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The Relationship Between Expenditure on Defence and Economic Growth in Spain

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Abstarct:

Purpose: *The objective of this article is to perform a causality analysis between defence expenditure and the economic growth in Spain from 1960 to 2018.*
Design/Methodology/Approach: *The VAR model together with the Granger causality test has been used so as to study which is the relationship between the military expenditure and the economic growth. In addition, using France as a benchmark, the results obtained, considering the same parameters, are in line with the obtained for Spain.*
Findings: *The results suggest the existence of a causal relation turning from defence expenditure to economic growth.*
Practical Implications: *In contrast with other studies in which no single conclusion can be arrived at concerning the possible positive or negative effects of defence investment on a country's economy, this work has obtained results that can serve to inspire relevant aspects of economic policy.*
Originality/value: *The relationship between defence expenditure and its impact on the growth of the economy has aroused the interest of not only numerous authors, but also of the countries which are trying to get a clear idea of the economic impact of defence spending before choosing to reduce expenses in order to control both the deficit and the public debt.*

Keywords: *Defence expending, defence-growth relationship, causality analysis.*

JEL classification: *O10, H56.*
Paper Type: *Research study.*

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1. Introduction

The General State Budgets are defined in General Budget Law 47/2003, of November 26th, as *"the quantified, joint and systematic expression of the rights and obligations to be settled during the year by each of the organs and entities that form part of the State's public sector",* and must be, in any case, as its Statement of Motives adds, oriented towards policies that favor the productivity and the growth of the economy (BOE, 2003). The budget for defence is included in these rights and obligations. The preamble of Law 36/2015, of September 28th, on National Security, establishes that security *"constitutes the basis on which a society can develop, preserve its freedom and the prosperity of its citizens, and guarantee the stability and proper functioning of its institutions"* (BOE, 2015).

However, although it is generally regarded as a public good, public opinion does not value it as positively as its values investments made in other areas of expenditure, for example, education or health, as they are considered as fields socially more necessary and beneficial. The main reason might be that the concept of defence is not only valued from a strictly economic point of view, but is also intrinsically affected by strategic, political and cultural components, which undoubtedly condition the different assessments. *"Guns will make us powerful; butter will only make us fat."* This quote announced by Göring in 1936 remains alive.

Since the seventies when the Nobel Prize Paul A. Samuelson used this expression in order to illustrate the production – possibility frontier – and the opportunity cost and Benoit (1973) who presented the contributions that defence expenditure had on the civil economy in four areas: (1) basic necessities incurred by military personnel, such as food, clothing or accommodation required by the military and which must be satisfied by the civil economy; (2) education and health care expenses; (3) expense in military installations for the use of scientific or civil services; and (4) expense on military intervention in quasi-civilian projects, this concern has not only worried the corresponding authorities, but also the different academics who have addressed this topic. Given this dichotomy, whereby there is no unanimity in criticizing the concept of defence, and there is no univocity in determining the veracity of these criticisms, it is worth asking whether defence expenditure is indeed a budget that adds or subtracts to the economy of a country.

Therefore, and in view of the existing literature review, the present paper contributes to reinforce the positive impact of the defence industry in the Spanish economy due to the positive relationship between the variables for the period 1961 and 2018. Even though, since Benoit, researchers have presented studies in this regard, there are few related to Spain.

The structure of the paper is as follows. In section 2, the conceptual framework will be described. Next, in section 3, the empirical study will be developed, being compared with France in order to validate the methodology. Finally, the conclusions and the main limitations will be analysed.

2. Conceptual Framework

There are numerous studies aimed at analysing the relationship between defence expenditure and the growth of the economy, and they are basically characterized by heterogeneity in the selected sample, in terms of the approach used, the time period analysed, the countries selected and the applied methodology. In consequence, the results obtained are equally disparate and without clear or obvious conclusions (Deger and Sen, 1995; Dunne and Uye, 2010; Emmanouilidis and Karpetis, 2018).

