Determinants of Military Expenditure in Brics Countries

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Abstract: The purpose of the paper is to use econometric methods to ascertain the main determinants of rising military expenditure in BRICS countries for the period of 1970 to 2017.The empirical result of the determinant for military expenditure of BRICS countries from 1970 to 2017 employed the panel data analysis approach. Based on the detailed theoretical and empirical literature on determinant for military expenditure, the neoclassical model was considered the best to analyzed determinant of BRICS countries military expenditure. BRICS countries political economy and security factors were incorporate for model specification. The determinant for military expenditure for BRICS include income, population, government expenditure, Security web (average military expenditure of neighboring countries within BRICS countries), internal threats and external threats. The economic, political and security factors are included. The empirical result suggest that BRICS countries military expenditure is mainly determined by its income, population, exchange rate, internal threats, inflation and political regime (proxy by democracy index). In conclusion, the result reveal that BRICS policy makers if they are interested in reversing their high unemployment and poverty rate should focus their attention on these encouraging the local production of their arms/ammunition (military industries) which will create job opportunities for their teeming youthful population. This result is in line with the findings of (Tambudzai, 2011), (Brauer, 2002) and Hartley and (Sandler & Hartley, 1995).

Keywords: Military Expenditure; BRICS countries; GDP

JEL Classification: E13; 011; H56

1. Introduction

Empirical studies on determinants for military expenditure in individual countries and cross-national countries abound, however, there are few/no studies for BRICS (Brazil, Russia, India, China and South Africa) covering the period of 1970 to 2017. Furthermore, the rationale for investigating BRICS countries for this study are as

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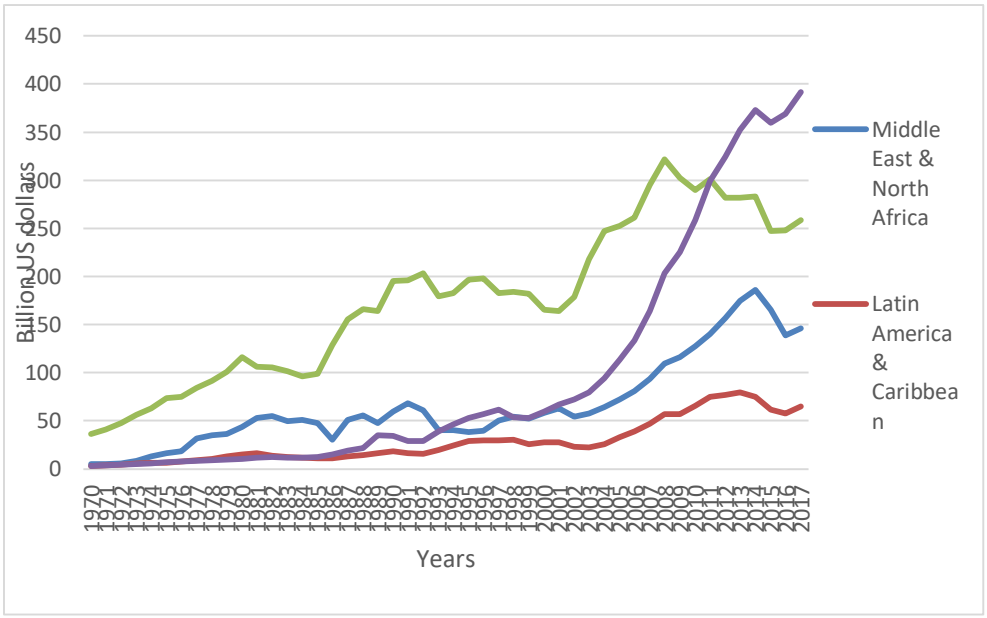
follows, one, BRICS countries accounts for about 26.11% of total world's military expenditure. The second reason is that of BRICS countries have been involved in regional peacekeeping missionaries in regional-conflicts makes this empirical investigation an interesting one to explore. For example, BRICS' countries involvement in regional and global peace keeping forces mission. Finally, on a general note, World's military expenditure has declined due to the peace dividend however; BRICS countries still assign a high percentage of their central government budgetary allocation to the military sector and industries despite witnessing harsh socio-economic inclusive growth challenges.

Figure 1.1 present BRICS countries military expenditure trend analysis covering the period of 1970 to 2017. The graph denotes that military expenditure has been rising in BRICS countries. For instance, in 1970, BRICS countries taken together spent over $3 billion on military expenditure. By 1980, the data shown that BRICS military expenditure had tripled to over $10 billion and still rising especially from 2000 to 2017. This therefore form the crux of this paper is to unravel what are the factors responsible for the rise in military expenditure in BRICS countries spanning across the periods of 1970 to 2017.

Figure 1.1. Brics Military Expenditure Trend For 1970 To 2017



Source: World Bank Database Indicator (2018)

The structure of this paper is as follows: Section 2 presents BRICS military expenditure and its ranking from 1970 to 2017, Section 3 presents theoretical models

for the determinant for military expenditure, Section 4 covers the empirical literatures, and Section 5 present the model specification and data description. In section 6, Data Analysis and Interpretation will be presented. In section 7. Conclusion

2. BRICS Military Expenditure and their Ranking

BRICS is one of the largest and most powerful economic bloc with over 500 billion people and has one of the largest combined military force in the world. The BRICS countries has combined military expenditure of USD 348942 (SIPRI, 2017, in constant 2016 prices). Table 1 present BRICS countries world country ranking and the its military expenditure by constant million USD.

Table 1. BRICS Military expenditure and their ranking

2017 Countries	World Country ranking by military expenditure	Military expenditure by Constant million USD
Brazil	11th	25751.34
Russia	4th	55327.10
India	5th	59757.10
China	2nd	228173.00
South Africa	43rd	3110.20
Total		**348942.40**

Source: SIPRI new extended database 2017

From Table 1, it denotes that BRICS countries has demonstrated a sustained increase in military expenditure and contributed to growth in World military expenditure in the recent years. BRICS countries real military expenditure has been rising for the period of 1946 to 2017. The BRICS combined military expenditure has rose from 1.0% in 1970 to 1.8 in 2017, which outweigh the average NATO members' military expenditure to Gross Domestic Product (GDP) benchmark contribution except for France, Germany and some Former Soviet Union's Countries.

2.1. Chorology of Wars Involving BRICS Countries from 1971 to Present

This section present both wars/conflicts as the main determinants for military expenditure in BRICS countries. The table 2 below provides a chorological start and finish dates, name of conflicts and BRICS countries involved consequently stimulating increased military expenditure from 1984 to 2017 has shown in above graph.

