A CAUSALITY ANALYSIS OF THE MILITARY SPENDING AND ECONOMIC GROWTH: THE COLOMBIAN CASE OF 1960-2016

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Corporación Centro de Interés Público y Justicia -CIPJUS-, Research Institute MS Research Hub

2019

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UN ANÁLISIS DE CAUSALIDAD ENTRE EL GASTO MILITAR Y EL CRECIMIENTO ECONÓMICO: EL CASO COLOMBIANO DE 1960-2016.

Abstract:

This paper establish an approximation to the existing causality relation between the military expenditure and economic growth for Colombia in the period of 1960 to 2017. The methodology uses the approach of the VEC models to estimate the long-run and short-run causality between the variables and its relative impact. The results indicate causality in Granger terms only from the military expenditure to the GDP and the existence of co-integration among them. In the short-run, the impact of this variable is positive to the GDP while in the long-run the military expenditure effect negatively the growth.

Keywords: Economic growth, Military expenditure. Granger causality, Co-integration.

JEL Classification: H40 - H56 –H83 – O11 – O40

Resumen:

Este escrito establece una aproximación a la relación de causalidad existente entre el gasto militar y el crecimiento económico para Colombia en el periodo de 1960 a 2017. La metodología usa el enfoque de los modelos VEC para estimar las relaciones de largo y corto plazo de causalidad entre las variables y su impacto relativo. Los resultados indican causalidad en el sentido de Granger del gasto militar al PIB y la existencia de co-integración entre las variables. En el corto plazo, el impacto es positivo en el PIB mientras que a largo plazo el gasto militar afecta negativamente el crecimiento.

Palabras Clave: Crecimiento económico, Gasto militar, Causalidad Granger, Co-integración.

Clasificación JEL: H40 - H56 –H83 – O11 – O40

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INTRODUCTION

The impact of the military expenditure over economic growth it's a topic of interest for those countries which are currently having armed conflicts, in this scenario it could be asked what kind of relationship does have the military expenditure and the real economic production. The objective of this paper is to contribute to the empirical literature related to the previous statement using an econometrical approach with time series analysis, in this order of ideas the Colombian case is studied from the years of 1960-2017. The variables of study are the real Gross Domestic Product (GDP) and the total amount of military expenditure in the Colombian economy in logarithms form.

The data of GDP and the military expenditure are taken from the World Bank Open Data indicators updated in 2019 for the Colombian economy. This military expenditure is derived from the Stockholm International Peace Research Institute (SIPRI) (2018) and is defined for this investigation as all current and capital expenditures on the armed forces which include peacekeeping forces, defense and government organizations engaged to the defense projects (SIPRI, 2018).

The methodology parts from the identification of stationary/unit root process of the variables to confirm their integration order as I (1), then it is proceeded with the lag selection order criteria to define the appropriate lag of analysis in order to use the Johansen Co-integration test to prove the existence of a long run co-integration equation. Once co-integration is confirmed, the Vector Error Correction Model (VECM) can be estimated. It is expected to define a co-integration relationship between the variables and to test the short run causality with hypothesis testing with the partial adjustment coefficients.

The results evidence that variables are integrated of order one, according to Johansen test the evidence of co-integration is confirmed and the only existing causality in Granger terms is the relationship from the military expenditure to the gross domestic product. The short-run causality implies a positive impact of military expenditure over gross domestic production, nevertheless in the long run, the causality analysis via estimation of the co-integration equation reveals a negative impact of the military expenditure over the economic growth.

It is concluded that the positive impact over production from the military expenditure is not sufficient to neutralize the negative externalities from internal conflict in Colombia since the positive short-run relationship of these variables changes drastically in the long-run. The estimated co-integration equation reflects that in the long-run a 1% increase in military expenditure leads to a decrease of 0.37% over GDP and this last variable is not a determinant of military expenditure according to estimations.