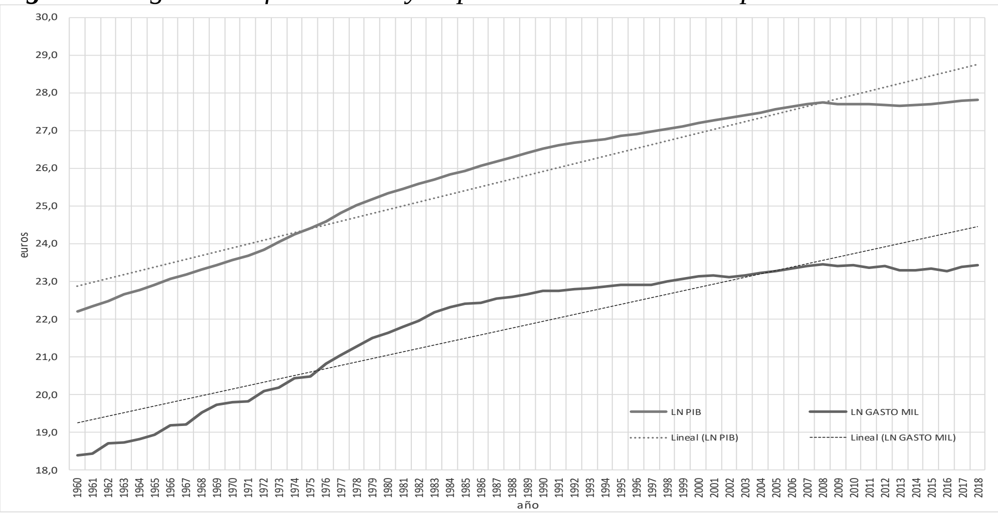
Thus, several analysis perspectives can be distinguished. Firstly, the approach from which this relationship is analysed is mentioned, distinguishing between the articles studied from the point of view of the demand (Smith, 1980), from the supply side (Yakovlev, 2007), or those that integrated both effects (Antonakis, 1997; Galvin, 2003). Secondly, it is necessary to distinguish the different methods of analysis used (Biswas and Ram, 1986; Hou and Chen, 2014; Yildirim *et al.*, 2005). Thirdly, the main countries under study are included (Dakurah *et al.*, 2001; Kollias *et al.*, 2007; D' Agostino *et al.*, 2019). And, finally, those studies that, in addition to defence expenditure and economic growth, incorporate other variables to their analysis, such as political instability, public debt, corruption or public investment, among others, are mentioned (Pradhan, 2010; Dunne *et al.*, 2019).

3. Empirical Study

In view of the work analysed, and in line with them, the relationship of causality and its direction, between defence expenditure and economic growth in Spain, for the period between 1960 and 2018, was determined empirically. The data used were obtained from the World Bank for military expenditure (*MilExp* in euros) and for GDP, as an indicator of economic growth (*GDP* in euros). The entire study was carried out by transforming the original data into logarithms (*lnMilExp* and *lnGDP*) (Figure 1).

Therefore, as they were time series, and in order to ensure that the empirical results were valid for the estimated regressions, the stages in the statistical analysis were as follows: First, the linear regression models, objective of the study, of the GDP on the Military Expenditure and the Military Expenditure on the GDP were established. Next, the stationarity of the variables, the model estimation and its validity were determined. Finally, and based on the results obtained, the causality, or not, between military expenditure and economic growth in the sense of Granger and the prediction were analysed.

***Figure 1**. Logarithm of the Military Expenditure and GDP in Spain 1961 to 2018*



***Source:** Self-elaboration according to the World Bank data.*

Linear regression model:

The first linear relationship model established is described in the following equation, with economic growth depending on military expenditure:

$$lnGDP_i = \beta_1 + \beta_2 lnMilExp_i + \mu_i \qquad i = 1,2...58 observations \qquad (1)$$

The results obtained can be seen in Table 1, demonstrating the validity to proceed with the study of causality, with an R^2 equal to 98.4%, that is, the variability of GDP was explained in the model by the variability of military expenditure in more than 98%.

