study. Moreover, public investment shows negative but insignificant results for Spain and for the period under study. Our results align with Acemoglu, Johnson, and Robinson (2001), Swaby (2007) and Warner (2014). Potential reasons for this could be crowding out and spillover effects, the quality of public investment, and institutional quality which could be the case in Spain which has historically focused more on current spending (e.g. wages and social benefits), than on public investment (e.g. transportation or environmental infrastructure) and has struggled with corruption and political instability over time, which may have negatively affected the implementation and impact of public investment (Kaufmann, Kraay, and Mastruzzi 2010).

Regarding *milex*, and starting from the short – run estimates, it is evident that it exerts both contemporaneous and lagged positive effects on economic output. Such a positive short – run effect, which contradicts the results of the few previous studies focused on the Spanish case, such as those of Dunne and Nikolaidou (2005) and Nikolaidou (2016), could possibly be attributed to Keynesian – type multiplier effects. If there is excess production capacity, a rise in *milex* can stimulate demand and thus the utilization of idle capital and labour. An increase in capital stock utilization may accelerate profitability which, in turn, can result in higher investment and economic growth (Faini et al. 1984, Pieroni, d'Agostino, and Lorusso 2008). This means that Spain's defense spending could be used as a fiscal tool in cases of insufficient demand. Specifically, according to the magnitude of the coefficient, a 1% increase in defence spending can enhance economic growth by approximately 0.04%.

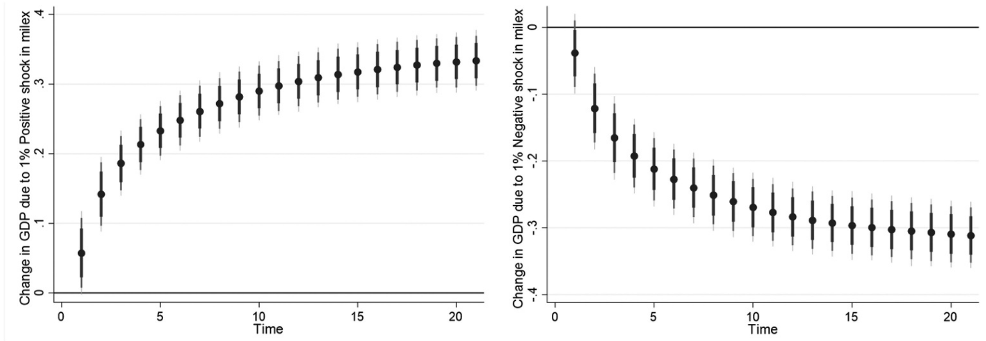
Meanwhile, the long – run estimates reveal the existence of a positive effect of defence spending on the Spanish *GDP*, consistent with results reported by Gomez –Trueba et al. (2020) (albeit only at a significance level of 10%). The long – run positive effects of *milex* could be due to some spin – offs (i.e. human capital enhancing activities, development of infrastructure, etc.) or technological spillovers that may have stemmed from military R&D programmes (Castro 2001). Another plausible explanation is that the reconstruction and modernization efforts in the Spanish defense sector since the mid–1970s have resulted in a remarkable arms export performance, as, according to SIPRI data (TIV tables[26]), Spain exhibited a remarkable improvement in that particular field over the last few decades. Besides, as mentioned above, *milex* could also promote economic activity by ensuring a safe environment for economic transactions and foreign investors (Sandler and Hartley 1995), while the military sector could be additionally responsible for preserving political stability (Yildirim, Sezgin, and Öcal 2005).

As noted above, through the DARDL simulation, it is possible to trace how various levels of military spending shocks affect the Spanish GDP series. Specifically, in the analysis that follows, the economic effects of positive and negative military spending shocks of 1, 5, 10, and 20% are examined. The visualization of the response of the Spanish GDP to the various levels of military spending shocks is depicted in Figure 7. The dots at the centre represent the average predicted value of GDP, while the dark to light lines correspond to the 75, 90 and 95% confidence intervals, respectively.