LITERATURE REVIEW

The empirical findings related to the impact of military expenditure and economic growth revealed two possible situations, the first one related to the positive impact of military expenditures over the economic growth, and the second which assumes the opposite way where exists a negative impact over the growth. An important mention is that the causality analysis of these impacts reflects different results relative to a specific context, it can be either one directional causality from military spending to economic production or vice versa.

DeGrasse (1983) establishes that the impact of military spending in the U.S economy has been complex and substantial since different contexts leads to heterogeneous results, under this idea the following cases occurred; a decrease of the employment level due to the reduction of the public sector has been shown with strong evidence in post-war periods while war spending produced inflationary surge that inflicted problems in the overall economy. This author also stated that the overall impact in the economy is relative on time and circumstances since the government actions have been oriented through different economic theories. Keynesianism in this case, had a bigger impact on policymakers during the first middle of the last century than it did after war periods. In this study, it is expressed that military spending could mean a prosperity opportunity for a nation like it did to the U.S. in the World War II experience or it can be a serious damage in the future to the economy in the long-term.

An empirical approach was performed by Khalid & Alsalim (2015) using Auto-Regressive Distributed Lag (ARDL) model for the U.S. economy in the period of 1970 to 2011, this model is a combination of the following variables; GDP, government expenditure, military expenditure and real interest rate. The results of their study indicate co-integration among the variables, where the government expenditure and first lagged value of interest rate produces a positive impact in economic growth of the U.S. economy, the results also provide evidence of a negative impact from the military expenditure over the economic growth.

For the Pakistani economy Ajmair, Hussain & Gohar (2018) examined the long run relationship between military expenditure, the number of the population engage to military forces and economic growth. The methodology used an ARDL model with these variables in the period of 1990-2015 and the results established that military expenditure was statistically insignificant to explain the economic growth in this country in the long run, while the number of persons engaged in this sector have a positive and significant impact related to the economic growth in the long term. The short-run analysis from this authors establishes that military expenditure and persons engaged in this sector have a positive impact when these variables increase individually in the overall economic growth.

On the contrary of this last case, the study of Sheikh, Akhtar, Abbas & Mushtaq (2017) includes the consideration of inequality in the analysis but the results evidence a positive relationship between the military expenditure and economic growth from 1972 to 2016 for Pakistan. The study also differs from the one performed by Ajmair et al. (2018) in terms of methodology since it uses an augmented Solow growth model with Harrod-neutral technology and an econometrical application of Generalized Method of Moments (GMM). Concerning to inequality, this variable is negatively linked to the economic growth according to this study. The authors' stated a positive impact of the military expenditure over Pakistani economic growth explained from the positive externalities and infrastructural facilities derived from defense expenditures included in military spending.

In the case of Egypt, Israel, and Syria the study of Abu-Bader & Abu-Qarn (2003) takes into consideration the causality approach in the analysis of government expenditure and economic growth. The methodology combines a VEC model with disaggregated expenditures of the public sector, the estimations reflected a positive bi-directional causality relation between these variables. When the authors analyzed the disaggregated government spending, the results indicate that military expenditures have a negative impact in the long run of economic growth while the government spending oriented to social costs tend to increase the growth in these economies.

For the countries members of the Southern African Development Community (SADC) the study of Biyase & Zwane (2014) over the period of 1990-2005 seeks to investigate the link between military expenditure and economic growth, the methodology used panel data regression with fixed-effects and two-stage least squares method. The results of the study indicate that military spending has no significant impact over the economic growth even when the two type of estimations where used, the authors conclude that increasing military spending doesn't help to increase or promote the economic growth.

In the Latin-American context, the study of Herrera Lasso (1983) presents one of the first approximations to analyze the conceptual relationship between economic growth, war, and defense spending. The methodology uses a comparative analysis derived from variables of GDP, GDP per capita, population and military spending, the results of the intuitive comparison made by Herrera Lasso reflects a differential correlation in terms of proportions between the gross production and the military expenditure. This author concludes that Brazilian and Mexican economies (strongest in the region) also have a lower proportion than rest of economies in terms of the military expenditure while some economies like Argentina and Chile have greater military spending even when the production levels are lower.