***Table 1.** Main statistics of the Linear Regression Model (1)*

$lnGDP_i = \beta_1 + \beta_2 lnMilExp_i + \mu_i$

lnGDP	**Coef.**	**Std. Err.**	**t**	**P>|t|**	**[95% Conf. Interval]**	
lnMilExp	1.07	0.01	58.70	0.00	1.04	1.11
Cons.	2.24	0.40	5.58	0.00	1.44	3.05

Number of obs	59
F (1,57)	3445.76
P> F	**0.00**
R – squared	**0.98**
Adj R- squared	0.98
Root MSE	0.23

***Source:** Own calculations.*

However, it is necessary to highlight the autocorrelation that existed among the variables studied, once the Breush - Godfrey Test was applied to measure it, as shown in Table 2.

Table 2. *Breush-Godfrey autocorrelation test for the Model (1)*

lags(p)	chi^2	df	Prob > chi^2
1	52.558	1.000	**0.00***
2	52.893	2.000	**0.00***
3	53.019	3.000	**0.00***
*H_0 rejected at 5%: *no serial correlation*			

Source: *Own calculations.*

The second linear relationship model was as follows where the military expenditure was the dependent variable and the economic growth was the independent one, in order to study the relationship between the two data series in the opposite direction.

$$lnMilExp_i = \beta_1 + \beta_2 lnGDP_i + \mu_i \qquad i = 1,2\ldots58 observations \tag{2}$$

The results are shown in Table 3, verifying also that there was autocorrelation between the variables, which could point towards inconsistent estimators (Table 4).

Table 3. *Main statistics of the Linear Regression Model (2)*

$lnMilExp_i = \beta_1 + \beta_2 lnGDP_i + \mu_i$

dlnMilExp	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
lnGDP	0.91	0.15	58.70	0.00	0.88	0.94
cons	-1.69	0.40	-4.22	0.00	-2.50	-0.89

Number of obs	59
F (1,57)	**3445.76**
P> F	**0.00**
R – squared	**0.98**
Adj R- squared	0.98
Root MSE	0.21

Source: *Own calculations.*

Table 4. *Breush-Godfrey autocorrelation test for the model (2)*

lags(p)	chi^2	df	Prob > chi^2
1	52.16	1.000	**0.00***
2	52.42	2.000	**0.00***
3	52.53	3.000	**0.00***
*H_0 rejected at 5%: *no serial correlation*			

Source: *Own calculations.*

Once the initial models were estimated, and the existence of a relationship between the variables was verified, the stationarity of the data series was studied.

Stationarity analysis:
This analysis determined whether the relationship between the variables was true and not spurious, thus allowing to generalize the results obtained in the regressions. There are numerous tests for the study of stationarity, such as KPSS (Kwiatkoski *et al.*, 1992); PP (Phillips and Perron, 1988); AIC (Akaine); MAIC (Modified Akaine); SIC (Schwarz) or NP (Ng and Perron). However, one of the most used methods is the Augmented Dickey – Fuller test (ADF) or unit root test.

This test compares the value of the ADF statistic with the critical value of MacKinnon, first, for the variable that measures economic growth and then for military expenditure in its variable. Therefore, the hypotheses tested were $H_0(1)$, that lnGDP is a non-stationary variable, its probability distribution depends on time and, therefore, has unit root problems, and $H_0(2)$, where lnMilExp is a non-stationary variable, its probability distribution depends on time and, therefore, has unit root problems.

Table 5. *Augmented Dickey-Fuller Unit Root Test lnGDP (0 lags)*

	Test Statistic	**1% Critical Value**	**5% Critical Value**	**10% Critical Value**
lnGDP	**-9.14**	-3.56	-2.92	-2.59
MacKinnon approximate **p-value for lnGDP = 0.00** *H_0 rejected at 5%.				

Source: *Own calculations.*

As shown in Table 5, the logarithm of GDP was a stationary variable ($H_0(1)$ is rejected). On the other hand, the logarithm variable of the military expenditure was verified to be stationary according to the DFA contrast applied (the $H_0(2)$ is rejected) (Table 6).

