Does Military Keynesianism work in BRICS countries? Empirical evidence from panel granger causality model

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1. Introduction

The research of military expenditure effect on economic growth is very controversial area among the researchers, policy makers and academia. However there are debates across the world that whether the increase of the military expenditure strengthen or deteriorate economic growth and welfare. It was estimated by SIPRI (2008) that around $1339 billion was spending for the military-head across the world, which was 2.5% of the total world GDP. Military spending increased by 45% in real terms between the year 1998 and 2007. This trend sustained due to the second Gulf War and the drastic intervention of the USA on Afghanistan, after 9/11 traumatize terrorist attack. In this contrast the World Bank data (World Development Indicators) displays that from 1988 to 2012, countries with highest military expenditure have more economic development whereas the countries with less expenditure have less economic development. Hypothetically military expenditure can the cause of both enhance as well hurdle the economic growth. On the one side it is harmful through its opportunity costs. Due to gun-butter trade off, it crowds out investment and other productive activities. Due to rise in military expenditure, there would be increased tax burden and government debt may reduce economic growth. Similarly, on the other hand, military expenditure is supposed to increase new technology that spills over to private sector, renders public infrastructure and protection against enemies, and enhances aggregate demand and employment through Keynesian multiplier effect.

The study follows as in the next section deals with brief reviews of earlier literature. In section 3, we give an account of the data and variable description. In section 4, we discuss the economic methodologies, results and discussion. In the final section we discuss policy implication and concluding remarks.

2. Review of Literature

Military expenditure is one of the predominate area of the budget allocation of the nations. Due to the international terrorist attacks and highly technological enhancement defence industries spread across the world. Military expenditure has a significant share of total GDP of the many countries. It supposes to deter economic growth in the long run. There are many studies have been carried out to investigate the relationship between military expenditure and economic growth by using different econometric models. Some studies are shown that military expenditure is positively and significantly related to the economic growth (Benoit, 1973, 1978; Weede, 1983; Biswas, 1993; Cohen et al., 1996; Yakovlev, 2007). It means military expenditure enhances the economic growth. However another set of studies are shown that military expenditure is one of the major hindrances to economic growth of the nation (Deger & Smith,1983; Faini et al., 1984; Deger,1986; Mintz & Huang,1990,1991; Pieroni,2009a;Ward & Davis,1992; Heo,1999). Some studied are shown that military expenditure neither hinder nor push the economic growth (Biswas & Ram, 1986; Alexander, 1990). Study has been made by Deger and Smith (1983) argues the relationship between military expenditure and economic growth in less developed countries. They found contradictory results. Though Benoit (1973) found positive relationship between ME and economic growth, Deger & Smith (1983) observed negative relationship between two variables. Cappelen et al. (1984) investigated interrelationship between economic growth, manufacturing output, investment and military spending for 17 OECD countries. They find that military spending have reverse effect on economic growth except some countries. There is some variation in economic growth and military spending in different countries on the basis of sample periods, socio economic structure and types of government etc. (Chowdhury, 1991; Kusi, 1994). Brempong (1989) studied to find out whether defence expenditure as an instrument of economic growth in less developed countries. But he found that the defence expenses and economic growth are negatively related. Ward and Davis (1992) focused the interaction between military expenditure and economic growth in United States between 1948 and 1990. Their finding shows that the economic growth can be increased by the declining in defence expenditure. A study (Antonakis, 1999) found that there is negative interaction between annual growth rate and size of the defence sector in Greece. In this contrast, Chen (1993) investigated that the long run relationship between military expenditure and economic growth for mainland China between 1950 and 1991. The result shows that unidirectional Granger causality running from military expenditure to economic growth. Heo & DeRouen Jr (1998) studied about the relationship between military expenditure, economic growth and technological change in the East Asian newly industrialized countries during the period 1961 to 1990. Their results display that military expenditure has negative impact on economic growth in these countries. Dakurah et al. (2001) made an attempt to investigate the causal relations between defence spending and economic growth in 62 developing countries. Study found that unidirectional causality for 23 countries, from either defence expenditure to economic growth or vice versa and only 7 countries experienced bidirectional causality. Causality did not exist in 18 countries that were integrated in same order whereas in case remaining 14 countries the data were integrated in different order.