Table 2. Conflicts involving BRICS countries from 1970 to present

(1) 1970- 1979		**Name of conflicts**	**Victorious Side**	**Defeated Side**
Start	**Finish**			
1971	1971	Indo-Pakistan wars and Conflicts	India & Bangladesh	Pakistan
1974	1974	Battle of the paracel Islands	China	South Vietnam
1975	2002	Angolan Civil Wars	Russia and others	South Africa and others
1975	**Ongoing***	Cabinda war	Russia	FLEC
1977	1978	Ethio - Egyptian war	Russia	Somalia
1979	1990	Sino-Vietnamese war	China	Vietnam
1979	1989	Soviet- Afghan war	Tehran Eight	Russia
B. 1980-1989				
1983	2009	Sri-Lankan Civil war	India (1987-1990)	Tamil Tigers
1984	1987	Siachen Conflict	India	Pakistan
1989	**Ongoing ***	Insurgency in Jammu and Kashmir(part of the Kashmir conflict)	India	Harket-ul-Jihad Isau and others
C.1990	**1999**			
1991	2002	Sierra-Leone Civil war	South Africa mercenaries and Nigeria ECONOMG and others	Revolutary United Front and others
1991	1993	Georgian civil	Georgian and Russia	Zviadist
1992	1992	East Progorodry conflicts	Russian Army and others	Ingush militia
1992	1992	War of Transnistria	Russia 14th Army and others	Moldova and others
1992	1993	War in Abkhazia (1992-1993)	Russia and Others	Afghanistan
1993	**Ongoing ***	Ethic conflict in Nagaland	India and others	Rebel forces
1993	1993	1993 Russian constitutional crisis	President of Russia and others	Supreme Soviet of Russia and others
1984	**Ongoing***	Armenia-Azerbaij border conflict	Russia Support Armenia	Azerbaijan supported by Turkey
1984	1996	First Chechen	Chechen Republic of Ichkeria and others	Russia
1996	2006	Nepalese civil war	China support Communist Party of Nepal	India support Kingdom of Nepal
1996	2001	Civil in Afghanistan	India supports USA and others	Al-Qaeda and others
1999	1999	Kargi War (part of Indo Pakistan war)	India	Pakistan
1999	1999	War of Dagestan	Russia	IIPB and Shura of Dagestan
1999	2009	Second Chechen War	Russia and Republic of Chechnya	Republic of Ichker and others
1996	**Ongoing***	South Africa farm attacks	South Africans	Foreign nationals and South Africans
2000	**Till date**			
2002	2007	First Ivorian civil war	Russia support	France/UN

2002	Ongoing	Taliban Insurgency	India Coalition forces and others	Taliban
2007	2015	War in Ingushetia	Russia and others	Caucasus Emirate and others
2008	2008	Russo-Georgia	Russia and others	Georgia
2009	**Ongoing***	Insurgency in the North Caucasus	Russia	Caucasus Emirate
2011	**Ongoing***	Syrian civil war	Russia support Syria	USA support Free Syrian Army
2012	2013	M23 rebellion	South Africa and others	March 23 movement

Sources:(Posen, 1986), Correlate of Wars (2017)

1. **1984-1979**- All BRIC countries were involved in diverse forms of conflict except South Africa still under Apartheid regime. However, the Cabinda war of 1975 is still ongoing till date.
2. **1980-1989**- Only India was involved in major conflicts ranging from wars, insurgency and border disputes with Pakistan. Worthy of note is the insurgency in Jammu and Kashmir is ongoing.
3. **1990-1999**- This can be referred to as **1990's War Era**. As BRICS countries, all witnessed diverse forms of conflicts ranging from border disputes, regional and international conflicts. This period all BRICS countries experienced a surge in their respective countries has shown in the graph where both all BRICS military expenditure grew to 1.0% of its GDP and assign minimum of 4.0% of their government spending to military sector. The following wars are still in progress: Ethic conflict in Nagaland; farm attacks from South Africans on foreigner's farms.
4. **2000- Till date**- The two dominants BRICS countries experiencing conflicts are Russia and India. The following wars are still in progress Syrian civil war and Insurgency in the North Caucasus.

3. Theoretical Model of Determinants of Military Expenditure

Empirical studies on determinants for military expenditure has been explored by utilizing diverse econometric estimation techniques. Furthermore, empirical studies also explored the possibility of political, geographical and socio-economic influence on military expenditure composition and trends. The determinants of military expenditure employed for this analysis is the neoclassical model

Neoclassical model

The military neoclassical model is chiefly center on (Smith, 1995; Smith, 1980) work. It encompasses how political and economic factors influencing military

expenditure component. The neoclassical model assumes optimization of welfare. The military neoclassical model can be written as:

$$W_1 = W(S, C, N, Zw)$$

W-Welfare of the country; S- Security of lives and property from attacks; C-Consumption and Zw- Other factors.

Since, S cannot be measured but can be measured by using a proxy of military expenditure and other countries (this can be allies and rivals) denoted as$M_1, M_2, \ldots., M_n$. Thus, this can be substituted and incorporated equation 1.

$$W_1 = W(M_1, M_2, \ldots., M_n, C, N, Zw)$$

N.B. Allies military expenditure rise the country security whereas rivals military expenditure pose a threat.

The mathematically military budget constraint can be written as

$$Y = P_C C + P_m M$$

Y-nominal aggregate income; P_m-Prices of military expenditure; P_c-Prices of consumption and M- real military expenditure

$$M_1 = M\left({}^{P_m}/_{P_c}, Y, N, M_1, \ldots., M_n, Z_w, Z_s\right)$$

Welfare function is given as

$$W = \propto \log(C) + (1 - \propto)\log(S)$$

The above is premised on the country has a rival neighboring country M_1 and absence of allies. The security function is assumed as

$$S = M - M^* = M - (\beta_0 + \beta_1 M_1)$$

Where

M^*- Military expenditure a country to resist its rival neighbour attack

β_0-Fixed element not linked to rival military expenditure, it is negative if neighbouring security are natural and negative if vice versa.

β_1-Relative effectiveness of military

4. Empirical Literature Review on Determinant of Military Expenditure

Diverse researchers have examined the determinants for military expenditure across the globe, both in developed and developing countries and their empirical results have been mixed, thus it cannot be generalized for all countries. The determinant for

military in emerging countries ranges from economic factors, socio-political factors and security to mention a few.

This section provides the relevant empirical literatures on determinants for military expenditure following the above categories.