Table 6. *Augmented Dickey-Fuller Unit Root Test lnMilExp (0 lags)*

	Test Statistic	**1% Critical Value**	**5% Critical Value**	**10% Critical Value**
lnMilExp	**-4.88**	-3.56	-2.92	-2.59
MacKinnon approximate **p-value for lnMilExp = 0.00*** *H_0 rejected at 5%.				

Source: *Own calculations.*

VAR Model Estimation:
To analyse the causality between the variables, there are several models that can be used, highlighting among others, the Granger causality model and the VAR model, to be used when the variables are stationary and the VECM model, with variables that are not stationary at first, but their first differences are. In view of the results presented in the previous section, the VAR model together with Granger model could be used to analyse the causality between the variables. However, before proceeding with its estimation, the optimal number of lags to be included in the model had to be selected. For this, different information criteria were used, collected in Table 7 (Bayesian Schwarz-SBIC, Hannan-Quimn-HQIC, Akaike-AIC, Final Prediction Error-FPE, Likelihood Ratio-LR). Based on the results obtained, the

model was estimated with two and three lags. As the series of data used were annual, two (three) lags implied that the model collected the historical effects of the biannual (three-year) variables.

Table 7. *Selection of the number of lags using different tests*

lag	LR	FPE	AIC	HQIC	SBIC
0		.117263	3.53	3.56	3.60
1	559.18	5.2e-06	-6.48	-6.40	-6.27
2	45.02*	2.7e-06	-7.16	-7.021*	-6.79*
3	8.91	2.6e-06*	-7.17*	-6.98	-6.66
4	5.66	2.7e-06	-7.13	-6.88	-6.47

Source: *Own calculations.*

Estimation with two lags:
In view of the data collected in Table 8, the estimated models with two lags are those presented below:

$$lnGDP_i = 0.26 + 1.66\, lnGDP_{i-1} - 0.68 lnGDP_{i-2} + 0.04 lnMilExp_{i-1} - 0.31 lnMilExp_{i-2} \quad (3)$$

$$lnMilExp_i = 0.26 + 1.15 lnGDP_{i-1} - 1.12 lnGDP_{i-2} + 0.68 lnMilExp_{i-1} + 0.26\, lnMilExp_{i-2} \quad (4)$$

Table 8. *Two-lag VAR model*

Sample	**1963 - 2018**			**Number of obs**	**57**	
Log likelihood	213.58			AIC	-7.14	
Det (Sigma_ml)	1.91e-06			HQIC	-7.00	
				SBIC	-6.78	
Equation	**Parms**	**RMSE**	**R-sq**	**chi^2**	**P>chi^2**	
lnGDP	5	0.02	0.99	333151.6	0	
lnMilExp	5	0.07	0.99	27525.73	0.00	
	Coef.	**Std. Err.**	**z**	**P>|z|**	**[95% Conf. Interval]**	
lnGDP						
lnGDP						
Ll.	1.66	0.10	15.56	0.00	1.45	1.87
L2.	-0.68	0.09	-7.01	0.00	-0.87	-0.49
lnMilExpl						
L1.	0.04	0.04	1.09	0.27	-0.03	0.13
L2.	-0.03	0.04	-0.75	0.45	-0.11	0.05
_cons	0.26	0.09	2.72	0.00	0.07	0.45
DlnMilExp						
lnGDP						
Ll.	1.15	0.33	3.45	0.00	0.49	1.81
L2.	-1.12	0.30	-3.65	0.00	-1.73	-0.52
lnGtoMil						
L1.	0.68	0.13	5.04	0.00	0.42	0.95
L2.	0.26	0.13	1.97	0.04	0.00	0.53
_cons	0.26	0.30	0.86	0.38	-0.33	0.87

Source: *Own calculations*

Estimation with three lags:
In view of the data collected in Table 9, the estimated models with three lags are as follows:

$$lnGDP_i = 0.29 + 1.76\, lnGDP_{i-1} - 0.78 lnGDP_{i-2} - 0.009 lnGDP_{i-3} + 0.02 lnMilExp_{i-1} - 0.09 lnMilExp_{i-2} + 0.09 lnMilExp_{i-3} \quad (5)$$

$$lnMilExp_i = 0.03 + 0.65 lnGDP_{i-1} - 0.04 lnGDP_{i-2} - 0.55 lnGDP_{i-3} + 0.74 lnMilExp_{i-1} + 0.26\, lnMilExp_{i-2} - 0.08 lnMilExp_{i-3} \quad (6)$$

