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INTERRELATIONSHIP BETWEEN MILITARY SPENDING AND ECONOMIC GROWTH (INVESTIGATION BY GMM TECHNIQUE)

HARUTYUNYAN, Gayane Ernik
PhD in Economics, Associate Professor

Strategic Gaming and Modeling Group , National Defense Research University, Ministry of Defense, Yerevan, Republic of Armenia

Abstract:
The reasoning about interrelationship between state's military spending and economic growth have never been apodictic truth, providing scientists with fertile ground for meaningful discussions. In this study, the impact of military spending on economic growth was examined for 15 countries with highest share of military spending in gross government expenditure, using the GMM (Generalized Method of Moments) over the period 2005-2017. For comparative analysis, we added dummy variables in the regression model to assess the impact of military spending on growth in each country separately. The results of study allow us to conclude that in the 15 surveyed countries the significant negative correlation exists between government military spending and GDP as well as the positive correlation exists between non-military spending and GDP. Herewith, an analysis carried out for individual countries by using dummy variables technique, showed that for some countries the influence of military spending on economic growth is positive, and it is negative for other countries.

Key words: military spending; non-military spending; economic growth; defense industry; generalized method of moments; dummy variable.

1. Introduction

Over the past 20 years (1998-2018), global military spending has increased by more than 58% and amounted to about $ 1 trillion 742 billion (Source: www.sipri.org). The world GDP recorded almost similar growth dynamics - 56%. According to the ordinary economic patterns (logical in the context of Keynesian cross model) the increase in military spending, as an important component of government spending, has a stimulating effect in aggregate demand and, consequently, on economic growth. Therewith, this pattern has been proved by various studies (see, for example Benoit, 1978, Looney, 1993, Ando, 2009). Per contra, studies have also been carried out, showing that the increase in military spending mainly has a negative impact on economic development (see, for example Musaev, 2015, d'Agostino et al., 2010, Faini et al., 1984). Another statistical fact is noteworthy. As of 2017, in countries with the most developed defense industry – export volumes were taken as a development indicator – there was a significant decrease in the share of military spending in government spending, while value figures of military spending showed stability or weak growth when analyzing data in constant

prices 2017 (Source: www.sipri.org). This trend found prominent expression in Turkey, South Korea, Singapore and India.

As noted by Aizenman and Glick (2006), in case of states involved in military conflict, as a rule the economy benefits more from defense, and although military spending does substantially reduce economic growth, nevertheless, in the case of external threats, the impact of increased military spending on economy can also be positive. But the external threat in itself cannot be a factor of positive relationship between military spending and economic growth. Otherwise, the example of Armenia will again remain marginal-controversial, where the absence of positive effect of high military expenditure on economic growth will not in no way be justified* (Harutyunyan, 2018).We are more inclined to consider it logical that if states were able to channel high military expenditures compulsive for various reasons – internal and external military threats, geopolitical alterations provision, balance of power maintenance in the region – to domestic defense industry development, then a considerable positive impact on economic growth had been achieved in the long-term period. Taking this assumption as a hypothesis, in our research we attempted to test this based on 15 countries panel data analysis using the generalized method of moments (GMM) and applying main findings and conclusions to Armenia.

2. Literature Survey

The issues of interrelationship between military spending and economic growth are always actual in almost all countries. Attributable to this, there are many studies serve the purpose of illustrating these issues. The approaches and methods of empirical research, sample of countries and time horizon are also diverse. In this section of our study, we will discuss in more detail the research using GMM method, in particular, the studies of Yildirim et al. (2005), d'Agostino et al. (2010), Hou&Chen (2013), Musaev (2015), Khalid & Noor (2015) and Rahman & Siddiqui (2019).