4.1. Security Threats

Provision of security for lives and properties of their citizens has been affirmed to be one the cardinal functions of the central government military and paramilitary agencies. The scope of the military and paramilitary agencies includes but not only limited to: intervening in communal clashes, inter-state boundaries disputes, national and international conflicts; Civil wars, and also participating in both regional and international peace keeping missions and ad-hoc joint task forces operations.

One of the key determinants for military expenditure identified by security/defence experts such as (Dunne & Perlo-Freeman, 2003) is external wars threat. (Dunne & Perlo-Freeman, 2003) consented that external wars is one of the major determinants if not the major driver for the rise for military expenditure in developing countries. They further explained that the rise in military expenditure is triggered and evident during wartime or crisis period via the procurement of arm ammunition and rise in voluntary enrolment/conscription of young youths during such periods.

Hewitt (1991, 1992 and 1993) a employing public-choice framework analyzing the association between military expenditure and threats for 125 Less Developed Countries (LDCs) over the period 1972-1990. The empirical result indicate that international wars positively does matter in increased military expenditure levels.

(Batchelor et al, 2000), using South Africa as a case study, explored the determinants for military expenditure. They incorporated Angolan war (1977-1993) in their estimation. The empirical result indicate a significant and positive effect of war on South Africa's increased military expenditure for the period considered.

(Dunne & Perlo-Freeman, 2003) presented a comparative analysis of a cold war (1981-1989) and post-cold war period (1990-1997) for developing countries. The result confirmed a positive impact from external wars on military expenditure. (Tambudzai, 2011) examined Zimbabwe's military expenditure determinants from 1998-2008. The external wars variable clearly indicate a positive impact on Zimbabwe military expenditure on a long run basis.

(Ball, 1983) asserted that internal threats (civil wars) is more sever and detrimental than external threats for developing countries.(Dunne & Mohammed, 1995), also examined 13 sub-Saharan countries determinants for military expenditure for the period 1967-1985. The empirical result show a significant and positive impact of civil war on military expenditure. (Collier & Hoeffler, 2002) carried out a comparative econometric analysis between civil war (internal threats) and

international wars (external threats) on military expenditure. The result indicate that civil war (internal threats) is significant and has positive impact on military expenditure than international threats (External threats).

(Collier, 2003) asserts that developing countries allocates 2.8 percent of its GDP to military expenditure during peacetime whereas during wartime assigns about 5 percent of national Gross Domestic Product to military expenditure and allied industries.

(Aziz et al, 2017) investigated the milex-growth nexus of seventy countries taking cognizance the presence of internal and external threats from 1990 to 2013 using Generalized Moments Methods (GMM) as well as fixed/random models. Their result suggests a negative relationship between military expenditure and growth for all the models.

4.2. Security Web

The concept of security web was a product of (Rosh, 1988) work. The concept refers to nation's X security web as all other countries capable of influencing country X's security both at national and regional level. (Rosh, 1988) further explained that country X's threats levels can be ascertained by average military expenditure of Gross Domestic Product of countries in the security web. (Rosh, 1988) work affirmed that security web plays significant role and positively stimulate the increased military expenditure of 63 LDCs over the period 1969-1978. (Dunne & Perlo-Freeman, 2003) and (Dunne et al, 2008) further explore the security web dynamics, by categorizing the countries in the security web into three distinct groups of Allies, neutral and rivalry/enemies. Their empirical result were mixed for all the three distinct groups. However, (Sun & Yu, 1999) depicts that China's military expenditure was significantly and positively influenced by Japanese military expenditure for the period of 1965-1993. Likewise, (Tambudzai, 2011) affirmed that Zimbabwe military expenditure was significantly and positively influenced by growth in South Africa military arsenal for the period of 1980-2003.

4.3. Economic Factors

(Barro & Sala-I-Martin, 1992) asserted that determinants of military expenditure is not affected by threat only but by host of economic, political and environmental factors. This section focus on empirically identified economic determinants of military expenditure.

(Looney, 1989) highlights that at aggregate level, economic variables such as income inequality disparity level, growth rate of GDP, budget size and Milex Industrial Complex (MIC). On a general note, GDP has been singled out as an important economic determinant of military expenditure. Other empirical studies have also used per capita and GNP to examine income on military expenditure

Other identified internal economic determinants include the presence of arms industries, Central Government Expenditure (CGE) and non-military government expenditure. For instance, (Hewitt & Van Rijckeghem, 1995) work on military expenditure-growth nexus suggest that GDP level clearly depicts real impacts of military expenditure. The empirical result indicate the existence of convex relationship. (Tambudzai, 2011) examined 12 Southern African countries determinant for military expenditure for the period 1997-2004. The empirical result indicate the significance of GDP per capita on military expenditure determinants estimation.

Conversely, in individual country studies, Gross national income variables has been suggested to have positive effect as a determinant for military expenditure. For instance, (Sun & Yu, 1999) examines the determinant for military expenditure for China. The result reveal military expenditure is significantly and positively related to its Gross National Product. In examining an African context,(Batchelor et al, 2000) find that South Africa military expenditure is related to its income level .

Central Government expenditure is the reported final budget details stated in the accounts. (Dommen & Maizels, 1988) work on military burden on developing countries use central government of GDP as one of the determinants for military expenditure. The empirical result show that Central government Expenditure is significant and positive. Likewise, (Dommen & Maizels, 1988) result was collaborated by (Hewitt, 1991). (Hewitt, 1991) further reinforce that central government expenditure is significant and positive in determining military expenditure.

(Yildirim et al, 2005) investigate government consumption effect on military expenditure for 92 countries for 1987-1997.The result found that central government expenditure is significant and positive on military expenditure. In summary, above empirical results affirmed that central government expenditure is significant and positive with military expenditure.

(Deger & Sen, 1990) included arms production as a variable to examine military expenditure on the Indian economy for the period of 1960-1985. However, the result show that arms production is insignificant in the estimation.

(Dunne & Perlo-Freeman, 2003) and (Dunne et al, 2008) included trade variable in their demand for military expenditure estimation. The empirical result show that trade does matter with a significant and positive impact on military expenditure whereas (Dunne & Mohammed, 1995) work indicate that trade is not significant in Sub Saharan Africa This may be due to low intra sub-Saharan trade activities.

4.4. Political Factors

In determining the factors that influence military expenditure, it has been suggested by (Hou, 2010), That, the political institution regimes does affect a nation's quest for

military effort. For instance, (Dommen & Maizels, 1988) has affirmed that democratic regimes tends to spend less whereas authoritarian regimes tends to invest more in military sector and allied industries to be full control of the nation. However, this above assertion cannot be generalized for all nations.

