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MILITARIZATION, ECONOMIC GROWTH AND PETROLEUM CONSUMPTION IN BRAZIL, RUSSIAN, INDIA, CHINA, TURKEY, SOUTH AFRICA AND MEXICO

Abstract. *This paper aimed to test the dynamic relationship between economic growth, petroleum consumption and militarization in Brazil, Russian, India, China, Turkey, South Africa and Mexico for the period 1987–2013. It was used to the bounds test approach and it was determined whether there was a short and a long-run relationship among militarization, petroleum consumption and economic growth. ARDL test found that militarization and petroleum consumption has a positive and a statistically significant impact on economic growth. Further, it was applied the Granger causality and determined the evidence of bi-directional causal relation between variables. Lastly, the forecast-error variance approach corrected the obtained results*

KeyWords: *Petroleum Consumption, Defence Industry, Militarization, Economic Growth, ARDL, Variance Decomposition, Granger Causality.*

JEL classification: O1, C5, H5

1. Introduction

After World Wars I. and II., the scale and the capabilities of the defence industry changed in effect of new weapons in capable of immense destruction, economic growth, geopolitics location etc. and effected the petroleum consumption and economic growth. Nowadays continues to growth in the impact of economic growth, technological advances, infrastructural development, geopolitical competition etc.

Economic growth and geopolitical competition continues militarization races (Jorgenson et.al:2010; *Jorgenson et.al:2012*) and defence industry encourage petroleum consumption and economic growth. The relationship between the economic growth, petroleum consumption and defence industry is complex and relate with each other.

Especially, following World War II., petroleum consumption increase in effect of militarization with the new weapons developed by the scientist because military and defence industry consumes large amounts of petroleum in planes, ships, and tanks even, in peace time, in military institutions and their activities (*Jorgenson et.al:2012*). Moreover, the energy consumption of the military is increased by industries that produce marginal equipment for the armed forces.

While impact of energy consumption on militarization and economic growth are very important, empirical papers investigated the relation between economic growths, energy consumption and militarization via econometric models are scarce. There are a few paper analyzed the effects on energy consumption of militarism.

Although in perspective of energy and defence economics, the relation between energy consumption-economic growth and the relation between defence expenditure- economic growths were analyzed by many paper, the relation between petroleum consumption-economic growth and militarization was analysed by a few paper.

This study aims to analyze the causal relation among petroleum consumption, economic growth, and militarization in BRICTSM countries. This study can be considered as complementary of the studies in literature of energy and defence economics. Auto Regressive Distributed Lag Bounds(ARDL) test used to determine if economic growth, petroleum consumption and militarization are cointegrated for these countries in a stable manner for whole period. For long-run results, the paper used three different method: ARDLdeveloped by Paseran et.al(2001), the dynamic ordinary least squares (DOLS) developed by Stock and Watson(1993) and the fully modified ordinary least squares(FMOLS) developed by Phillips and Hansen(1990) models. To determine causality was used Granger causality methods. Lastly, it was used generalized foreast-error variance decomposition technique proposed by Pesaran and Shin (1998) to test the strength of the casuality analysis.

Literature review is given the second section. The relation between militarization, economic growth and petroleum consumption in BRICTSM countries show the third section. Data specifications and econometric methodology are identified in the fourth section. The fifth section consists of the empirical results while the last section includes conclusions and policy implications.

2. Literature Review

2.1. Treadmill destruction theory

Treadmill destruction theory investigated the environmental inequalities and degradation caused by militarization. Treadmill of destruction theory was inspired by the treadmill of production argued the increasing environmental degradation. The fundamental logic of the treadmill of destruction show concerns to environmental protection.

Treadmill of destruction theory show the energy consumption are positively associated with levels of militarization, measured by various national-level military characteristics. Theirs' results determine positive correlations between militarization and national energy consumption.

The treadmill of destruction theory shows that arm races expand militarization through technological innovation (Hooks and Smith 2005, 2004). This expansion is very important in terms of scope, breadth, and potency of military operations through investments in military research (Hooks and Smith 2005, 2004). Expanding military requires consumption of vast amounts of petroleum. Even outside of war, military institutions and their activities consume massive amounts of petroleum (Dycus;1996).

The effect of expanding militarization were used to analyse various econometric method.

Kentor's (2000) measure relative position in the international stratification system and includes per capita GDP, total GDP, military expenditures, military exports, global military control, trade dependence, foreign capital dependence, and military dependence. And so Kentor (2000) provides a proxy index in the form of standardized values (i.e. 'Z scores').

Hooks and Smith (2004, 2005) determined the relationships between the military, environmental degradation and energy consumption. According to theirs opinion, the military is significant energy consumer caused by its own expansionary dynamics.

Clark et.al(2010) used to panel data analysis and indicated that per soldier and military personnel consumed energy. According to their's results, energy consumption is positively associated with militarization and these relationships hold across all tested models.

Givens (2014) found the support to treadmill of destruction theory supported that military have an independently significant effect on environmental degradation.

2.2 The Literature of Relationships Between Economic Growth- Defence Expenditure and Economic Growth-Energy Consumption

Benoit (1978) showed that defence expenditure accelerated economic growth in less developed countries. In pursuit of this paper, many studies have tested the relation between defence expenditure and economic growth via single regression equations in frame of Neoclassical or Keynesian approaches and they determined that the results could be positive or negative. While the Neoclassical models based the supply-side effects, the Keynesian models based on the demand-side ones.