Specifically referring to the Colombian experience about military spending but not strongly related to the analysis in economic growth, Grautoff & Chavarro Miranda (2009) analyzes the public spending on defense and security in the period of 1950 to 2006. The methodology is a combination of macroeconomic and microeconomic approaches with considerations taken from dynamic and static optimizations, game theory and econometrics. The authors used the Hodrick-Prescott filter in order to find the real behavior of defense and security spending, thus they concluded that the real behavior of this sector is derived from external effects since the focus on defense didn't have any structural shifts over time when the violence and homicides increased over the time. A Granger causality analysis was performed over the homicides to the spending in defense, but results indicate no causality as well.

In this context of Colombia, a study from Vargas Pulido & Gody Estrella (2013) appointed that economic growth and internal conflict have coincided in important changes leading to an increase in spending of defense and security over the recent years. The time of study is divided into two main sections; the first is related to the years of 1993 and 2002 where illegal armed groups increased the insecurity and violence all over the country, and the second related to 2002 and 2012 where military activities lowered violent actions performed by terrorist groups. The impact of defense government spending over the Colombian economic growth is analyzed through important variables such as; GDP, foreign investment and labor force. The results indicate a possible relationship between these variables from a conceptual explanation which follows this logic; the proven positive correlation between spending in defense and security with foreign investment extends a positive externality for the increase in the economic growth, which is more significant in the second period of analysis. This spending also promotes the occupation as it's reflected in the total labor used in the military sector, the authors conclude that it's complex to establish such definitive relationship, but it appears that internal threatens impulses an increase in military spending which tend to neutralize the negative effect over the economic growth.

METHODOLOGY

In order to study the relationship between military expenditure and economic growth of the Colombian economy, the variables of consideration are the real GDP and the total amount of real military expenditure in USD millions with constant prices of 2011. The data is taken from the World Bank (2019) organization and it's converted into logarithms.

The econometrical procedure to use the VEC model implies the following steps:

1- Analysis of stationary/unit root process of the variables
2- Determination of integration order of the series as I (1)
3- Lag ideal selection criteria analysis
4- Co-integration test between the variables and ideal lags with Johansen (1991) test
5- Confirmation of co-integration and VEC estimation

This procedure needs that variables of study are integrated of order one (in levels they should have a unit roots process but in first difference should be stationary) which is tested by the Augmented Dicky-Fuller –ADF- test.

This test was developed by Dickey & Fuller (1979) to test unit roots inside the variables, from this Hamilton (1994) presented different cases where this test can be applied. This ADF test involves fitting the model presented in equation (1):

$$\Delta y_t = \alpha + \beta y_{t-1} + \delta t + \sum_{i}^{h} \xi_i \Delta y_{t-i} + \varepsilon_t \tag{1}$$

Where h is a number of lags evaluated for the augmented test in order to determine if y variable is a unit-root process, the constant α is interpreted as the drift in the test and a linear trend time represented in t. Three approximations can be done for the test in order to prove if variable y is stationary or possess unit-root processes by testing hypothesis over the coefficients in equation (1). The first is where α and δ equals zero which is the test to establish a random walk without drift, the second where the constant α is in the model and δ equals zero (test with drift), finally where we include the linear trend coefficient δ in the test which we assume that variable y possess a linear time trend.

If variables have unit-roots in levels but in first differences they are stationary, we have series integrated of order 1 (Lutkepohl & Kratzig, 2004), after the integration order of the series is defined, different lag selection criteria are used with the considerations of Liew (2004) which for samples lower than 120 observations, final prediction error (FPE) and Akaike information criterion (AIC) have more power to select the optimal lag length.