Other notable empirical works that have investigated political regimes in the milex demand debates are as follows: (Dommen & Maizels, 1988) milex demand work use political regimes (from military to democratic) for 72 countries for the period of 1978-1980. Their result revealed that two fifth of military regimes make use of military force against the public

On the other hand , (Dunne et al, 2008; Dunne & Perlo-Freeman, 2003) incorporated democracy index from POLITY 1998 in estimating determinant for developing countries covering 1981 to1997. Their result indicates that democracy do have significant and negative impact on military expenditure on developing countries.(Hou, 2010) identified the relevance of political regimes investigating India's demand for military expenditure discuss. (Sun & Yu, 1999) examined the change of China's leadership from war oriented to economic development after 1979. Their result indicate an inverse change on Chinese military expenditure level for 1965-1993. (Batchelor et al, 2000) empirical work on South Africa military demand incorporated a political dummy to capture change of leadership administration. The empirical result indicate an inverse relationship with military expenditure. (Yu, 2002) use US-China conflict and major political shock as an independent variable for determinant for Taiwan's military expenditure for 1966 to 1992. The empirical result indicate a significant and positive impact as a determinant for military expenditure.

1.4.5. Other Factors

(Dunne & Perlo-Freeman, 2003) identified population as a significant determinant for military expenditure based on "Public good" theory. They opined that a large population does make military expenditure more effective. Also, (Hewitt & Van Rijckeghem, 1995) found that population is significant and positive for developing countries. However, (Dunne et al, 2008) found that there exist an inverse relationship between population and military expenditure for countries with large population whereas countries with small population invest more on military hi technologies. They suggest that countries with large population tends to focus more on consumption demand than security matters. Other notable variables identified by empirical studies on determinant for military expenditure includes external threats. (Dunne & Mohammed, 1995) explores military participation-military expenditure nexus for 13 sub-Saharan countries. They use proportion of armed forces. The empirical result show that proportion of armed forces significantly and positively affect military expenditure level. (Yildirim et al, 2005) use ratio of armed forces per 1000 population to estimate determinant for military expenditure for 92 countries for

1987 to 1997. Their panel analysis result indicate that higher ratio of armed forces per 1000 population is linked to an increased military expenditure levels. (Dommen & Maizels, 1988) and (Dunne & Perlo-Freeman, 2003) identified geographical factor as a possible contagion effect especially in Middle East countries embodied in conflicts. Their empirical analyses attest the presence of regional factor as a significant and positive determinant for military expenditure for all Middle East countries.

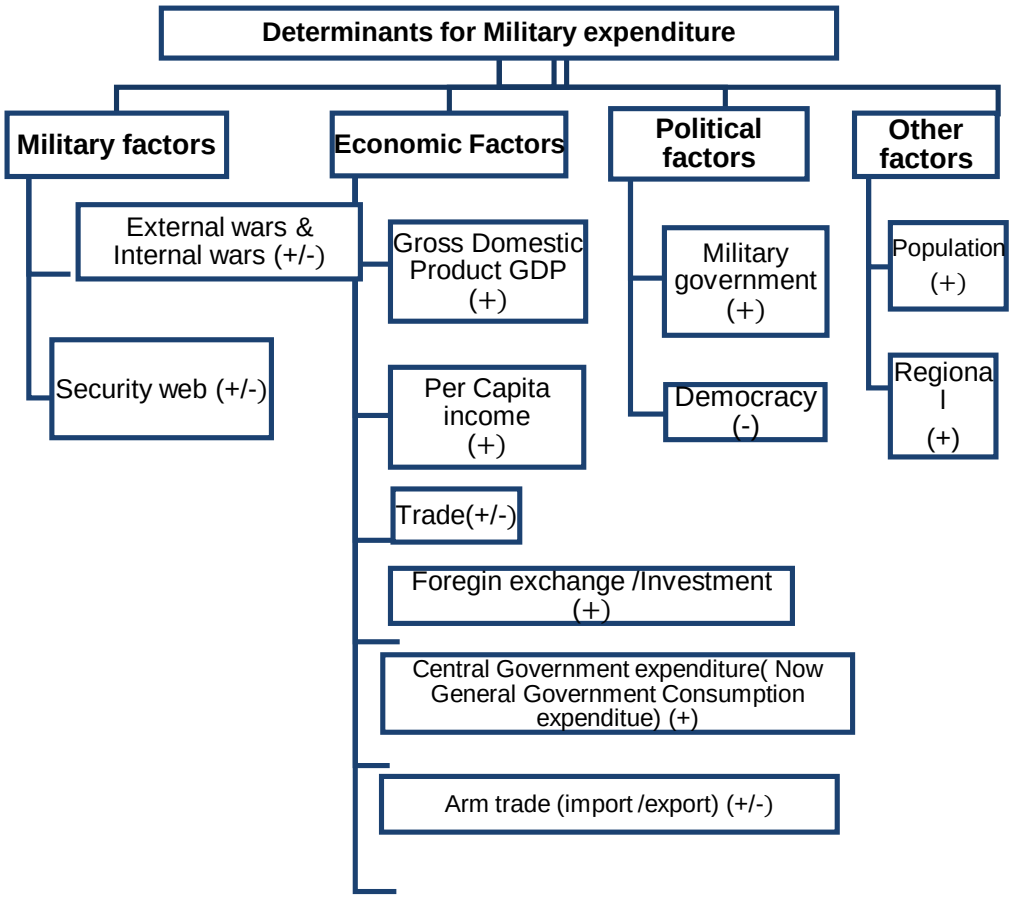


Figure 2. Determinants for Military expenditure

5. Model Specification and Data

The military neoclassical model is chiefly center on (Smith, 1995; Smith, 1980) work. It encompasses how political and economic factors influencing military expenditure component. The neoclassical model assumes optimization of welfare. The military neoclassical model can be written as:

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$$W_1 = W$$

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The mathematically military budget constraint can be written as

$$Y = P_C C + P_m M$$

Y-nominal aggregate income; P_m-Prices of military expenditure; P_c-Prices of consumption and M- real military expenditure

$$M_1 = M\left({}^{P_m}/_{P_c}, Y, N, M_1, \ldots., M_n, Z_w, Z_s\right)$$

Welfare function is given as $W = \propto \log(C) + (1 - \propto)\log(S)$

The above is premised on the country has a rival neighboring country M_1 and absence of allies. The security function is assumed as

$$S = M - M^* = M - (\beta_0 + \beta_1 M_1)$$

Where

M^*- Military expenditure a country to resist its rival neighbour attack

β_0-Fixed element not linked to rival military expenditure, it is negative if neighbouring security are natural and negative if vice versa.