Yildirim et al. (2005) assessed the effects of military exoenditures on economic growth for 11 Middle Eastern countries and Turkey. As an estimation equation the modified by Ward et al. (1991) version of the famous Feder-Ram model was used:

$$\frac{\dot{Y}}{Y_{-1}} = \alpha \frac{I}{Y_{-1}} + \beta \frac{\dot{L}}{L_{-1}} + \left(\frac{\delta}{1+\delta} - \theta\right)\frac{\dot{M}}{Y_{-1}} + \theta \frac{\dot{M}}{M_{-1}}$$

where Y denotes GDP, I investment, L labor force, M military expenditures, δ is the parameter that characterizes the factor productivity and the dot over variables denotes its differences. From the point of view of the research results the most interesting are $\frac{\dot{M}}{Y_{-1}}$, that represents the size effect of total defense spending and $\frac{\dot{M}}{M_{-1}}$, that represents the defense spending side effects – externalities. The equation was estimated employing both static (fixed effect panel data analysis) and dynamic (by GMM) estimation techniques, and the results in both cases were identical. According to these findings, the size effect of defense sector and the externality effect of military

expenditures on economic growth are positive and statistically significant. Moreover, the authors also conclude that the defense sector is more productive than the civil sector.

D' Agostino et al. (2010) carried out a series of research using data for 28 countries over the period 1960-1997. At that, the estimation of Feder-Ram model for one and two-way fixed effects and Swamy random coefficient was performed as well as the dynamic panel data analysis by GMM. The results and findings observed in static research models are rather poor – not significant – concerning the impact of military spending, which was expected and illustrate the limitations of Feder-Ram model according to the authors. As a result, the authors propose to conduct research using modified Solow growth model enabling panel data research. In this case, the results are significantly improved, and the correlation between military spending and economic growth is assessed as negative and significant for the fixed effects models (suggesting that one percent increase in military spending reduces long-run per capita income permanently by 0.03 to 0.04 percent). Research conducted by GMM also show that high military burden leads to a slowdown in economic growth suggesting an elasticity of -0.6%.

Hou&Chen (2013) used augmented Solow growth model to estimate the impact of military spending on economic growth in 35 developing countries over the period of 1975-2009.The following model was estimated:

$$growth = a_0 + a_1 lny_0 + a_2 lnh + a_4 \ln(n + g + \delta) + a_5 lnm,$$

where $growth$ is the growth rate of income per capita, Y0 is the initial level of income per capita, k and h are, respectively investment and human cpital variables, $(n + g + \delta)$ is the growth rate of effective labour plus depreciation and m is military burden.

These authors havealso carried out static (standard cross-sectional analysis) and dynamic (panel data analyses) analyses. In the first case, the research that carried out for 1975 revealed a negative impact of military spending on economic growth, but the results were not significant. Thus, the estimation results are not strong enough to make the conclusion of the negative effect from defense to economic growth in the long run. Panel data analysis was carried out using both first-differences GMM and system GMM estimators***. Whereas the results of first-differences GMM estimators reveals that the impact of human capital on eceonomic growth is negativ, the authors conclude that the first-differences GMM estimator is like to be poorly behaved, and the estimation using this method is inappropriate. But the results of system GMM estimate show that military burden has a negative and significant effect on economic growth.

Taking as a starting point the idea that not only the country's economic capabilities (including natural resources, education and public administration), but also internal end external conflicts and military spending have a great influence on eceonomic growth, Musaev (2015)conclude that the impact of military spending on economic growth must be considered from the viewpoint of all these factors' reciprocity effect. The research is based on a balanced dynamic panel data set consisting of 89 countries over the 1970-2010 period constructed of non-overlapping five-year ingtervals. This methods allow to filter out short-run cyclicl fluctuations, and focus the analysis

on lonf-run growth effects. According to the research results, the impact of military expenditures in growth is a non-linear function of the so-called "effective militarized threats" posed by internal and external forces.That is to say, security threaths without expenditure reduce growth, military expenditure without threats also decrease growth, while in case of availability sufficiently large threats the impact of military expenditure on growth would be positive. On the other hand, the research shows that the impact of military spending on ceonomic growth is also negative in presence of corruption in country.

Khalid & Noor (2015) applied the GMM to investigate the relationship between military spending and economic growth in 67 developing countries based on data between 2002 and 2010. It is noteworthy that in the introduction of paper the authors note that the findings of research confirm the existence of positive relationship between military spending and economic growth, referring to the similarity with Benoit's research results of 1973(Benoit, 1973). However, the model actually chosen for research is that the estimation of GDP impact on military spending is possible, but not vice versa. Therefore, it would be wrong to classify this study as one of those studies confirming the positive relationship between military spending and economic growth.