Forward to this, Johansen (1991) test of co-integration is performed in order to determine if there's at least one co-integration equation between the variables, this test is developed to establish a r number of co-integration equations between two or more variables. In order to do this, a trace statistic method is used following the maximum likelihood (ML) estimator of the parameters which is based in a VEC basic model as it's presented in equation (2):

$$\Delta x_t = \alpha\beta' x_{t-1} + \sum_{t-1}^{p-1} \Gamma_i \Delta x_{t-i} + e_t \tag{2}$$

Where x is a (K x 1) vector of variables integrated of order one with parameter matrices α and β of order (K x r) which rank is $r < K$, Γ represents a matrix of coefficients with order (K x K) with K as the number of endogenous variables. The vector residual is represented in e and the lags of the model are defined in p. The trace test presented in equation (3) has as a null hypothesis that there are r or lower co-integrating relations.

$$Tr(r) = -T \sum_{i-r}^{K} \ln(1 - \hat{\lambda}_i) \tag{3}$$

In equation (3) the number of observations are T and $\hat{\lambda}_i$ represents the estimated eigenvalues. The large values of the trace statistic are evidence in contraposition of the null hypothesis that there at most r or lower co-integration relationships. The test starts by default with $r = 0$ and moves on as we reject null hypothesis every time until we cannot reject it.

After evidence of co-integration is established, the VEC model can be estimated from the following general VAR specification designed for this case of study:

$$\Delta GDP = \alpha + \sum_{i=1}^{k} B_i \Delta GDP_{t-i} + \sum_{i=1}^{k} \delta_i \Delta ME_{t-i} + \varphi ECT_{t-1} + \tau t + \mu_i \quad (4)$$

$$\Delta ME = \alpha + \sum_{i=1}^{k} B_i \Delta GDP_{t-i} + \sum_{i=1}^{k} \delta \Delta ME_{t-i} + \varphi ECT_{t-1} + \tau t + \mu_i \quad (5)$$

Where *GDP* is the real Gross Domestic Product of the Colombian economy, *ME* is the real military expenditure, *ECT* represents the error correction term associated to the long run relationship of the variables derived from the residuals of ordinary least squares – OLS- thus is defined as $ECT_{t-1} = GDP_{t-1} - \beta_0 - \beta_1 ME_{t-1}$ for equation (4) and the opposite for equation (5) defined as $ECT_{t-1} = ME_{t-1} - \beta_0 - \beta_1 GDP_{t-1}$, τ is an estimated coefficient for the linear trend variable t. In this case, *k* represents the number of the ideal lags for the VEC estimation.

The short-run causality can be determined by doing hypothesis testing over the partial adjustment coefficients associated with the opposite variable, for example in equation (4) Granger causality is tested for estimated coefficients associated with ΔME which reflects a short-run causality from military expenditure to gross domestic product. Therefore, for equation (4) the null hypothesis of no causality in Granger terms can be represented as $H_0 : \sum_{i=1}^{k} \delta_i = 0$ and if this hypothesis is rejected, it can be said that military expenditure Granger cause in the short-run the gross domestic product. The same analysis can be done for equation (5) testing $H_0 : \sum_{i=1}^{k} B_i = 0$ after the VECM estimation.

The long-run causality is established if the coefficient φ is significant and negative in the estimation since it is derived from the long-run association of the variables. When this happens in their respective equation, it can be said that long-run causality exists which is directional from the independent variable to the dependent one. In other words, if φ is negative and significant for equation (4) reflects that in the long run the military expenditure cause the gross domestic product and the same goes with equation (5). If coefficients associated to the *ECM* term in both equations are significant then long-run bi-directional causality is happening.

After estimation of equations (4) or (5) if long-run dynamics exist, normalized coefficients for the long term co-integration equation can be established with the respective coefficients in order to understand the approximated impact between these variables in the long-run.

EMPIRICAL FACTS & RESULTS

The summary of descriptive statistics for the variables of real GDP and military expenditure (and their logarithm form) are presented in table 1, the table also presents the approximated growth rates of each variable since it was used the difference of logarithms for their calculation.