β_1-Relative effectiveness of military

The Lagrange function of above budget constraint

$$L = \propto \log(C) + (1 - \propto)\log(M - M^*) + \lambda(y - P_C C - P_m M)$$

The First Order Condition (FOCs) are

$$\frac{\partial L}{\partial C} = \frac{\partial L}{\partial C} - \lambda P_C = 0 \; i.e. C = \frac{\alpha}{\lambda P_C}$$

$$\frac{\partial L}{\partial C} = \frac{1-\alpha}{M - M^*} - \lambda P_m = 0 \; i.e. M = \frac{1-\alpha}{\lambda P_m} + M^*$$

$$\frac{\partial L}{\partial C} = Y - P_c C - P_M M = 0$$

This gives

$$\frac{\partial L}{\partial C} = \frac{\partial L}{\partial C} = \frac{1-\alpha}{M - M^*} - \lambda P_m = 0 \; i.e. M = \frac{1-\alpha}{\lambda P_m} + M^*$$

$$y - P_C \frac{\alpha}{\lambda P_c} - P_m \left(\frac{1-\alpha}{\lambda P_m} + M^* \right) = 0$$

The Lagrange multiplier can be eliminated by

$$\frac{1}{\lambda} = Y - P_m M^*$$

The two linear equations = M= $\frac{1-\alpha}{\lambda P_m} + \alpha(\beta_0 + \beta_1 M_1)$

C = $\frac{\alpha}{P_C} + (Y - P_M \, (\beta_0 + \beta_1 M_1)$

Some of the (Smith, 1995) work landmark achievements includes but not limited to, one, the model distinguish between military force stock and military expenditure levels effects. Two, the impact of political regimes and how it affect military expenditure budgetary decisions. Therefore, employing neoclassical models for examining the determinant for military expenditure is ideal. The neoclassical model has ability to accommodate diverse components spanning across economic variables such as income, prices and population to mention a few as well as socio-political variables such as strategic factors and military expenditure. The neoclassical model has been suggested to be more comprehensive, well detailed and a present's reasonable economic outcome on determinants for military expenditure in an economy.

Estimating Techniques

Panel data provides regression analysis with both a spatial (a cross -section of units) and sequential (periodic observations) dimension. (Gujarati, 2009) provides an extensive list of advantages of panel data:

1. The problem of heterogeneity in panel data units is solved by estimation techniques that allows for individual-specific variables.
2. Data gives "more informative data, more variability, less collinearity and greater degrees of freedom and more efficiency".
3. Panel data are more appropriate for investigating the dynamics of change.
4. Panel data can better detect and measure effects that cannot be observed in pure time series or pure cross-section data.
5. Panel data allows us to study behavioural models that are more complicated.
6. Panel data minimizes bias caused by aggregation of micro units' data.

Yaffee 2003 discusses a number of panel data analytical models, particularly constant coefficient, fixed effects and random effect models. In the midst of these types of models are dynamic panel, robust and covariance structure models.

The Pooled Regression Model

Also known as the constant coefficient model, pooled regression models use constant coefficient (both intercepts and slopes) and is relevant when there is neither significant country nor significant temporal effects. We pool all the data and run an OLS regression model.

$$y_{it} = \beta_1 + \sum_{k=2}^{k} \beta_k x_{it} + \varepsilon_{it}$$

For N cross-section units- i= 1, 2,….,

Periods T=1, 2,…., T

K are number of the explanatory variables- k = 2,…

β_k are the slope coefficients and are assumed to be constant over countries and time.

ε_{it} is the random error term for the i^{th} country and t^{th} year.

Y is a dependent variable and X an independent variable;

x_{kit} is an observation on the k^{th} explanatory variable for the i^{th} country and the t^{th} time period.

This model has the drawback that it assumes that all parameters are the same for each country, thus ignoring country specific factors.

In addition, the cross -section variation will drown the time-series effects.

Fixed Effect Models

Fixed effect model allows the intercept to change across groups (countries in our class) but the model will have constant coefficients (slopes). There will no importance sequential impact but important countries differences. The intercepts are cross section specific and differ from country to country, but they may not differ over time.

$$y_{it} = \beta_{1i} + \sum_{k=2}^{k} \beta_k x_{it} + \varepsilon_{it}$$

Where, β_{1i} represent the country specific effects. The intercepts are assumed different for individual countries but constant over time. This type of fixed effects model is called the Least Squares Dummy Variable model.

There are four other types of fixed effects models. One type of fixed effects model could have constant slopes but intercepts that vary according to time. A third type could have coefficient that are constant, but the intercept varies over the country and time. A fourth kind has differential intercepts and slopes varying according to the country. The last type is a fixed effect models in which both the intercepts and the slopes might are over time and across the countries.

The Random Effect Models

It is a regression model with a random constant term. The constant in this model is not fixed, but is an independent random variable. The model can be presented as follows,

$$y_{it} = \beta_{1i} + \sum_{k=2}^{k} \beta_k x_{kit} + \varepsilon_{it}$$

Where β_{1i} is an independent random variable with mean, β_{1i} and σ_{μ}^2

While $\beta_{1i} = \beta_1 + \mu_i$

Equation (3) becomes

$$y_{it} = \bar{\beta}_1 + \sum_{k=2}^{k} \beta_k x_{kit} + \mu_i + \varepsilon_{it}$$

In order to permit analyze to be carried out at aggregate military expenditure, the above regression model was estimated as panel data model- random effects and fixed effect models. (Gujarati, 2009) provides an extensive list of advantages of panel data:

1. The problem of heterogeneity in panel data units is solved by estimation techniques that allows for individual-specific variables.
2. Data gives "more informative data, more variability, less collinearity and greater degrees of freedom and more efficiency".
3. Panel data are more appropriate for investigating the dynamics of change.
4. Panel data can better detect and measure effects that cannot be observed in pure time series or pure cross-section data.
5. Panel data allows us to study behavioural models that are more complicated.
6. Panel data minimizes bias caused by aggregation of micro units' data.