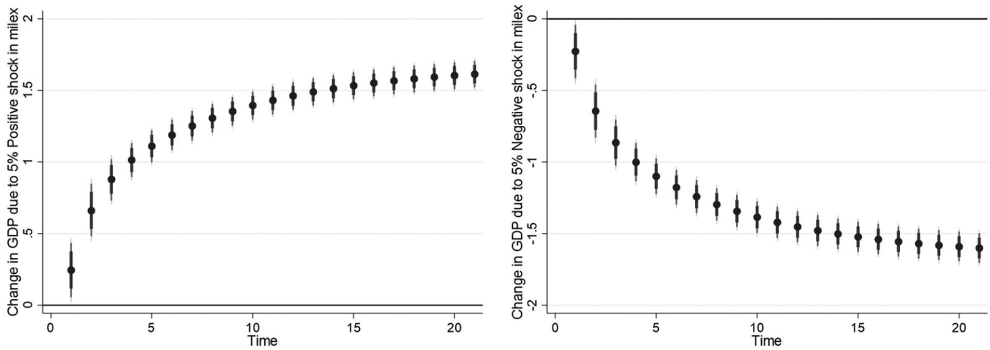
Clearly, the results confirm the positive relationship between *milex* and economic growth. A 1% increase (or decrease) in the defence burden leads to similar – type of change in GDP of about 0.3% in the long run (20 periods ahead after the shock). Of course, the larger the military spending shock, the greater the economic effect produced. Furthermore, changes in defense spending have a relatively large impact on income in the first few periods following the shock, regardless of the size and type of the shock. However, the marginal effect of defense spending declines over time. This implies that defense spending could be a useful fiscal tool for countercyclical economic policy, but not a lever of sustained growth. These results are consistent with Gomez –Trueba et al. (2020), who also obtained similar results from an impulse response analysis (IRF).

Nevertheless, one could assume that the marginal effect of military spending may be contingent upon its level. For that reason, the analysis proceeds with the KRLS method which relaxes the assumption of constant marginal effects. The closed – form marginal effects of the pointwise derivatives are shown in Table 6.

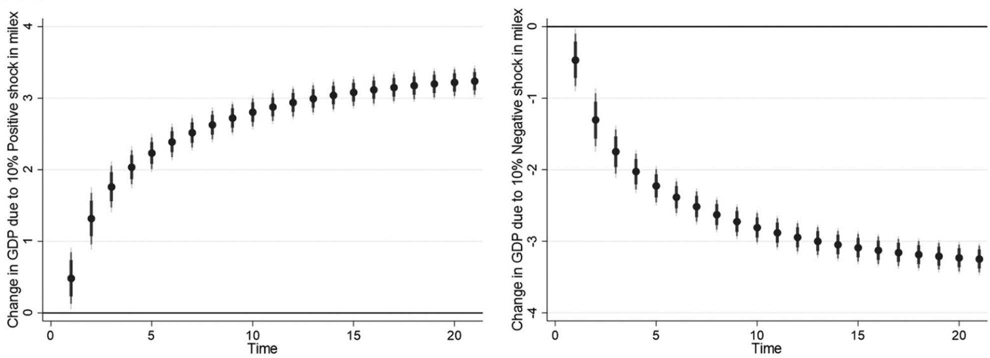
It can be seen that the mean pointwise marginal effects of *milex*, *civ*, *tr_openess, pop* and *inv* are 0.0504, 0.0419, 0.0096, −0.0320 and 0.0004 respectively. However, only *civ, tr_openess* and *inv* found to be statistically significant at all examined levels, while *milex* is statistically significant at 10%. Obviously, the positive sign of the *milex* coefficient is consistent with the results obtained from the



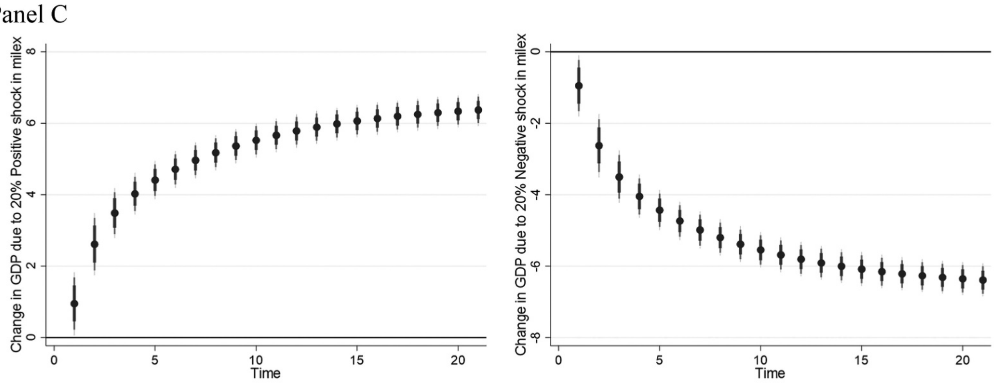
Panel A



Panel B



Panel C



Panel D

Figure 7. Impulse Response Plots of Spanish GDP due to a 1% (Panel A), 5% (Panel B), 10% (Panel C) and 20% (Panel D) positive and negative shock in military spending.