Some recent studies have been made an attempt to examine the relationship between military expenditure and economic growth taking various models and techniques.

Karagianni & Pempetzoglu (2009) carry out a study by using linear and nonlinear Granger Causality methods to investigate the relationship between military spending and economic growth in Turkey from 1949 to 2004. Study found that both nonlinear causality between military spending and economic growth in Turkey. Kumar & Tiwari (2010) examine the relationship between GDP and defence expenditure in India employing VECM model. They found that there is bi-directional causality between GDP and defence expenditure in India. Chang et al. (2011) examine the possible relationship between the military expenditure and economic growth by applying GMM model for 90 countries spanning over 1992-2006. Results show that on the basis of high, middle and low income countries (World Bank), military spending have negative impacts on economic growth in low income countries while military expenditure have positive impacts on economic growth in high income countries. Dimitraki & Ali (2013) examine the long run causal relationship between military expenditure and economic growth in China over the period 1952 -2010. They find that the existence of a single long-run equilibrium relationship between the variables. Again result shows that primarily military expenditure originate from different sources rather than economic growth. Farzanegan (2014) examines the response of the Iranian economy to shocks in its military budget from 1959 to 2007, applying impulse response and variance decomposition analysis. The Granger causality result shows that there is unidirectional causality from the military spending growth rate to economic growth rate.

3. Data sources and Variable description

Data has been extracted on per capita military expenditure and per capita economic growth for the period 1992 to 2013 in BRICS (Brazil, Russia, India, China and South Africa). Per capita GDP is collected from World Development Indicators, World Bank while the per capita military expenditure is from SIPRI (Stockholm International Peace Research Institute). GDP is on US dollars. The military expenditure is composed of capital and current expenditures on defence ministries and others government agencies in defence projects, space activities of military and paramilitary forces. The selection of BRICS countries is based on the growing economic development data availability. For all the estimation the standard version of EVIEWS 7.1 is used.

4. Model Specification and Econometric Applications

In order to investigate the existence of military Keynesianism the study employed the following liner panel model where military expenditure is independent variable and GDP is dependent variable.

$$PGDP_{it} = \alpha_i + \beta_{it} \, PMLEXP_{it} + \varepsilon_{it} \quad (1)$$

for t = 1,…..T; I=1,……., N where T refers to the number of observation over time and N refers to the number of individual countries in the panel. PGDP refers to per capita GDP and PMLEXP refers to per capita military expenditure.

4.1 Panel Unit Root Test

In order to test the panel Cointegration among variables, the first step is to examine the unit roots properties of the data, because the variables must be integrated of the same order. In the present study we have used four unit roots methods viz. Levin-Lin-Chu (LLC et al., 2002), Im-Pesaran-Shin (Im et al., 2003), Fisher ADF and Fisher PP tests respectively. The null hypothesis of all these Panel unit roots tests have always consider non-stationary of the data in its null hypothesis. IPS combines information from the time series dimension with that from the cross section dimension, such that fewer time observations are required for the test to have power. Most of the researches have opined that IPS test have superior test power to analyze the long-run relationships in panel data and therefore, the present study have employed this procedure. IPS begins by specifying a separate ADF regression for each cross-section with individual effects and no time trend.

$$\Delta y_{it} = \alpha_i + \rho i \, y_{i,t,1} + + \sum_{j=1}^{pi} \beta_{ij} \, \Delta Y_{i,t,j} + \varepsilon_{it} \quad (2)$$