Table 3. Apriori expectation of military expenditure determinant variables

S/N	Variable	Expected Signs
1	**Military factors**	
	a. External/Internal wars	+ / -
	b. Security web	+ / -
2	**Economic factors**	
	a. a. Gross Domestic Product	+
	b. Per capita Income	-
	c. Trade	+ / -
	d. Foreign exchange /Investment	+ / -
	e. Central government expenditure	+
	f. Arm trade	+ / -
3	**Political factor**	
	a. Military government	+
	b. Democratic government	-
4.	**Other factors**	
	a. Population	+
	b. Regional	+

Table 4. Description of Variables and data source

Variables	Definition	Sources
Key variables		
ME	Military expenditure (Share of GDP)	World Bank and Stockholm International Peace Research Institute new extended database 1946-2017
Ext.	External threats are classified as wars involving two independent countries	International Country Risk Guide (ICRG) database 1984 - 2017
Inter threats	Internal threats include Civil war[1], insurgency crisis and communal clashes	
POP	BRICS Population growth rate	World Bank Development Database 2018 **(WDI)**
Security Web	BRICS Security Web measured by averaging of the ratio of military expenditure to GDP of BRICS neighboring countries	
GDP	GDP per capita	
TB	Trade Balance	
Pol.	Political factor proxy was Democracy Index[2]	Polity IV database

6. Data Analysis and Interpretation

The summary of statistics is important to explore the time series distribution of the data collected on each of the variables. Table 5 indicate that all the variables used as determinants for military expenditure are positive. This reveals that on the average all the determinants are positive. This is a pointer to the fact that BRICS countries determinants are positive during this periods. The mean of military expenditure from the table is 2.111923 while the standard deviation is 1.348055. The mean distribution value is an indication that across the BRICS military expenditure is still relatively on the average because the mean distribution values for in between the upper and the lower limit. Again, the variance of 1.348055 is closer to the minimum limit than the

[1] An International war is differentiated from civil war, if it involve more than one country. To be called a war it must include 1,000 battle causalities in both cases.

[2] Democracy Index is an **index** compiled by the UK-based company the Economist Intelligence Unit (EIU) that intends to measure the state of **democracy** in 167 countries, of which 166 are sovereign states and 165 are UN member states.

maximum limit thus showing the data on military expenditure is not widely dispersed.

Table 5. Summary of Descriptive Statistics for determinant of military expenditure in BRICS countries

Variable	Obs	Mean	Std. Dev.	Min	Max
Me	240	2.111923	1.348055	0	5.503756
Internal	240	5.672019	4.255748	0	11.91667
External	240	6.521458	4.726551	0	12
security web	240	2.768716	1.452574	0	9.361947
GDP	221	7.987818	1.250257	5.430738	9.385589
TB	240	8.74e+07	2.15e+09	-5.31e+09	8.56e+09
Demo Index	240	1.491667	10.67276	-88	9
Exchrate	240	8.616337	13.17995	0	58.59785
Inflation	183	2.359151	1.418705	-1.05611	7.988791

Source: Author's computation

Table 6 presents the correlation matrix of the variables used in the study. Correlation matrix shows the degree of association and direction of relationship among the variables. The dependent variable (military expenditure) as a percentage of GDP. The degree of association that exists among the independent variables reveals that all independent variables can be included in the same model without the fear of multicollinearity.

Table 6. Correlation Matrix for determinant of military expenditure in BRICS

	Me	**Int**	**Ext.**	**Secweb**	**GDP**	**TB**	**Demo**	**Exch**	**Infl.**
Me	1.0000								
int.	-0.4740	1.0000							
ext.	-0.4273	0.9293	1.0000						
Secweb	0.1812	-0.2647	-0.2598	1.0000					
GDP	-0.1749	0.2978	0.3349	-0.0980	1.0000				
TB	0.2709	0.2137	0.1372	-0.0290	0.5324	1.0000			
Demo	0.0370	-0.1006	-0.0535	-0.2354	-0.0421	-0.0603	1.0000		
Exch	0.2283	0.0803	0.0847	-0.2737	-0.3978	0.0200	0.1646	1.0000	
Infl.	0.0998	-0.0284	0.0901	0.0501	0.2098	0.1673	0.0634	-0.1614	1.0000

Source: Author's computation

6.1. Panel Unit root test for Determinant of BRICS countries military expenditure

Various studies such as Kutu and Ngalawa, 2016; Omolade and Ngalawa, 2014 among others have advised researchers to always use more than one methods of panel unit root test in order to be sure of the order of integration of the variables to be included in a particular model. The reason behind this might not be unconnected to the fact that a non-stationary variable constitutes an outlier among other variable and the inclusion can significantly influence the outcome of the empirical analysis.

For this study both the IPS, LLC and ADF methods of Panel unit root tests are adopted for consistency sake. Their results are presented in table 7.

Table 7. Panel unit root tests for Determinant for BRICS countries military expenditure

	Levin et al. (2002)				Im et al. (2003)			
	Level		First Diff		Level		First Diff	
Variables	**Stat.**	**P-val**	**Stat.**	**P-val**	**Stat.**	**P-val.**	**Stat**	**P-val**
ME	-1.20247	0.1146	-10.3185	0.0000	-1.10034	0.1356	-10.4873	0.0000
INT.threat	-1.02950	0.1516	-15.9196	0.0000	0.17815	0.5707	13.4058	0.0000
EXT. Threat	-1.20438	0.1143	-16.0053	0.0000	0.11704	0.5466	-13.6685	0.0000
SECWEB	-1.39839	0.0810	-12.0931	0.0000	-1.67129	0.0473	-13.3773	0.0000
GDP	13.3771	1.0000	-1.57036	0.582	9.31774	1.0000	-3.81231	0.0001
TB	-2.67451	0.0037	-	-	-3.33891	0.0004	-	-
DEMINDEX	-1.876221	0.0303	-	-	-2.2048	0.0137	-	-
Exch	0.24073	0.5951	-12.9703	0.0000	0.15184	0.5603	-9.17874	0.0000
INF	-6.6041	0.0000	-	-	-5.80599	0.0000	-	-
Pop	1.05006	0.8532	2.88857	0.9981	2.02843	0.9787	-3.95287	0.0000

	ADF Fisher Chi Square				
	Level		First Diff		
Variables	**Stat.**	**P-val.**	**Stat**	**P-val**	**Status**
ME	14.1463	0.1664	108.814	0.0000	**I(1)**
INT.threat	6.14092	0.8033	143.486	0.0000	**I(1)**
EXT. Threat	6.31176	0.7884	145.900	0.0000	**I(1)**
SECWEB	17.5762	0.0625	141.552	0.0000	**I(1)**
GDP	4.01389	0.9467	57.9757	0.0000	**I(1)**
TB	33.3252	0.0002	-	-	**I(0)**
DEMOINDEX	22.5096	0.0041	-	-	**I(0)**
EXCh.	6.68203	0.7551	6.68203	0.7551	**I(1)**
INF	55.4634	0.0000	-	-	**I(0)**
Pop	2.26245	0.9939	34.6852	0.0001	**I(1)**

Source: Author's computation

It is evident from table 7 that all the variables are either stationary at levels or after the first difference. The implication of this is that they are suitable for all the analysis adopted in the study. The methods of panel unit root test give the same levels of integration for each variable. This speaks volume of the consistency level of the panel unit root results. Furthermore, the results indicate that apart from the trade balance, inflation, Demo index and Inf. that are stationary at levels, all other variables in the table are stationary after the first difference that is integration of order one I (1).