One of the most recent studies on the subject under consideration is perhaps, the Rahman & Siddiqui's (2019) research, published in June 2019, containing the estimation of the impact of military spending on economic growth and per capita GDP in 85 countries for the last 20 years, i.e. from 1998 to 2017. Based on research results, the authors conclude that military spending in generally have negative effect on growth, but in case when high military spending is complemented by weapons exports, the increase of spending turns favorable for GDP.

1.Research Methodology and Data Sources

The relationship between military spending and economic growth will be explored using simplest Keynesian Cross model, as done in paper of Khalid and Razaq (2015).

It is well known that

$$GDP_t = C_t + I_t + G_t + Nx_t, \quad (1)$$

where GDP is Gross domestic product,
C is Consumption of household sector,
I is Investment of firms,
G is Government expenditures,
Nx is Net export and equals Export minus Import.

Considering that:
Ct=a+b(GDP-Tt),
Tt=c+dGDPt, (where T is real taxes),
It=e-fRt (where R is real interest rate),
Gt=MSt+NMSt (where MS is military spending and NMS is non-military spending of Government),
Nxt=g-hGDP-iRt,
(1) can be represented as follows:

$$GDP_t = a_1 + a_2 NMS_t + a_3 MS_t + a_4 R_t + u_t, \quad (2)$$

where a1= $\frac{a-bc+e+g}{1-b(1-d)+h}$, a2 = a3 = $\frac{1}{1-b(1-d)+h}$, a4 = $\frac{-(f+i)}{1-b(1-d)+h}$

at that a1, a2, a3>0, and a4<0, u_t is the stochastic error-term.

Commonly, models describing economic growth almost always involve the presence of endogenous variables stipulated by certain specific effects that cannot be measured and keep under observation. For example, an increase in military spending can stimulate GDP growth, but on the other hand, an increase in GDP can also lead to increase in military spending, which by the way, was shown in our previous research on the example of Armenia (Harutyunyan, 2018). In this instance, the instrumental variables must be included in regression model. However, the standard instrumental variables method also has some disadvantages, especially in case of heteroskedasticity presence. In this matter Arellano & Bond (1991) suggest to use the first-differences of variables – which is the same as using lags of endogenous variables t-2 and earlier – as instruments in order to get unbiased and consistent estimates of the coefficients. Applying the regressor's first-differences allows removing all possible deviations that might arise from unobserved country-specific effects and other variables not included in model. There are two different approaches to estimation by GMM: so-called "difference GMM" and "System GMM". The second approach has been suggested by Blundell and Bond (1998) referring to the poor quality and ineffectiveness of difference GMM estimators in some research – where the time series are persistent or close to random walk processes. To determine which approach is most appropriate to apply, the Hansen test (Esener and Ipek, 2015) or Sargan test (Yildirim et al., 2005) are used. System GMM is selected when these tests show that the instruments are valid, otherwise difference GMM would be implemented. Since for our research we have used the EViews 8.0 software package – where mentioned tests not applied for checking instrumental variables' overidentifying, we will analyze J-statistic test as an equivalent for this purpose.
The choice of GMM is conditioned not only by small sample of panel data – as in such cases the effectiveness of method use is cogent (Yildirim et al., 2005, Esener & Ipek, 2015) – but also

because the GMM allows to include country-specific variables and conduct individual analyzes for each country included in the sample.

The survey was initially intended to be conducted for 22 countries with highest share of military spending in gross government expenditure over 20 years' time horizon from 1999 to 2018 (see Figure 1).