Table 9. *Three-lag VAR model*

Sample	**1963 - 2018**			**Number of obs**	**56**	
Log likelihood	214			AIC	-7.16	
Det (Sigma_ml)	1.61e-06			HQIC	-6.96	
				SBIC	-6.65	
Equation	**Parms**	**RMSE**	**R-sq**	**chi²**	**P>chi²**	
lnGDP	7	0.02	0.99	326368.2	0.00	
lnMilExp	7	0.73	0.99	26423.73	0.00	
	Coef.	**Std. Err.**	**z**	**P>|z|**	**[95% Conf. Interval]**	
lnGDP						
lnGDP						
Ll.	1.76	0.14	12.28	0.00	1.48	2.05
L2.	-0.78	0.24	-3.23	0.00	-1.26	-0.30
L3.	-0.00	0.12	-0.07	0.94	-0.26	0.24
lnMilExpl						
L1.	0.02	0.04	0.44	0.65	-0.06	0.10
L2.	-0.09	0.05	-1.77	0.07	-0.19	0.00
L3.	0.09	0.04	2.01	0.04	0.00	0.18
_cons	0.29	0.10	2.84	0.00	0.09	0.49
lnMilExp						
lnGDP						
Ll.	0.65	0.45	1.42	0.15	-0.24	1.55
L2.	-0.04	0.77	-0.06	0.95	-1.57	1.48
L3.	-0.55	0.41	-1.34	0.18	-1.36	0.25
lnGtoMil						
L1.	0.74	0.14	5.15	0.00	0.46	1.03
L2.	0.26	0.16	1.61	0.10	-0.05	0.58
L3.	-0.08	0.14	-0.55	0.57	-0.36	0.20
_cons	0.03	0.32	0.09	0.92	-0.61	0.67

Source: *Own calculations.*

Model Validity:
To confirm the validity of the models, the residues were analysed, it being desirable

that there is no autocorrelation in the residues, that they follow a normal distribution and that they meet the stability condition.

Validity of the model with two lags: autocorrelation, normality and stability:
To analyse whether or not there was autocorrelation in the residues, the Lagrange Test was used. In view of the results obtained, the non-existence of autocorrelation of the residues was confirmed (Table 10).

Table 10. *Lagrange multiplier test for the model with two lags*

lag	chi2	df	Prob> chi2
1	8.44	4	0.07
2	5.62	4	0.22
3	1.43	4	0.83
4	1.83	4	0.76
* H_0 rejected at 5%: no autocorrelation at lag order			

Source: *Own calculations.*

In view of the results shown in Table 11, we can also affirm that the residues were normally distributed.

Table 11. *Contrast of normality for the model with two lags*

	Jarque-Bera Test			Skewness Test			Kurtosis Test		
Equation	chi^2	df	$P>chi^2$	chi^2	df	$P>chi^2$	chi^2	df	$P>chi^2$
DlnGDP	2.75	2	0.25	-0.24	1	0.45	3.95	1	0.13
lnMilExp	0.52	2	0.77	0.19	1	0.53	2.75	1	0.70
ALL	3.27	4	0.51		2	0.62		2	0.31
dfk estimator used in computations *H_0 rejected at 5%.									

Source: *Own calculations.*

Finally, it was verified that the VAR model with two lags met the stability condition, in view of the data obtained in the Eigenvalue test (Table 12).

Table 12. *Eigenvalue Stability condition model with two lags*

Eigenvalue	Modulus
0.96 + 0.02i	0.96
0.96 – 0.02i	0.96
0.73	0.73
-0.31	0.31

Source: *Own calculations.*

Validity of the model with three lags: autocorrelation, normality and stability:
Again, the Lagrange Test confirmed the non-existence of autocorrelation of the residues (Table 13). However, a question to highlight in this contrast, in relation to that made in the model of order 2, is that in the previous one, the *p-value* associated with it was 0.07, being able to doubt the non-existence of autocorrelation, while in the model with three lags, the *p-value* values, all higher than 0.3, confirmed this interpretation.