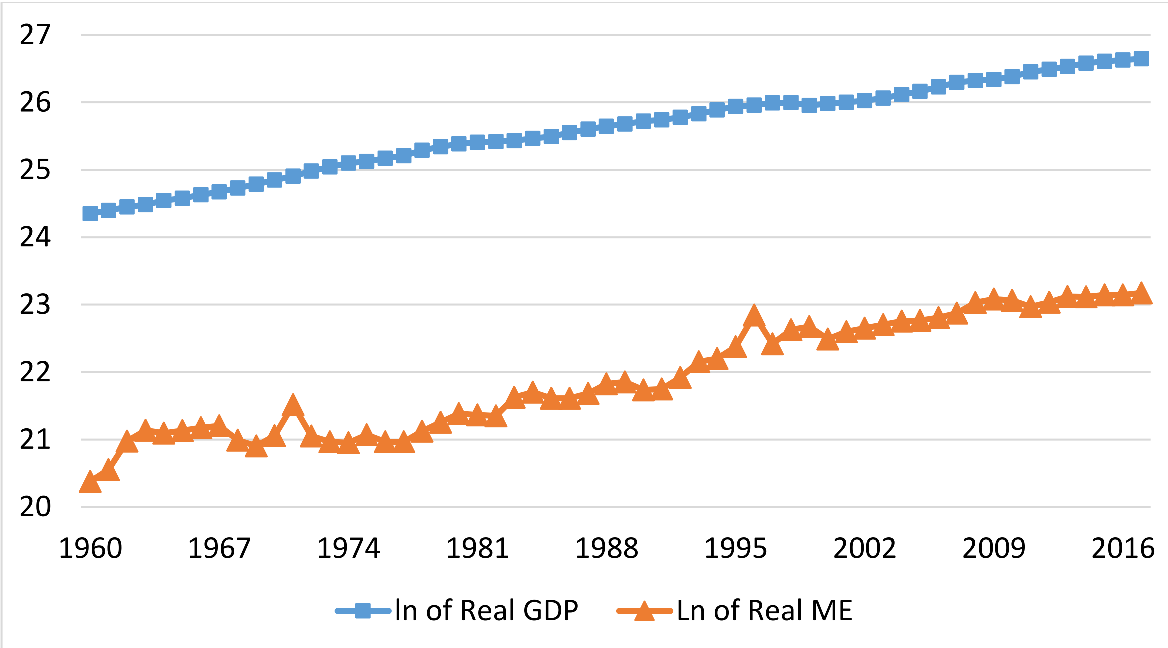
Table 1
Descriptive Statistics of the variables 1960-2017
(*GDP and military expenditure (ME) in USD millions with constant prices of 2011*)

Variable	Obs	Mean	Std.Dev.	Min	Max
Real GDP	58	1.59e+11	9.65e+10	3.75e+10	3.73e+11
Real Military Exp.	58	4.61e+09	3.57e+09	7.07e+08	1.16e+10
Log_GDP_r	58	25.592	.664	24.348	26.646
Log_ME_r	58	21.925	.835	20.377	23.173
G_GDP_r	57	.04	.021	-.043	.081
G_ME_r	57	.049	.164	-.466	.471

Note: Variables with initial G_ stands for the approximated Growth rate as the first difference of the logarithms variables of GDP and ME, Source: World Bank (2019)

The behavior of the variables in logarithms are presented in Graph 1 which exhibits a positive long-run tendency implying a possible co-integration among them, the positive trend component should be taken in consideration as the graphical behavior reflects this tendency.

Graph 1
Behavior in logarithms of Colombian Real GDP and ME 1960-2017
(Values of the natural logarithm of the real GDP and ME)



Note: The calculus was performed using real constant prices of 2011 of the variables. Source: World Bank (2019)

The average growth of the Colombian economy is around 4% over the period of 1960-2017 but military expenditure growth is approximated 4.9% which represents that over the final half of last century and the first two decades of the new millennium, the military expenditure has raised in average more than the economic growth did.