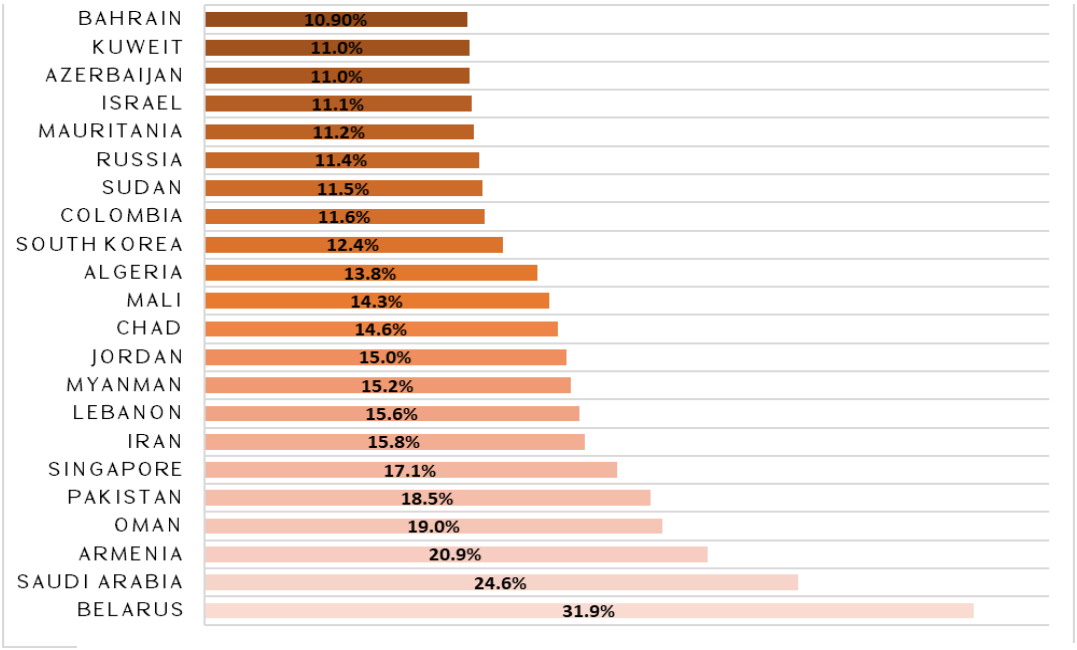

Fig. 1. Countries with highest share of military spending in Gross government expenditure in 2018 (Source: www.sipri.org)

However, given that for Armenia – the most interested country in our sample – statistics of the main explanatory variable (the share of military of military spending in gross government expenditure) prior to 2005 are not available, besides for some countries – Myanmar, Chad, Sudan, Mauritania – the comprehensive statistical data for variables included in the model are lacked, we have shortened the time horizon to 13 years (from 2005 to 2017), correspondingly reducing the number of countries included in the sample to 15. Figure 2 shows the dynamics of military spending (at 2017 constant prices, USD) in these countries over the mentioned period.