Table 6. Pointwise Derivatives using KRLS.

		Avg	P-25	P-50	P-75
GDP					
$milex_t$		0.0504* (0.0275)	−0.1124	−0.0432	0.2714
civ_t		0.0419*** (0.0034)	0. 0077	0.0359	0.0761
$tr\_openness_t$		0.0096*** (0.0006)	0.0070	0.0105	0.0128
pop_t		−0.0320 (0.0255)	−0.0212	−0.0474	0.0958
inv_t		0.0004*** (0.0006)	0.0018	0.0049	0.0069
Diagnostics					
Lambda	0.4065	Sigma	9.0000	R − squared	0.9809
Tolerance	0.6000	Eff. Df	10.5100	Looloss	1.1360

Notes: Avg. denotes the average marginal effect. *P*-25, *P*-50 and *P*-75 represent the 25^{th}, 50^{th} and 75^{th} percentiles, respectively. Lambda is the regularization parameter. Tolerance reflects the sensitivity of lambda optimization. Eff. Df stands for the effective degrees of freedom and Looloss for the sum of squared leave-out-one error.
*,**,*** denote significance at 10%, 5% and 1%, respectively.

DARDL model. Moreover, the results of Table 5 make evident the heterogeneity of the marginal effects of defence spending. Specifically, at the first quartile, a unit increase in military spending causes a 0.11% decrease in GDP, at 50% the effect is still negative but somewhat lower (–0.04%), whereas at the third quartile a unit increase in military spending leads to a 0.27% increase in GDP. Therefore, for values below the median, that is defence spending 2% of GDP, impedes economic activity, whereas from 2.3% of GDP (corresponding to the 75th percentile of military spending) and above, the economic impact of defence outlays becomes positive. Such a finding contradicts part of the literature (Cuaresma and Reitschuler 2004, Stroup and Heckelman 2001, Phiri 2019), which has shown that defence spending enhances an economy only at low levels, that is when it is below a specific threshold level (e.g. NATO's 2 percent metric), whereas at higher levels its effect becomes negative. Nevertheless, in the presence of high defence burdens a negative – to –positive relationship can be observed (Pieroni 2009). In general, a strong military sector, except for internal security, can enhance a country's bargaining power on economic or trade issues (Heo 1998).

Going further, it is also possible to analyse the long – term variation in military spending and how it affects income, and vice versa. The results are shown in Figure 8, which supports the argument that

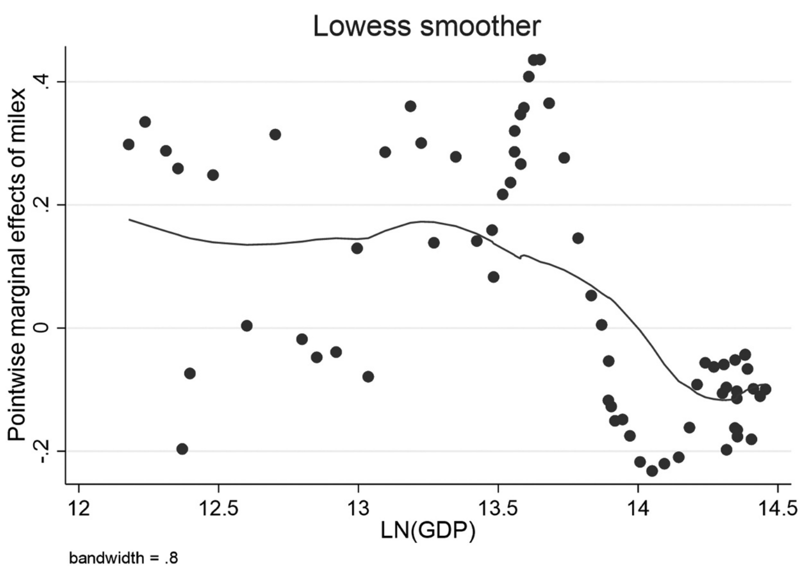


Figure 8. Pointwise Marginal Effect of Military Spending.

Table 7. Pointwise Derivatives using KRLS – Restricted Sample (1954-1974).

	Avg		P-25	P-50	P-75
GDP					
$milex_t$	0.0437**(0.0134)		−0.1363	0.1122	0.2788
civ_t	0.0149*** (0.0008)		−0.0066	0.0073	0.0464
$tr\_openness_t$	0.0218*** (0.0004)		0.0107	0.0182	0.0309
pop_t	−0.0880*** (0.0094)		−0.1871	−0.0678	−0.0175
inv_t	0.0163*** (0.0007)		−0.2245	0.0257	0.0586
Diagnostics					
Lambda	0.0225	Sigma	2.0000	R − squared	0.9997
Tolerance	0.0800	Eff. Df	19.4300	Looloss	1.3180

Note: *See* Table 5.

milex has negative marginal returns with increasing economic activity. In other words, the marginal effect of military spending is positive up to middle levels of income but becomes negative at higher levels. Particularly, *milex* is harmful to economic activity when GDP is above approximately 1.2 billion euros, whereas it is conducive to economic output at lower levels of GDP.