In order to analyze the integration order of the series, the ADF test is shown in table 2 with the respective possible specification of the test (this includes constant, drift and trend) for the log converted variables in levels and in first differences.

Table 2
ADF test for unit root of the variables 1960-2017
(Statistical values from calculations of the ADF test in units)

Augmented Dicky-Fuller test						
Name of the Variable	Test Statistic z(t)	1% Critical Value	5% Critical Value	10% Critical Value	MacKinnon pvalue for Z(t)	Decision
Log_GDP_r	-1.614	-3.572	-2.925	-2.598	0.4756	Unit Root
Log_ME_r	-0.950	-3.572	-2.925	-2.598	0.7709	Unit Root
G_GDP_r	-3.572	-3.573	-2.926	-2.598	0.0063	Stationary
G_ME_r	-7.518	-3.573	-2.926	-2.598	0.0000	Stationary

Augmented Dicky-Fuller test with Drift						
Name of the Variable	Test Statistic z(t)	1% Critical Value	5% Critical Value	10% Critical Value	MacKinnon pvalue for Z(t)	Decision

Log_GDP_r	-1.614	-2.399	-1.674	-1.298	0.0562	Unit Root
Log_ME_r	-0.950	-2.399	-1.674	-1.298	0.1731	Unit Root
G_GDP_r	-3.572	-2.400	-1.675	-1.298	0.0004	Stationary
G_ME_r	-7.518	-2.400	-1.675	-1.298	0.0000	Stationary

Augmented Dicky-Fuller test with Trend						
Name of the Variable	Test Statistic z(t)	1% Critical Value	5% Critical Value	10% Critical Value	MacKinnon pvalue for Z(t)	Decision
Log_GDP_r	-2.071	-4.137	-3.494	-3.176	0.5623	Unit Root
Log_ME_r	-2.810	-4.137	-3.494	-3.176	0.1932	Unit Root
G_GDP_r	-3.808	-4.139	-3.495	-3.177	0.0161	Stationary
G_ME_r	-7.424	-4.139	-3.495	-3.177	0.0000	Stationary

Note: The test with the different specifications determines that the variables have unit roots in levels but in first differences they become stationary indicating the order of integration as I (1) variables. Calculations were done using Stata 15. Source: Own elaboration with information of World Bank (2019)

The results of the tests indicate clearly that the logarithms of GDP and ME in levels have unit root processes while the first difference variables are stationary, confirming the property of integration as I (1) variables. The lag selection order criteria are presented in table 3 and results indicate that ideal lag should be 2 between the variables which are considered for the next stage of the co-integration test.

Table 3
Lag Selection Order Criteria of GDP and ME in natural logarithms 1962-2017
(Statistical values from estimations in units)

Lag	LL	LR	df	p-value	FPE	AIC	HQIC	SBIC
0	-48.010	-	4	-	.022628	1.88718	1.91577	1.96153
1	159.873	415.770	4	0.000	0.000	-5.807	-5.721	-5.583
2	168.188	16.629*	4	0.002	8.8e-06*	-5.96934*	-5.82639*	-5.59759*
3	170.257	4.140	4	0.387	0.000	-5.897	-5.696	-5.376
4	173.595	6.675	4	0.154	0.000	-5.872	-5.614	-5.202
5	176.404	5.619	4	0.230	0.000	-5.827	-5.512	-5.009

Note: The * represents the ideal lag level for each criterion. Sample: 1962 – 2017. Calculations were done using Stata 15. Source: Own elaboration with information of World Bank (2019)

According to the results in table 3 and the consideration of positive trend among the behavior of both variables, the Johansen (1991) co-integration test is presented in table 4 and the results evidence one co-integration equation among the variables since we reject the null hypothesis of no co-integration at rank 0. There's no evidence of more than one co-integration equation according to the test.