.2. Pool Regression Analysis for Determinant of Military Expenditure BRICS Countries

The essence of pool regression analysis is to verify if there will be need to use panel data analysis for the estimation of the equation or not. Panel data application might not be necessary if there is no problem of cross-sectional dependence. In other words, if the estimated pool regression model does not have specific effect then pool regression will suffice for the analysis but if otherwise then, panel data analysis is more suitable to be used for the estimation. One of the sort comings of the pool regression is the problems of heterogeneity which is not present in the panel data.

Table 8. Pool regression results for Determinant for BRICS countries military expenditure

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Demo_Index	0.014325	0.007229	1.981492	0.0487
Exch__Rate	0.049175	0.006123	8.031229	0.0000
External	0.079268	0.057617	1.375775	0.1702
Gdp	0.000101	2.41E-05	4.209215	0.0000
Inflation	0.000241	0.000253	0.950460	0.3429
Internal	-0.103914	0.059950	-1.733331	0.0844
Securityweb	0.434569	0.036863	11.78863	0.0000
Tb	5.13E-11	3.97E-11	1.292722	0.1974
R-squared	0.373526	Mean dependent var		2.110150
Adjusted R-squared	0.354542	S.D. dependent var		1.350604
S.E. of regression	1.085081	Akaike info criterion		3.034086
Sum squared resid	271.9794	Schwarz criterion		3.150453
Log likelihood	-354.5732	Hannan-Quinn criteria		3.080978
Durbin-Watson stat	0.348895			

Source: Author's computation

The results on table 8 is an indication that many of the variables have significant impact on ME as percentage of GDP. This is shown from the probabilities of the t statistics of each of the independent variables in the estimated model, which are significant at 5% level. Adoption of Gross Domestic Product particularly showed significant impact on Military expenditure. Notwithstanding, this approach of pool regression might not be sufficient to explain the relationship between the independent variables and the dependent variable because the results are prone to specific effects/heterogeneity influence which might undermine the reliability of the parameter estimates in the estimated model. Consequently, cross-sectional dependence test is conducted to ascertain if there is presence of specific effect in the result. The result of the cross-sectional dependence test is presented in table 9.

Table 9. Cross-sectional dependence test (Pool-ability test) for determinant for BRICS countries military expenditure

Residual Cross-Section Dependence Test			
Null hypothesis: No cross-section dependence (correlation) in residuals			
Test	Statistic	d.f.	Prob.
Breusch-Pagan LM	72.92935	10	0.0000
Pesaran scaled LM	12.95340		0.0000
Pesaran CD	-0.831331		0.4058

Source: Author's computation

The results from table 9 show that the null hypothesis is rejected and the alternative hypothesis that there is cross-sectional dependence in the estimated panel model is accepted. The implication of this result is that it is not appropriate to pool the data. Therefore, the pool regression results are not reliable for the purposes of forecasting and empirical inferences. Consequently, panel model approach is used to reduce the problem of cross-sectional dependence. The results of panel estimation are presented as follows:

6.3. Panel Data Estimation for Determinant of Military Expenditure in BRICS Countries

Following the results of the pool regression, it is obvious that there will be need for panel data estimation in other to get reduce the implications of the problem of cross-sectional dependence. Both fixed and random effects are used in this study to be able to ascertain the level of consistency in the panel results as well as investigating the approach that is more suitable for the nature of our data. The results of the fixed and random effects are presented in tables 10 and 11 respectively.

Table 10. Fixed effects panel results for determinant of military expenditure in BRICS

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Internal	-.0845414	.0555871	-1.52	0.130
External	.0626497	.0499752	1.25	0.211
Security web	.3381968	.0463219	7.30	0.000
GDP	.000222	.0000332	6.68	0.000
TB	2.12e-10	5.07e-11	4.19	0.000
Demo Index	-.0034721	.0066425	-0.52	0.602
Exchrate	.0022599	.0070385	0.32	0.748
Inflation	.0004513	.0002169	2.08	0.039
Cons	.1566255	.2011105	0.78	0.437
sigma_u | 1.3324109 sigma_e | .89206655 rho | .69048958 (fraction of variance due to u_i) --- F test that all u_i=0: F(4, 226) = 27.00 Prob > F = 0.0000				

Source: Author's computation

Table 11. Random effects panel results for determinant of military expenditure in BRICS

Variable	Coefficient	Std. Error	t-Statistic (Z)	Prob. P>|z|
Internal	-.1307021	.0605125	-2.16	0.031
External	.0973939	.0576178	1.69	0.091
Security web	.3584819	.0491526	7.29	0.000
GDP	.000075	.0000265	2.83	0.005
TB	7.39e-11	4.05e-11	1.82	0.068
Demo Index	.0172946	.0072763	2.38	0.017
Exchrate	.0433276	.0065718	6.59	0.000
Inflation	.0002008	.0002517	0.80	0.425
Cons	.4678524	.2022761	2.31	0.021
sigma_u | 0 sigma_e | .89206655 rho | 0 (fraction of variance due to u_i)				

Source: Author's computation

From tables 10 and 11 it is clear that there are similarities in the results of the fixed and random effects. Firstly, all the variables that are significant under the fixed effects are also significant under the random effects. That is security web and GDP are all significant in both estimated models. Notwithstanding, there coefficients are different slightly. The overwhelming similarities in the two results is an evidence of consistency in the results. Notwithstanding, HAUSMAN test is conducted to know which of the two estimated panel models is more suitable for this study. The results of the HAUSMAN test is presented in table 12.