Where i = 1. . . N and t = 1. . . T

IPS use separate unit root tests for the N cross-section units. Their test is based on the Augmented Dickey-fuller (ADF) statistics averaged across groups. After estimating the separate ADF regressions, the average of the t-statistics for P_1 from the individual ADF regressions

t_{iTi} (P_i).

$$\bar{t}_{NT} = \frac{1}{N} \sum_{i=1}^{N} t_{iT} (P_i \beta_i) \quad (3)$$

Then the t-bar has been standardized and it converges to the standard normal distribution as N and T approaches towards infinity. IPS (1997) proposed that when N and T are small in the panel model the t-bar test performers better than other tests. In panel unit root estimation they proposed a cross-sectionally demeaned version of both test to be used in the case of errors of different regressions which contains a common time specific component.

Table.1 Panel Unit Root Test Result

Variables	LLC Test		IPS Test	
	C	C & T	C	C & T
Y	4.00(1.00)	0.75(0.22)	6.00(1.00)	1.37(0.08)
MEXP	3.07(0.99)	1.49(0.06)**	1.41(0.92)	1.38(0.08)
Y	3.01(0.00)***	4.98(0.00)***	3.13(0.00)***	2.72(0.00)***
MEXP	5.23(0.00)***	3.94(0.00)***	3.86(0.00)***	2.31(0.01)***

Notes: Numbers in parentheses are p-values. C refers to the specification with intercept; C & T refers to the specification with intercept and trend. ***, ** & * indicate 1%, 5% & 10% level of significance, respectively.

The results of table 1 presents both the Levin et al. (2002) and Im et al.(2003) confirm that all the series are non-stationary at their level that is, we cannot reject the null hypothesis of non-stationarity, or the series contains a unit root. Hence, after the first order differentiation the test statistics show that we can reject the null hypothesis of non-stationarity for all the series at 1% level of significance. In conclusion, all series are stationary at their first order differences, or they are I (I) variables. All the variables for the case of BRICS countries are integrated of order one. Since the variables are integrated of order of one for series, the Peronei(1999, 2004) cointegration test will be applied to understanding the long-run equilibrium relationship among the variables. The Pedroni (1999, 2000) test of cointegration has been explained in below.

4.2 Panel Cointegration Tests

Pedroni (1997, 1999) has proposed a heterogeneous panel Cointegration test which has been used to estimate the cointegration between CO_2 consumption and other variables in the study. This test allows various cross sectional interdependence along with other different individual effects in order to establish the Cointegration. He defines two kinds of test statistics where the first one is based on pooling residuals within the dimension of the panel. The tests are as follows:

Panel v Statistic:

$$T^2 N^{3/2} Z \hat{\upsilon}_{N,T} \equiv T^2 N^{3/2} [\sum_{i=1}^{N} \sum_{t=1}^{T} L^{\wedge -2}{}_{11i}\, \hat{e}_{i,}{}^{2}{}_{t-1}]^{-1} \quad (4)$$

Panel e statistic:

$$T\sqrt{NZ}\hat{p}_{N,T} \equiv T\sqrt{N}\, [\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}{}^{-2} \hat{e}_{i,t-1}{}^{2}]^{-1} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}^{-2}{}_{11i}\, (\hat{e}_{I,t-1}\, \Delta\hat{e}_{i.t} - \hat{\lambda}_i) \quad (5)$$

Panel t statistic (Non-parametric):

$$Z_{tN,T} \equiv [\tilde{\sigma}^2{}_{N,T} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}^{-2}{}_{11i} \hat{e}^2{}_{i,t-1}]^{-1/2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}^{-2}{}_{11i} (\hat{e}_{I,t-1} \Delta\hat{e}_{I,t} - \hat{\lambda}_i) \quad (6)$$

Panel t statistic (Parametric):

Z^{*} tN,T $\equiv [\hat{S}^{*2}{}_{N,T} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}^{*2}{}_{i,t-1})^{-1/2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}^{-2}{}_{11i} (\hat{e}^{*}{}_{I,t-1} \Delta\hat{e}^{*}{}_{i,t})$ (7)