Table 13. *Lagrange multiplier test for the model with three lags*

lag	**chi^2**	**Df**	**Prob> chi^2**
1	1.13	4	0.88
2	5.37	4	0.25
3	1.22	4	0.87
4	2.02	4	0.73
* H_0 rejected at 5%: no autocorrelation at lag order			

Source: *Own calculations.*

In view of the results shown in Table 14, the residues were normally distributed.

Table 14. *Normality contrasts for the model with three lags*

	Jarque-Bera Test			**Skewness Test**			**Kurtosis Test**		
Equation	**chi^2**	**df**	**P>chi^2**	**chi^2**	**df**	**P>chi^2**	**chi^2**	**df**	**P>chi^2**
lnGDP	1.13	2	0.56	0.27	1	0.60	0.86	1	0.35
lnMilExp	1.05	2	0.59	1.04	1	0.30	0.01	1	0.91
ALL	2.18	4	0.70	1.31	2	0.51	0.87	2	0.64
dfk estimator used in computations *H_0 rejected at 5%.									

Source: *Own calculations.*

All the Eigenvalues lie inside the unit circle. The VAR model with three lags met the stability condition, in view of the data obtained in the Eigenvalue test (Table 15).

Table 15. *Eigenvalue stability condition model with three lags*

Eigenvalue	**Modulus**
0.96 + 0.03i	0.96
0.96 – 0.03i	0.96
0.61 + 0.25i	0.66
0.61 - 0.25i	0.66
-0.32 + 0.14i	0.35
-0.32 - 0.14i	0.35

Source: *Own calculations.*

Choice of model:
After two models were analysed, the first model with two lags (models 3 and 4) and the second model with three lags (models 5 and 6), it was possible to determine which one was the most suitable. For these purposes, the criteria previously selected, AIC, HQIC and SBIC, allowed to answer this question, being optimal the model that provided the lowest levels.

In view of the results shown in Table 16, although both models had similar levels, the selected model was the model with three lags as it provides the lowers.

***Table 16**. Choice of model: with three lags*

Model with two lags		**Model with three lags**	
AIC	-7.16	AIC	-7.17
HQIC	-7.02	HQIC	-6.98
SBIC	-6.79	SBIC	-6.66

***Source:** Own calculations.*

Causality analyses and prediction:
The results of the causality test can be seen in Table 17, where it is shown that there was a bidirectional relationship between the studied variables, suggesting the existence of a causal order stable over time. The values of military expenditure influenced GDP in the sense of Granger, and GDP Granger-cause military expenditure.

***Table 17.** Granger's Causality: Wald Tests*

Equation	**Excluded**	**chi^2**	**Df**	**Prob>chi^2**
lnGDP	lnMilExp	6.04	3	**0.10***
lnMilExp	lnGDP	9.31	3	0.02
*H_0 rejected at 10%.				

***Source:** Own calculations.*

Prediction:
The graphs presented in Figure 2, show the impacts induced by shocks in the system variables (*lnGDP* as a function of *lnMilExp* and *lnMilExp* as a function of *lnGDP*), namely, after introducing an alteration in the random disturbance of an equation (generally equal to the value of its standard deviation), the result that this alteration had on the whole system was verified. As there were correlations between the disturbances of the different equations, the individual effects of each disturbance could not be clearly distinguished.

In the first graph, *lnMilExp* as a function of *lnGDP*, the shock in the logarithm of GDP influence the *lnMilExp*. It seems that the evolution of military expenditure was dependent of the evolution of GDP. On the other hand, in the second graph, *lnGDP* as a function of *lnMilExp*, the shock occurred initially in military expenditure and subsequently affected the logarithm of GDP. Moreover, the results have being compared with France, which has the same positive and bidirectional effect between both variables (Figure 3).