6.4. HAUSMAN Test for Determinant of Military Expenditure in BRICS

As earlier said the results of the HAUSMAN test is to determine which of the fixed or random effect model is more suitable for the analysis. The results of the HAUSMAN test is presented in table 12

Table 12. HAUSMAN test for determinant of military expenditure in BRICS

Test Summary		Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random				
Cross-section random effects test comparisons:				
Variable	Fixed	Random	Var(Diff.)	Prob.
	(b) (B)	(b-B) Difference	sqrt(diag(V_b-V_B))	
Internal	-.0845414	-.1307021	.0461607	.0287306
External	.0626497	.0973939	-.0347442	.0175242
Security web	.3381968	.3584819	-.0202851	.0264584
GDP	.000222	.000075	.0001471	.0000301
TB	2.12e-10	7.39e-11	1.38e-10	4.57e-11
Demo Index	-.0034721	.0172946	-.0207667	.0033361
Exchrate	.0022599	.0433276	-.0410677	.0053624
Inflation	.0004513	.0002008	.0002505	.0000703

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg
Test: Ho: difference in coefficients not systematic
chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 74.37
Prob>chi2 = 0.0000
(V_b-V_B is not positive definite)

Source: Author's computation

The HAUSMAN test revealed that the chi square probability is significant at 5% level. This is an indication that the null hypothesis is rejected and the alternative hypothesis is accepted. The implication of the results is that fixed effect is more preferable for this study hence we go ahead to interpret the results of the fixed effects.

In conclusion, from the fixed effects results four variables have significant impacts on Military expenditure namely security web, GDP, inflation, and Trade Balance. The Security Web represents the variables that captured the possibility of arm race for each BRICS neighbours. The coefficient is significant and positive. The implication of this is that there is a positive significant relationship between activities of BRICS countries regarding arms purchase and that of their neighbouring countries.

Again, Economic growth is the most significant determinant for Military expenditure. The coefficient of Economic growth, which is proxy by GDP, is positive and significant. This indicates that BRICS countries economic growth is majorly responsible for drive to invest military expenditure. The implication is that the BRICS countries economic prosperity dicattes the levels of their investment in the military.

The third variable with significant effect on ME is the trade balance. From the results of the fixed effect the coefficient of the variable is positive and significant. It shows that there exist favourable trade transaction among the BRICS countries. This might be due to the fact that they all have active defence industries. The more positive trade balance the more effective government policies are implemented in the countries.

The fourth variable with the least significant effect on determinant of BRICS military expenditure is inflation. This indicates that rising BRICS military expenditure is inflation driven especially if military expenditure finance is through debt, this might be inflationary in nature.

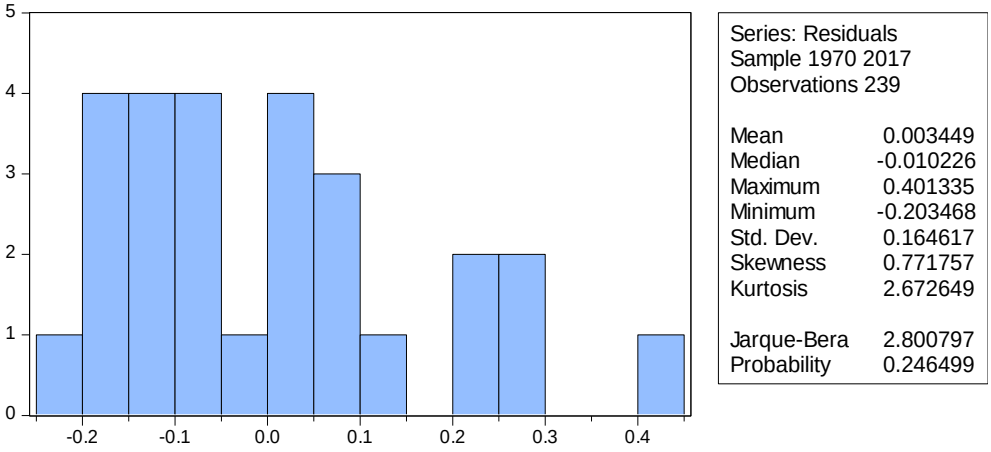
Finally, the overall results from the fixed effect reveal that four out of the eight variables considered in this study are significant. The significant variables are TB, security web and GDP. They are all significant at 1% and 5% respectively. While GDP effect on military expenditure under fixed effect is positive and significant. It is worthy of note that all variables under fixed effect have positive effect on military

expenditure. While GDP, security web, Trade balance are the major determinants of military expenditure under fixed effect, inflation is the least determinant.

6.5. Post Estimation Tests for determinant of military expenditure in BRICS

Some diagnostic tests are necessary for the panel data analysis. These tests are required to verify the validity of the parameter estimates .To ascertain the appropriateness of panel linear regression, the study conducts the normality test on the residual and the results is presented in figure 3.

Figure 3. Normality test for the determinants of Military Expenditure in the BRICS



Source: Author's computation

The result of the normality test shows that the probability value of the Jarque-Bera statistics of 0.246499 is greater than 5%, indicating that the residuals from the estimates are normally distributed. Again, the estimated panel result is re-verified for cross-sectional dependence the result is shown in table 13

Table 13. Pesaran's test of cross sectional independence

Test Statistics	Probability
-1.582	1.8862

Source: Author's Computation

The results from the table confirms the nonexistence of cross sectional dependence because the probability of the Pesaran's statistics is not significant. Therefore we accept the Null hypothesis of no cross-sectional dependence unlike what we saw in the pool regression analysis.

7. Conclusion

This section discuss the empirical result of the determinant for military expenditure of BRICS countries from 1970 to 2017 employing the panel data analysis approach. Based on the detailed theoretical and empirical literature on determinant for military expenditure, the neoclassical model was considered the best to analyzed determinant of BRICS countries military expenditure. BRICS countries political economy and security factors were incorporate for model specification. The determinant for military expenditure for BRICS include income, population, government expenditure, Security web (average military expenditure of neighboring countries within BRICS countries), internal threats and external threats. The economic, political and security factors are included. The empirical result suggest that BRICS countries military expenditure is mainly determined by its income, population, exchange rate, internal threats, inflation and political regime(proxy by democracy index).

The result reveal that BRICS policy makers if they are interested in reversing their high unemployment and poverty rate should focus their attention on these encouraging the local production of their arms/ammunition (military industries) which will create job opportunities for their teeming youthful population. This result is in line with the findings of (Tambudzai, 2011), (Brauer, 2002) and Hartley and (Sandler & Hartley, 1995).

In conclusion, non-military options should be adopted by the BRICS countries policymakers for attaining peace, which are cost-effective in ensuring peace and progress within and outside the BRICS country.

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