Group e statistic:

$TN^{-1/2}\hat{Z}\hat{p}_{N,T-1} \equiv TN^{-1/2} \sum_{i=0}^{N}[\sum_{t=1}^{T} \hat{e}^{2}{}_{i,t-1})^{-1} \sum_{t=1}^{T}[\hat{e}_{i,t-1} \Delta\hat{e}_{I,t} - \hat{\lambda}_{i}]$ (8)

Group t statistic (non-parametric):

$N^{-1/2}\hat{Z}_{tN,t-1} \equiv N^{-1/2} \sum_{i=1}^{N}[\hat{\sigma}^{2}{}_{i} \sum_{t=1}^{T} \hat{e}^{2}{}_{i,t-1}]^{-1/2} \sum_{t=1}^{T}[\hat{e}_{i,t-1} \Delta\hat{e}_{I,t} - \hat{\lambda}_{i}]$ (9)

Group t statistic (parametric):

$N^{-1/2}\hat{Z}^{*}{}_{tN,T} \equiv N^{-1/2}\sum_{i=1}^{N}[\sum_{t=1}^{T} \hat{S}^{*2}{}_{i} \hat{e}^{*2}{}_{i,t-1}]^{-1/2} \sum_{t=1}^{T}[\hat{e}^{*}{}_{i,t-1} \Delta\hat{e}^{*}{}_{i,t}]$ (10)

For the testing of long-run equilibrium in the panels Pedroni (1999) has proposed two types of residual-based tests that are i.e. without dimension tests (panel V static, panel e static, panel t statistic (Non-parametric) and panel t statistic (parametric) and within dimension. Kao and combined Fisher ADF tests are also applied for the panel cointegration.

Table.2 Pane Cointegration Result

Panel Cointegration Test	Individual Intercept	Individual intercept and Trend
	Within Dimension	
Panel V-Statistic	1.855179(0.0318) ***	0.217626(0.4139)
Panel rho-Statistic	-1.101188(0.1354)	0.090146(0.5359)
Panel pp-Statistic	-1.583949(0.0566) ***	-0.137729(0.4452)
Panel ADF-Statistic	-1.288555(0.0988) **	-0.082956(0.4669)
	Without Dimension	
Group PP-statistic	0.361191(0.6410)	0.692072(0.57556)
Group rho-statistic	-1.513200(0.0651) ***	-0.325938(0.3722)
Group ADF Statistic	-0.871033(0.1919)	-1.369278(0.0855) ***

Table.3 Kao Test

ADF	-2.560121 (0.0052) ***
Residual Variance	483.0429
HAC Variance	375.1221

Since all the variables are *I (1)*, Pedroni's cointegration test and Kao test are employed to investigate the null hypothesis of no cointegrating relationship against the alternative hypothesis of the existence of cointegrating relationship. Panel V statistics and panel PP statistics are significance at 1% and 5% while the panel ADF statistics is at 10% level of significance. In case of group rho statistics it is significance at 10%. The results show long run relationship between the two variables in BRICS countries. However the cointegration relationship does not speak about the long and short-run dynamics of the variables. For the sake of knowing the long run and short run elasticities we have employed the Fully Modified Least Square. In case of fully modified least square the study estimates the long run elasticities of the variables.