Table 4
Johansen test Co-integration of GDP & ME 1962-2017
(Statistical values from estimations in units)

Maximum Rank	parms	LL	eigenvalue	Trace statistic	5% critical value
0	8	171.6159	.	22.8672	18.17
1	11	181.47332	0.29676	3.1524*	3.74
2	12	183.0495	0.05474		

Note: The * indicate the number of co-integration equations. Total number of observations was 56. The lag-length used for the test was 2 with trend estimation. Results indicate 1 co-integration equation since Trace statistic is bigger than 5% critical value at rank=0 which rejects the null hypothesis of none co-integration. Source: Own elaboration using Stata 15 with information of World Bank (2019)

This result allows the use of the VEC approach to estimate short-run and long-run dynamics which would produce via hypothesis-testing the causality of the variables. The estimation of the VEC model is presented in table 5 which included a trend term since both variables evidenced a positive tendency over time.

Table 5
Vector Error Correction Model of GDP and ME 1962-2017
(Calculations in units)

		Coef.	St.Err.	z	p-value	[95% Conf	Interval]	Sig
D_log_GDP_r	L._ce1	-0.149	0.046	-3.26	0.001	-0.238	-0.059	***
	LD.log_GDP_r	0.355	0.136	2.60	0.009	0.087	0.622	***
	L2D.log_GDP_r	0.091	0.140	0.65	0.516	-0.183	0.365	
	LD.log_military_sp~r	0.034	0.017	1.98	0.048	0.000	0.069	**
	L2D.log_military_s~r	0.039	0.016	2.44	0.015	0.008	0.071	**
	_trend	0.000	0.000	-2.22	0.026	-0.001	0.000	**
	Constant	0.036	0.009	3.95	0.000	0.018	0.054	***
D_log_ME_r	L._ce1	-0.505	0.406	-1.24	0.214	-1.302	0.291	
	LD.log_GDP_r	1.480	1.213	1.22	0.222	-0.898	3.858	
	L2D.log_GDP_r	-0.202	1.245	-0.16	0.871	-2.642	2.238	
	LD.log_military_sp~r	-0.049	0.155	-0.32	0.752	-0.353	0.255	
	L2D.log_military_s~r	-0.154	0.143	-1.07	0.283	-0.434	0.127	
	_trend	0.000	0.001	0.07	0.941	-0.003	0.003	
	Constant	0.021	0.081	0.26	0.794	-0.137	0.180	

R^2 of D_log_GDP_r equation:	0.8706	Sample size:	55
R^2 of D_log_ME_r equation:	0.2078	Akaike crit. (AIC)	-6.0665
Log likelihood = 181.8287		HQIC	-5.854795

Note: The nomenclature of significance levels are *** p<0.01, ** p<0.05, * p<0.1. Source: Own elaboration using Stata 15 with information of World Bank (2019)

VEC estimation derived in an important result, there's only one long-run dynamic between the military expenditure and the economic growth. This first model expressed in equation (4) which dependent variable is the variation of GDP has a long-run dynamic because the associated coefficient to the ECM term is negative and significant at 1%, while the second model where the dependent variable is the variation of military expenditure represented generally in equation (5) doesn't report any long-run relationship since the coefficient associated with the ECM appears to be statistically insignificant.

The fact that equation (5) is not statistically significant even with the partial adjustment coefficients derived from the VEC estimation provide evidence that military expenditure doesn't depend from the GDP variable and it's exogenous in its determination. This could be linked to what Grautoff & Chavarro Miranda (2009) appointed about external factors like political interests in the determination of the military expenditure in Colombia.