This finding contradicts Yang et al. (2011) who reported that *milex* have a negative and statistically significant effect when income is below a specific threshold (less than or equal to $475.93). In this spirit, it is quite reasonable to assume that for low levels of economic growth, *milex* produces a high crowding out effect and consequently, a clear negative impact on income (Huang, Wu, and Liu 2017). As previously mentioned, Spain experienced a multi – year military regime that spent on average higher amounts in the defence sector (see Figure 3) than were spent in subsequent years, especially after the mid–1980s with the reorientation of the army and the transformation of military policies.[27] This relatively high defence burden coincided with lower income levels but also with the economic boom during the period of 1959-1974. For robustness reasons, we stratify our sample to assess policy effectiveness and regime specific effects (Stock and Watson 2003). Indeed, as the results of Table 7 reveal, during the period between 1954 and 1974, defence spending had a positive and statistically significant relationship with GDP, as under Franco's regime, military spending was a key priority and represented a significant portion of government expenditures. Those results are consistent with Goldsmith (2003) and Sabaté (2016). A 1% rise in defense spending appears to increase income by 0.04% on average. On the contrary, during the period 1975-2021 (Table 8), *milex* hinders economic activity, consistent with results reported by Dunne et al. (2008) and Töngür et al. (2013). Specifically, after Franco's death in 1975, the new democratic government that emerged, pursued a different approach to military spending (it sought to reduce military spending and redirect resources toward social and economic development). The government also sought to distance itself from the militaristic policies of the Franco era. The results reveal that a military build – up of 1% can induce an economic decline of 0.08%.

The previous empirical findings are rather inconsistent with Compton and Paterson (2016), who showed that the adverse effects of military spending can be moderated by the presence of

Table 8. Pointwise Derivatives using KRLS – Restricted Sample (1975-2021).

	Avg		P-25	P-50	P-75
GDP					
$milex_t$	−0.0867*** (0.0092)		−0.1737	−0.0887	−0.0092
civ_t	0.0061*** (0.0016)		0.0022	0.0064	0.0138
$tr\_openness_t$	0.0043*** (0.0002)		0.0012	0.0035	0.0065
pop_t	−0.0294 (0.0080)		−0.0970	−0.0143	0.0442
inv_t	0.0016*** (0.0003)		−0.0004	0.0017	0.0039
Diagnostics					
Lambda	0.3586	Sigma	5.0000	R − squared	0.9916
Tolerance	0.5000	Eff. Df	12.3300	Looloss	0.2887

Note: *See* Table 5.

institutional quality. According to Wang, Hou, and Chen (2022), though, in countries under non – democratic regimes[28] and high military burden, the economic impact of the latter, albeit negative in the short run, becomes zero or slightly positive in the long – run.

Conclusions

While the accumulated outcome of empirical research on the economic effects of defence spending is extremely large, examining the existing relationship within the Spanish economy is a research topic that has received little attention. By utilizing data over the period of 1954-2021 and employing a Barro – style regression, the aim of the present study is to contribute to the existing part of the literature that has focused on the Spanish case. Another distinctive element of the present study, is the implementation of methods that enable a distinction between short – and long – run effects, and account for the presence of non – linearities and heterogeneous effects.

Overall, the findings of the present study are clearly consistent with the Keynesian aggregate demand stimulation channel, given the positive and statistically significant short – run effect of *milex*. Consequently, *milex* could be employed as a countercyclical fiscal tool in periods of mild recessions due to insufficient demand. However, in the long – run, the relationship between the variables of interest becomes weaker, albeit still positive, as significance arises only at 10%. In addition, the impulse responses stemming from various level shocks of military spending point to the same conclusions, that is a positive marginal effect of *milex* that is decreasing over time.

Hence, the empirical results derived from the KRLS method shows that the aforementioned positive effect is owed to the upper 25% of values of defense spending. This indicates that Spain should not invest more in its defence, since according to our results that spending has a negative impact with increasing economic activity. The above has further important policy implications for Spain considering that its defence spending has to be increased by 2029 to meet its NATO commitments. The findings are also similar when we stratify our sample and for the period of 1975-2021. Consequently, direct and indirect factors leading to this result should be the subject of future research.