4.3 Fully Modified Least Square

The fully modified least square estimation has been adopted form *Christopoulos* and *Tsionas* (2004) for estimating the asymptotically efficient consistent in panel series where the method takes in to consideration of non-exogeneity, serial correlation and heterogeneity (Pedroni, 1996). As all the explanatory variables are cointegrated with time trend , henceforth there is a existence of long-run equilibrium relationship among the variables through the panel unit root test (LLC, IPS, Fisher ADF & PP) and panel cointegration test (Pedroni, 1990). The study proceeds to estimate the Equation (1) by the method of fully modified OLS (FMOLS). The FMOLS allows consistent and efficient estimation of cointegrating vector and at same time it addresses the problem of nonstationary regressors, as well as the problem of simultaneity biases in the heterogeneous cointegrated panels. The OLS estimation is not as powerful as FMOLS and it yields biased results in regressors that are endogenously determined in the *I(1)* cases. The model can be written as:

$Y_{it} = \alpha_{it} + x'_{it}\,\beta + \varepsilon_{it}$ (11)

$X_{it} = x_{i,t\ 1} + \varepsilon_{it}$

Where $\xi_{it} = [e_{it}, \varepsilon'_{it}]$ is the stationary with covariance matrix Ω_i .The estimators will be consistent with the error process ω_{it} + $[e_{it}, \varepsilon'_{it}]'$ statistics the assumption of cointegration between y_{it} and x_{it}. The limiting distribution of OLS estimator depends upon nuisance parameters. Following Phillips, and Hansen (1990), a semi- parametric correction can be made to the OLS estimators that elements the second order biases caused by the fact regressors are endogenous. Pedroni (1990 and 2000) follows the same principle in the panel data context, and allows for the heterogeneity in the short run dynamic and fixed effects. FMOLS Pedroni's estimator is constructed as follows

$$\hat{\beta}_{FM} \quad \beta = \sum_{i=1}^{N} \hat{\Omega}_{22}{}^{2}{}_{i} \quad \sum_{t=1}^{T} (x_{it}\ \hat{x}_t)^2 \sum_{i=1}^{N} \hat{\Omega}_{11} i^1\ \hat{\Omega}_{22i}{}^{1} \sum_{t=1}^{T} (x_{it}\ \overline{x}_t)\ e_{it}\ T\ \hat{\gamma}_i \tag{12}$$

$$\hat{e}_{it} = e_{it}\ \hat{\Omega}_{22}{}^{1} \quad \hat{\Omega}_{21i}, \qquad \hat{\gamma}_i = \hat{\Gamma}_{22i} + \hat{\Omega}_{22i}{}^{0}\ \hat{\Omega}_{21i}\ (\ \hat{\Gamma}_{22i} + \hat{\Omega}_{22i}{}^{0}\ ) \tag{13}$$

Where the covariance matrix can be decomposed as $\hat{\Omega}_1 = \hat{\Omega}_1 + \hat{\Gamma}_i + \hat{\Gamma}_i$ where Ω_i^0 is the contemporaneous covariance matrix and $\hat{\Gamma}_i$ is a weighted sum of auto-covariance. The $\hat{\Omega}_i{}^0$ represents an appropriate estimator of $\hat{\Omega}_i{}^0$.

This study has used panel group FMOLS test from Pedroni (1996, 2000). This test allows for greater flexibility in the presence of heterogeneity of the cointegrating vectors. The null hypothesis constructed for the test statistics of the panel group estimators is that H_o: $\beta_i = \beta$ for all i against the alternative hypothesis H_A: $\beta_i \neq \beta$, so that the values for β_i are not constrained to be the same under the alternative hypothesis. This is clearly an advantage. Another advantage lies with the interpretation of the point estimates in the event that the true cointegrating vectors are heterogeneous. It can be interpreted as the mean value for the cointegrating vectors (Pedroni, 2001).

Table.4 Long-run Elasticity coefficient of FMOLS
Dependent variable is Y (PGDP)

Country	MLEXP	t-Statistics	Prob.
Panel Group	**-18.84847**	**-1.684528**	**0.0950****

The null hypothesis for the *t*-ratio is H0=βi= 0; *, **, and *** denotes 10%, 5% and 1% level of significance.

Table.5 shows the long run elasticity of the military expenditure on economic growth. From the results it is clear that there is a negative impact on economic growth due to military expenditure in the BRICS countries. As one unit increase in military expenditure the economic growth will decrease by 18 units. The results are significant at 10% level of significance. For the short run and long run dynamics of economic growth and military expenditure we have adopted the panel granger causality model based on panel VECM and F-statistics.