The short-run dynamics can be established from the partial adjustments coefficients via hypothesis testing as it was mentioned in the methodology. The summary of this hypothesis testing and the overall causality is presented in table 6

Table 6.
Granger Causality Summary from GDP and ME (1962-2017)
(*Statistic values in units*)

Temporality	**Granger Causality order**	**Chi^2**	**df**	**P-value**	**Conclusion**
Short-run	Log_ME_r Granger-Cause Log_GDP_r	7.69	2	0.0214	Causality exists.
Short-run	Log_GDP_r Granger-Cause Log_EM_r	1.72	2	0.4240	Causality doesn't exist.
Temporality	**Causality order**	**Z statistic**		**P-value**	**Conclusion**
Long-run	Log_ME_r Causes Log_GDP_r	-3.26		0.001	Causality exists.
Long-run	Log_GDP_r Causes Log_EM_r	-1.24		0.214	Causality doesn't exist

Note: The long-run causality was taken from the VEC estimation of individual hypothesis testing of the coefficients associated with the ECM. The short-run causality was done using the hypothesis in methodology. Source: Own elaboration using Stata 15 with information of World Bank (2019)

These results indicate that exist only one directional short-run Granger causality from the logarithms of the military expenditure to the logarithm of gross domestic product, as a consequence the VECM estimation showed positive partial adjustment coefficients of ME to GDP, meaning that in the short-run the military expenditure has a positive impact on the gross domestic product of Colombia. The hypothesis testing of the Granger causality from GDP to EM was statistically insufficient, thus we only accept the short-run causality from military expenditure to the gross domestic product.

In the long-run the impact changes as well, the causality can only be established from the military expenditure to the GDP but instead of a positive impact, the normalized coefficients of the long-run dynamics presented in equation (6) report evidence of a negative association between the military expenditure to the economic growth.

$$\ln(GDP) = 32.22082 + 0.577 trend - 0.3741 \ \ln(ME) \qquad (6)$$

Equation (6) includes the estimated coefficient associated to the trend term with a positive sign and the negative impact of the military expenditure in the gross domestic product. The interpretation since equation (6) is in logarithms follows this logic: a 1% percent increase in the real military expenditure causes in the long-run a decrease of 0.37% over the GDP for the Colombian economy, significant at 1% ceteris paribus. The average growth rate of the Colombian economy from 1963 to 2017 is 5.7% each year ceteris paribus according to the trend coefficient.

The result that in the long-run the GDP decreases by increases on the military expenditure indicate that the positive impact of military expenditure in the short-run over GDP is not sufficient to neutralize the consequences of war in Colombia, in fact it may be evidence that it can produce or increase negative externalities (like violence-facts and destruction of economic activity) which result in hurting the economic growth over the long run.

CONCLUSIONS

This paper established the existing Granger-causality of the military expenditure and the gross domestic product in real terms for Colombia over the period of 1960-2017. This causality was only proven from the military expenditure to the gross domestic product but with different impacts in short & long run dynamics.

As a result of the study both variables have one co-integration equation nevertheless, this co-integration equation expresses causality only from the military expenditure to the gross domestic product. According to the estimation of this long-run equation, the impact of military expenditure is negative to the economic growth. The estimated normalized coefficients reflect that by 1% increase in the military expenditure causes a decrease of 0.37% over GDP in the long-run for the Colombian economy.

On the other hand, the short-run dynamics provided evidence of Granger causality from the military expenditure to the gross domestic product but with a positive impact as a result of the positive signs in the partial adjustment coefficients. These results indicate that the impact of military expenditure changes over time from a positive impact in the short-run dynamics to a negative impact in the long-run.

A possible interpretation from this result could be that military expenditure is able to provide some sort of positive externalities (like investment confidence and security) to the Colombian economy in the short-run, but in the long-run this positive impact of externalities is not sufficient to neutralize the negative externalities of war among the population (this referred to terrorist groups and military forces confrontations which result in damage to the civilian population). This negative externalities as it was mention by Grautoff & Chavarro Miranda (2009) represents the implication of violent acts and homicides with the possible destruction of economic activities that lead to the negative impact over the long-run from increases in the military expenditure to the GDP.

Finally, the results of the VEC estimation indicate that military expenditure cannot be explained by either its own past values or the GDP variable, providing evidence that military expenditure has other determinants possible related to the different public policy approaches of different governments in Colombia. The increase or decrease of military expenditure may depend specifically on government strategies to attack the internal conflict which may explain the exogenous determination of military expenditure.

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