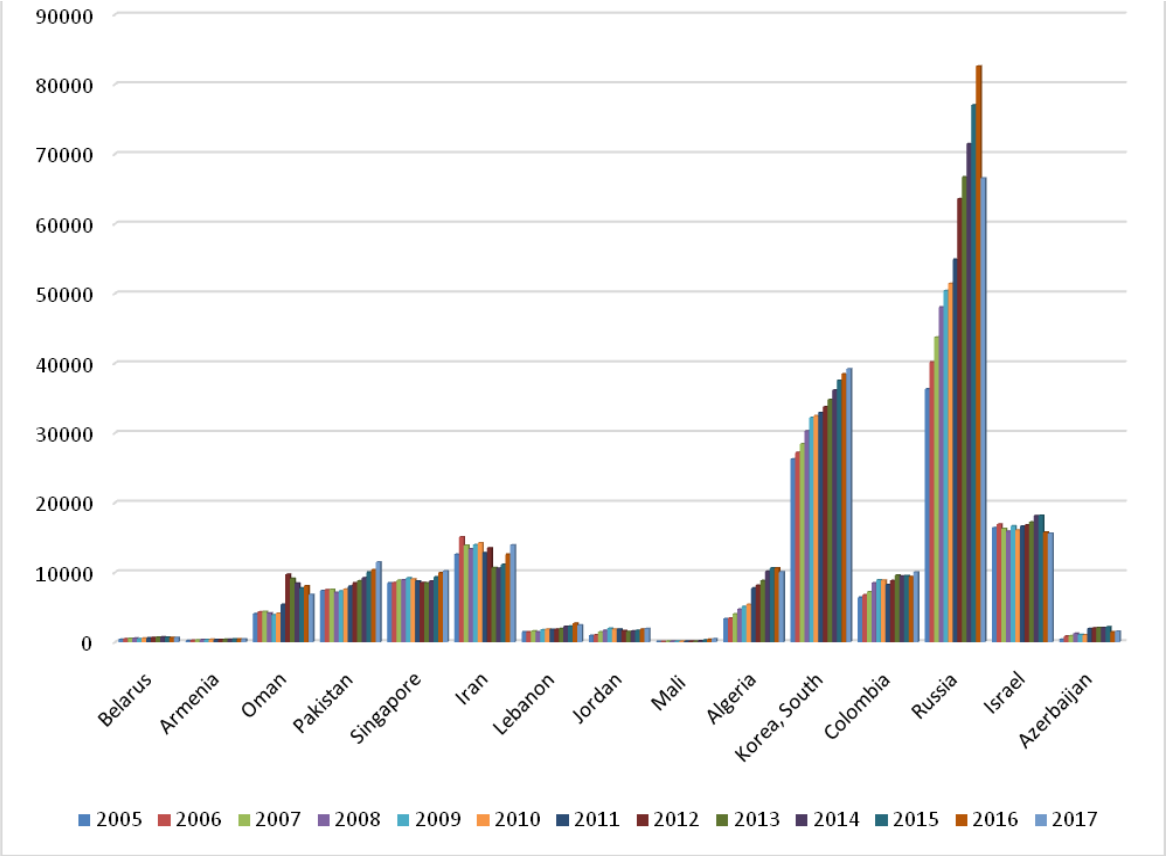

Fig. 2. The dynamics of military spending in the countries under study (2005-2017)
Source: https://databank.worldbank.org/source/world-development-indicators

World Development Indicators electronic database. GDP at constant 2010 prices (USD) was selected as indicator of GDP. As indicator of military spending we are selected the share of military spending in gross government expenditure from database of Stockholm International Peace Research Institute presented on the website www.sipri.org. We built the non-military spending time series on our own as a difference of gross government expenditures (in constant 2017 prices, in local currency, source: World Development Indicators) and military spending (in constant 2017 prices, in local currency, source: www.sipri.org), that is, non-military spending are represented in value term in order to mitigate correlation between variables. The source for building the real interest rate time series in also World Development Indicators.

4. Results

The research was conducted by using the EViews 8.0 software package. The results of the analysis without using instrumental variables are presented in Table 1.

Dependent Variable: GDP		
Method: Panel Generalized Method of Moments		

Date: 08/03/20 Time: 16:32				
Sample: 1 195				
Periods included: 13				
Cross-sections included: 15				
Total panel (balanced) observations: 195				
White period instrument weighting matrix				
White period standard errors & covariance (d.f. corrected)				
Instrument specification: C MILEX NMEXP RIR				
Constant added to instrument list				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
MILEX	1.60E+11	9.27E+10	1.728253	0.0856
NMEXP	32960.36	2774.902	11.87802	0.0000
RIR	-8.40E+08	6.48E+08	-1.294880	0.1969
R-squared	0.939248	Mean dependent var		3.05E+11
Adjusted R-squared	0.938615	S.D. dependent var		4.39E+11
S.E. of regression	1.09E+11	Sum squared resid		2.27E+24
Durbin-Watson stat	0.158247	J-statistic		0.617229
Instrument rank	4	Prob(J-statistic)		0.432079

Table 1. GMM without using instrumental variables

Note that although the results obtained for the regressor we are more interested in (military spending) are generally significant, and the coefficient determination R2, in essence, indicates that the model is appropriate, the small value of Durbin-Watson statistics suggests that here is autocorrelation between the residuals. This is also confirmed by the Breusch-Godfrey test. Therefore, we can conclude that the results of our research have not any practical importance. Then we conducted a study using first-differences GMM. The results are presented in Table 2.

Dependent Variable: GDP		
Method: Panel Generalized Method of Moments		
Transformation: First Differences		
Date: 08/03/20 Time: 17:38		
Sample: 1 195		
Periods included: 11		
Cross-sections included: 15		
Total panel (balanced) observations: 165		
White period instrument weighting matrix		
White period standard errors & covariance (d.f. corrected)		
Instrument specification: @DYN(MILEX, -2) @DYN(NMEXP, -2)		
Constant added to instrument list		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	0.768066	0.002825	271.9006	0.0000
MILEX	-1264061.	24169.16	-52.30060	0.0000
NMEXP	4602.115	60.17536	76.47840	0.0000
RIR	-3.09E+08	14523329	-21.27898	0.0000
	Effects Specification			
Cross-section fixed (first differences)				
Mean dependent var	8.71E+09	S.D. dependent var		2.07E+10
S.E. of regression	2.20E+10	Sum squared resid		7.78E+22
J-statistic	11.27742	Instrument rank		15
Prob(J-statistic)	0.420323			