4. Conclusions

The different countries selected in the studies analysed, the time period, the theoretical specifications, and the different methodologies used for the studies prevent reaching a consensus on whether defence expenditure positively or negatively affects the economy of the countries, and whether it constitutes a bidirectional or unidirectional relationship between the growth of the economy and defence expenditure. Likewise, the perspective from which the relationship is analysed (point of view of supply, demand, or both), also significantly varies the conclusions reached.

Figure 2. *Logarithm Prediction of Military Expenditure and GDP*

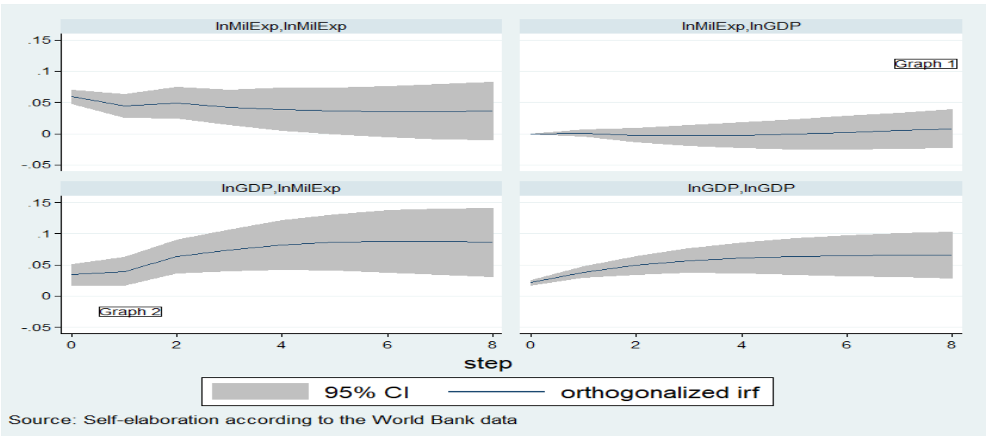
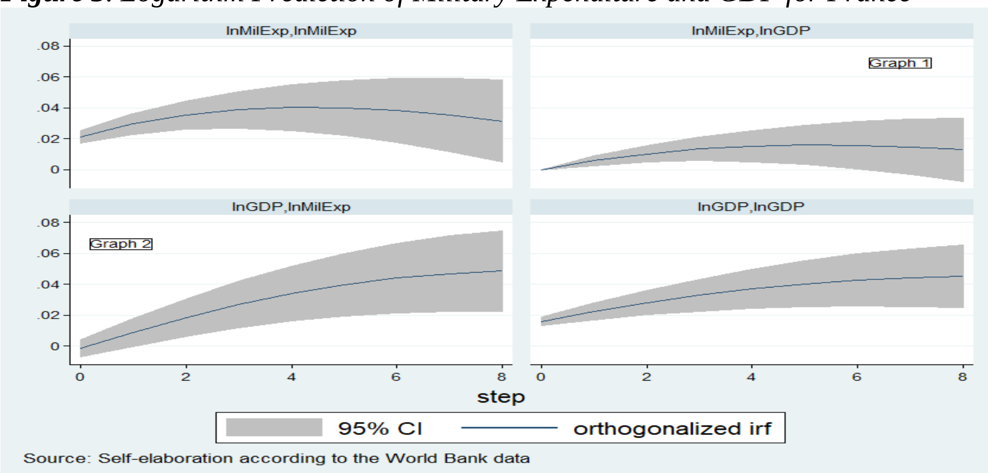


Figure 3*. Logarithm Prediction of Military Expenditure and GDP for France*



This paper contributes to reinforce the studies in which the relationship between both variables are positive, in Spain, where it is not easy to find studies about this topic. Thus, the causal relationship between military expenditure and GDP in the period between 1961 and 2018 was studied by using time series techniques, through the VAR model with three lags as the optimal number. As a result, it was found a positive bidirectional causality in the sense of Granger running from military expenditure on defence to gross domestic product and vice versa. Considering the same approach, methodology, period and data base, this study was done for France, concluding with the same positive results.

A line that will have to be further explored would be to carry out similar studies from other developed and emerging and developing countries to know not only the existence or not of the relationship but the directionality of causality.

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