4.4. Panel Granger Causality (VECM)

The study has applied Engle and Granger (1987) suggests two-step procedure in order to examine the short-run and long-run dynamic relationships between expenditure on education and economic growth. In the first step the long-run model specified in Eq. (1) is to be estimated and in the next step we have to define the lagged residual obtained as the error correction term (ECT). The estimation of dynamic vector error correction (VECM) model is as follow;

$$\Delta MLEXP_{it} = \theta_{1i} + \sum_{j=1}^{q} \theta_{1,1ij}\,\Delta MLEXP_{it-j} + \sum_{j=1}^{q} \theta_{1,2ij}\Delta GDP_{it-j} + \lambda_{1i}\, ECT_{it-1} + \mu_{1it} \quad (14)$$

$$\Delta GDP_{it} = \theta_{2i} + \sum_{j=1}^{q} \theta_{2,1ij}\,\Delta GDP_{it-j} + \sum_{j=1}^{q} \theta_{2,2ij}\,\Delta MLEXP_{it-j} + \lambda_{2i}\, ECT_{it-1} + \mu_{2it} \quad (15)$$

Where, the (error correction term) is derived from the long-run FMOLS results of Eq. (1).

Table .5 Panel Granger Causality Test result (PVECM)

Dependent Variable	Source of causation (Independent variable)		
	Short-run		Long-run
	Δ Y	Δ EXPEDU	ECT
Δ Y	……….	1.3065(0.2765)	-0.0769[-0.86612]
Δ EXPEDU	1.9375(0.101)		0.2777[2.54817] ***

Lag lengths: 2, P-value listed in parentheses and t-statistic listed in brackets. ***, **& * indicates significance level of 1%, 5% and 10%, respectively.

Table 6 shows the dynamics of per capita military expenditure and per capita economic growth in BRICS countries (Brazil, Russia, India, China, and South Africa). The panel vector error correction shows no long run causality exits between military expenditure and economic growth. From the F-Statistics it is evident that no short run granger causality running from military expenditure to economic growth and vice-versa. The results are not in favor of the existence of military Keynesianism in BRICS.

5. Conclusion and Policy Suggestion

The study has been carried out by taking data on per capita military expenditure and per capita economic growth (GDP) for the period of 1992 to 2013 across all the BRICS countries. The econometric approach of this study is panel cointegration, Fully Modified OLS, and panel vector error correction method and panel Granger causality. The main purpose of the study is to investigate the existence of military Keynesianism in context of the BRICS countries. The military expenditure is a kind of public goods and considered as a tool for fiscal policy. The results of the cointegration shows that there is a long run association between per capita military expenditure and per capita economic growth, but as the cointegration does not speaks about the dynamics of the variables we have applied panel VECM model to understand the short run and long-run causality between military expenditure and economic growth in BRICS. FMOLS presets a negative long run relationship in per capita economic growth due to per capita military expenditure by the government. The theory of military Keynesianism is missing in case of BRICS countries. The direction of causality is not evident from military expenditure and economic growth. The study does not find any multiplier effect. Our study is consistent with other studies (Deger & Smith, 1983; Faini et al., 1984; Deger, 1986; Mintz & Huang, 1990, 1991; Pieroni, 2009a; Ward & Davis, 1992; Heo, 1999, Biswas & Ram, 1986; Alexander, 1990). With a view to make military expenditure an effective source of economic growth, the government has to support the local production of high-technological military goods. This can ensure positive externality and can increase income, employment, skill up-gradation and R&D to cause GDP growth. There should be expenditure on engineering sciences which can improve the quality of military goods through the help of increased knowledge and productivity in the defence sector. However the main and foremost priority must be in bringing about welfare of the society and economic development rather diverting of resources to military expenditure at the cost of civil expenditure.

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