Table 2. First-differences GMM test results

In this case, as we can see, the results are also significant, suggesting that the increase in military spending and real interest rate in the countries under study had a remarkable negative effect on economic growth. The 1% increase in the share of military spending in gross government expenditure led to decline in GDP by $ 1.264 million, and a 1% increase in real interest rate reduced GDP by 309 million. Whereas, the non-military spending growth has had a positive impact on economic growth. The increase in non-military spending by $1 led to GDP growth by $ 4,602. But the results of this research also can't have practical importance, since J-stat test shows that there is overidentification of variables and it is necessary to apply system GMM. The results of system GMM estimation are presented in Table 3.

Dependent Variable: GDP				
Method: Panel Generalized Method of Moments				
Transformation: Orthogonal Deviations				
Date: 08/03/20 Time: 18:20				
Sample: 1 195				
Periods included: 11				
Cross-sections included: 15				
Total panel (balanced) observations: 165				
White period instrument weighting matrix				
White period standard errors & covariance (d.f. corrected)				
Instrument specification: GDP(-1) MILEX NMEXP RIR				
Constant added to instrument list				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	0.823865	0.146504	5.623508	0.0000
MILEX	-6721038.	44076.10	-1.540161	0.0001
NMEXP	1011.197	1591.532	0.635361	0.0000
RIR	-1.90E+08	2.83E+08	-0.673439	0.0012

	Effects Specification		
Cross-section fixed (orthogonal deviations)			
Mean dependent var	-2.62E+10	S.D. dependent var	4.05E+10
S.E. of regression	1.72E+10	Sum squared resid	4.78E+22
J-statistic	3.90E-24	Instrument rank	4

Table 3. System GMM estimation results

The obtained results are largely the same as the results of first-differences GMM estimation. They demonstrate more clearly the negative impact of military spending – a 1% increase in the share of military spending in gross government expenditure led to decline in GDP by $ 6721038. Non-military spending has had a positive impact – the increase by $1 resulted in GDP growth by $1011. As for the real interest rate, according to study using system GMM, the negative impact on GDP was mild – a 1% increase led to decline in GDP by $190 million. All obtained results are significant, J-test shows that the model is appropriate, and the implementation of instruments is reasonable.

For comparative analysis, we added dummy variables in the regression model to assess the impact of military spending on growth in each country separately. To include dummy variables in the model, we were using the military expenditure indicator (in constant 2017 prices, USD) instead of share of military spending in gross government expenditure. The results of research (conducting with system GMM estimation model) are presented in Table 4.

Dependent Variable: GDP				
Method: Panel Generalized Method of Moments				
Transformation: Orthogonal Deviations				
Date: 08/03/20 Time: 20:31				
Sample: 1 195				
Periods included: 12				
Cross-sections included: 15				
Total panel (balanced) observations: 180				
2SLS instrument weighting matrix				
Instrument specification: MILEX NMEXP RIR ARM IS KOR SING RUS AZ BEL MALI LEB JOR IR COL ALG PAK @SYSPER				
Constant added to instrument list				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
MILEX	11746751	7871047	1.485503	0.0095
NMEXP	10527.62	1567.050	6.718113	0.0000
RIR	-87583442	1.76E+08	-0.497186	0.0198
ARM	-1.34E+08	51256366	-2.608660	0.0001
IS	3173108.	2265960.	1.400337	0.0035

KOR	16065161	1176174.	13.65883	0.0000
SING	17759425	3500414.	5.073522	0.0000
RUS	859694.7	749506.0	1.147015	0.0002
AZ	-3626746.	4741553.	-0.764886	0.0041
BEL	1062768	3177040	0.334515	0.0005
MALI	-1.54E+08	47805840	-3.212094	0.0016
LEB	-24524328	9452142.	-2.594579	0.0004
JOR	-33683108	13246528	-2.542788	0.0120
IR	7832545.	1966281.	3.983432	0.0001
COL	5377352.	2191582.	2.453640	0.0153
ALG	-4362396.	1958370.	-2.227565	0.0074
PAK	1184892.	1808657.	0.513239	0.6085
	Effects Specification			
Cross-section fixed (orthogonal deviations)				
Period fixed (dummy variables)				
Mean dependent var	-2.94E+10	S.D. dependent var		4.70E+10
S.E. of regression	1.60E+10	Sum squared resid		3.88E+22
J-statistic	5.95E-26	Instrument rank		29