Notes

1. As Frieden (2020, 7) puts it: ‘The economy [is all about] … high politics, and much of politics … [is] about the economy’.
2. For a detailed analysis see: Duch-Brown and Fonfría (2014).
3. Spain’s particular geographical location between Europe and North Africa and between the Mediterranean and the Atlantic and as a State that includes the mainland, the Balearic and Canary archipelagos and the two autonomous cities of Ceuta and Melilla.
4. For a detailed analysis of Spain’s global security strategies see: Government of Spain (2013).
5. The key differences between DARDL, ARDL, and Johansen’s approaches lie in their specifications of lag structures and the types of models used for testing cointegration. DARDL allows for a more flexible and dynamic lag structure, while ARDL allows for the inclusion of both stationary and nonstationary variables. Johansen’s approach involves estimating a VECM using maximum likelihood estimation, which allows for the modelling of multiple cointegrating relationships. See Jordan and Philips (2018) for a detailed discussion on DARDL vs. ARDL by Pesaran, Shin and Smith (2001) vs. Johansen (1991, 1995) approaches to cointegration testing.
6. Each autonomous community is composed of provinces, each of which has a government institution with autonomy to manage its own interests. They are: the Andalusia, Aragon, the Principality of Asturias, the Balearic Islands, the Canary Islands, Cantabria, Castilla-La Mancha, Castilla and León, Catalonia, Extremadura, Galicia, La Rioja, the Community of Madrid, the Region of Murcia, Navarre, the Basque Country and the Valencian Community (Smith and Heywood 2000).
7. See Casanova and Andrés (2014) for a detailed account of the Spanish political history.
8. WE is a population weighted average of Austria, Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Norway, Sweden, Switzerland, and the UK.
9. For a detailed discussion regarding the differences in structural change between Spain and other WE nations from the mid-twentieth century until 2015 see: González-Díez and Moral-Benito (2019).

10. For more see De la Escosura (2000, 2007).
11. For a detailed analysis of the 1959 liberalization plan in Spain see Martínez-Ruiz and Pons (2020).
12. Spain suffered from high unemployment since 1994 (about 15%) reaching 20% in 2013. See more at Ortega and Peñalosa (2013).
13. Spain joined NATO in 1982 but did not align its military structure until 1999.
14. Major military transformation policies were: 'the Law 20/1981, which reduced the number of officials, … the General Plan for the Modernization of the Army (META, Spanish acronym) in 1983, the Plan for the Reorganization of the Army (RETO) in 1990, the Plan for the New Organization of the Army (NORTE) in 1994, and … the reorganization of the army set by the Royal Order 416/2006' Sabaté (2016, 392). Additionally, on the evolution of defence policy in Spain and its relationship with the economy, see Velarde (2000).
15. Spain 2004 defence transformation's initiative was to be harmonized with both NATO and European Union plans and programs.
16. For a general overview of the Spanish contemporary security policy, see Maxwell (1991) and Ortega (2008).
17. See more in Fonfría (2013).
18. The so-called *guns vs. butter* debate.
19. The lagged values model the dynamics of the spending process to allow a hangover from the previous years' spending (Dunne, Smith, and Willenbockel 2005, Heo 2010).
20. For a thorough discussion see Martí and Pérez (2015).
21. For a detailed analysis of the policies associated with the restructuring of the defence sector and military reforms, see Molas –Gallart (1992, 1997) and Brzoska and Lock (1992).
22. For a detailed discussion regarding the choice of the Barro-style model and variables, see: Dimitraki and Menla Ali (2015).
23. The graphical representation of our main series has been also done but not included in the paper – available upon request.
24. To select a smoother, less complicated function the KRLS method minimizes the squared loss of a Tikhonov's regularization problem. See Hainmueller and Hazlett (2014) for a detailed discussion.
25. For comparison purposes, the ARDL model has been estimated as well, which provides similar results since similar specification is used (e.g. the DARDL estimates rely on fitting the most appropriate ARDL model – For more see Jordan and Philips 2018). However, DARDL is preferred, in the current paper as it allows for a more dynamic adjustment process. The results are not reported in this paper but are available upon request.
26. Data are available at https://www.sipri.org/databases/armstransfers.
27. For a detailed analysis see Sabaté (2016).
28. Wang, Hou, and Chen (2022) use the variable Demo from the Polity IV dataset which provides levels of democratic development via regime classification, ranging from – 10 (hereditary monarchy) to 10 (consolidated democracy).

Disclosure statement

No potential conflict of interest was reported by the authors.

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