Table 4. Resultes of assessment of military expenditure impact on economic growth in countries under study (using dummy variables technic)

The results in Table 4 show that military spending had a negative impact on growth in Armenia, Azerbaijan, Mali, Lebanon, Jordan and Algeria, while in Israel, South Korea, Singapore, Russia, Belarus, Iran, Colombia and Pakistan the impact on economic growth was positive. Although the obtained results for some countries (for example Pakistan and Jordan) have little significance, the estimates are generally appropriate and have a practical importance.

It is noteworthy that all countries where the impact of military spending (in value terms) on GDP turned out to be positive, can be characterized as counties with developed defense industry (Israel, Singapore, South Korea, Russia) or with some level of defense industry's development (Colombia, Iran, Belarus). Meanwhile countries where the relationship between military spending and economic growth was assessed as negative, don't have their own defense industry.

5. Conclusion

The assessment of the impact of military spending on economic growth has long led to ambiguous conclusions in various studies. Obviously, the problem is not the imperfection of the applied methodology, but the peculiarities of the studied countries, in each particular case requiring including in the model such a variable (regressor) that may not influence on the results of such assessments for other countries. On the other hand, a number of circumstances related to the effectiveness of military spending management remain underestimated, since they did not lend themselves to quantitative measurements and therefore cannot be used in research. As such

an important factor, for example, we consider the effectiveness of military-economic cooperation with allies or other partners. It should be noted that in case of Armenia could use to the fullest extent the advantages of strategic ally with Russia and disseminate these relations in a beneficial way to the development of the military-industrial domain, a different picture might have appeared when assessing the relationship between military spending and economic growth. Such factors are also the spread of corruption in the country, the patriotism of the population, the level of national self-consciousness, the social and political cohesion in the society.

Even in the case of such assumptions, the results of this study are surprisingly and fortunately not contradictory, and basically confirm the thesis we have put forward earlier that military spending has a stimulating effect on economic growth only when a large part of state's military order will be performed by local defense industry. And when the latter is not developed, the effect on economic growth is negative. Thus, the results of study using system GMM showed that in the 15 countries with highest share of military spending in gross government expenditure the significant negative correlation exists between government military spending – more specifically, changes in the share of military spending in gross government spending – and GDP (the coefficient is -6721038) as well as the positive correlation exists between non-military spending and GDP (the coefficient is 1011.2).

However, an analysis carried out for individual countries by using dummy variables technique, showed that for some countries the influence of military spending on economic growth is positive, and it is negative for other countries. Herewith, in the countries that have a developed defense industry, the effect of military spending on economic growth is positive (for example, in Russia, Israel, South Korea, Singapore), and in countries with a week defense industry is negative (for example, in Armenia, Algeria, Mali, Lebanon and Azerbaijan).

The study allows us to draw some conclusions about non-military expenditures, the impact of which is positive on economic growth. This situation can be explained from two points of view. In Armenia, military spending is the second largest item in the state budget, and the first is social security spending, which is mainly used for consumer goods – especially for basic necessities, most of which are produced domestically. On the other hand, other social expenditures on education and healthcare create the basis for human capital development and reproduction, thereby contributing to economic growth. Thus, the effectiveness of defense resource management presupposes the development of indigenous defense industry and dual-use manufacturing sectors on the one hand and the development of human capital on the other hand. Only in this case the military spending will benefit the country's economic growth, and not vice versa.

NOTES

* In our earlier research we showed through the Granger causality test that in Armenia the military spending did not have stimulating effect on economic growth, moreover, military spending with 1-year lag has been driven by a percentage of GDP. See the analysis in more detail: Harutyunyan G. (2018).

** Models with fixed effects allow to take into account the influence of the observed object describing non-measurable – therefore unobservable – characteristics, which are invariant across time and correlated with the independent variable. In case of models with random effects, these characteristics are considered as stochastic variable. The estimation of two-way fixed effects model implies assessment of both group and time individual effects.

*** The authors have also analyzed panel data using other methods, but we present only the GMM results.

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