On the other hand, the causal relation between energy consumption and economic growth is very important in terms of economic growth since production without energy cannot be performed. Beaudreau (1995) determined that production is not possible without energy consumption. Not only production but also economic growth can not explain without energy. Moreover economic growth cannot be explained by the simple accumulation of capital invested since the 1950s (Ayres et.al 2007). In addition to unexplained economic growth, macroeconomic theory after 1950 remains insufficient to explain convergence in living standard.

Orthodox economists assumed that energy is an intermediate product of the economy. That is, capital and labor produce output and energy is intermediate that are subsequently converted into products and output(Bildirici:2015).

The orthodox growth model analyse to economic growth of countries with energy without energy. The growth models of Harrod (1939), Domar (1947), and Solow (1956) focus on investment, the capital stock, and the labor force without reference to natural resources. But economic growth cannot be explained by the simple accumulation of capital invested since the 1950s, many models of long-term economic activity assume that changes in the energy supply or demand have no significant impact on economic growth (*See Ayres et.al:2007 and Bildirici:2015 for detailed information*).

On the other hand, the economists have not completely ignored energy because of the oil crisis of the 1970s. Many papers challenged the assumptions about energy made by macro-economics textbooks and discussed the importance of energy in economic growth.

Kraft and Kraft (1978) found the relation between energy consumption and GNP as unidirectional causality from GNP to energy consumption. In pursuit of these pioneer studies, many papers tested the causal relation between energy consumption and GNP and has been investigated by different studies for different countries in different times again and again, despite of the usage of same variables were obtained the results with different coefficients and causality relationships even in the studies for the same countries[1].

[1]Following the above-mentioned discussion and investigation of the literature in terms of the differentiated results about the relation between energy consumption and economic growth and additionally in terms of the direction of the causality, it was formed four different hypotheses in the study. *Hypothesis 1:the growth hypothesis.* The growth hypothesis questions the determinacy of the significance of the impact of energy consumption on economic growth and further investigates if energy complements labor and capital in the production function. *Hypothesis 2: the conservation hypothesis*. Conservation hypothesis aims at testing if uni-directional causal link from economic growth to energy consumption exists. *Hypothesis 3: the feedback hypothesis*. Feedback hypothesis investigates the interdependent relationship between energy consumption and economic growth. The feedback hypothesis accept the presence of a two-way causal link between economic growth and energy consumption. *Hypothesis 4: the neutrality hypothesis*. Neutrality hypothesis is supported by the absence of causal link between economic growth and energy consumption. Their results are change and the difference in the results are mainly caused by the methods used.

Although the relationship between energy consumption-economic growth and military expenditure -economic growth were analysed by numerous papers, relationship between energy consumption and militarization was analysed by a few paper. But Bildirici (2015) and Bildirici(2016) tested these causal link . Bildirici (2015) investigated link among economic growth, energy consumption and militarization in China for the period 1987–2013. She determined the evidence of bi-directional causality between selected variables. Bildirici(2016) analysed the causal relationship among CO2 emissions, militarization, economic growth, and energy consumption for USA for the period 1960–2013. She found the evidence of a unidirectional causality running from militarization to CO2 emissions, from energy consumption to CO2 emissions, and from militarization to energy consumption all without a feedback was found.

However military and defence industrysector is important sector in energy consumption. Defence industry and militariesof all countries in the world consume a lot of energy.

3. Militarization and Energy Consumption in BRICTSM Countries

BRICTSM's economic growth are closely linked to the country's energy consumption, military and defence industry sector, and the rest of the world's energy consumption and economic growth is increasingly linked to BRICTSM's especially China's economic growth.

BRICTSM aim to develop comprehensive military modernization program designed to improve its armed forces' capacity (DOD:2015 see for China).In effect of economic growth, BRICTSM's defence industry sector has lived a dramatic change since the late-1990s, and its companies and research institutes continue to re-organize in an effort to improve weapon system research, development and production capabilities. And BRICTSM continue to develop a variety of capabilities designed to limit or prevent the use of space-based assets by adversaries during a crisis or conflict, including the development of directed-energy weapons and satellite jammers.

BRICTSM has a powerful and potentially destabilizing military force—a regional and a political superpower (Muldavin:1997) And theirs' military and defence industry sector consume large amounts of energy in planes, ships, and tanks. Even in peace time, military institutions and their activities consume vast amounts of fossil energy for research and development, maintenance, and operation of the overall infrastructure.

Military in BRIC-TSM countries employ equipment, personnel and advanced weaponry that require an enormous amount of fossil fuel energy to facilitate the rapid movement of troops. Modern high-tech military that are one of the major institutions of a vast infrastructure of advanced weapon-technologies, military bases and personnel consume a lot of energy, even during peacetime. Planes, helicopters, ships, tanks and armed vehicles etc. consume enormous amounts of fossil-fuel energy. BRICTSM's military force and defence industriesvoraciously consume energy.

4. Data Specifications and Econometric Methodology

4.1. Data specifications

The annual data used in this study span the period from 1987 to 2013 for BRICTSM countries. The petroleum consumption, defence expenditure, and real perCapita GDP variables are used.

Data were logged (ln) to minimize skewness and so all variables were measured in logarithms.

Defence expenditure (M) was used as measure of militarization (ML) and was taken from SIPRI. The petroleum consumption (C), defence expenditure (M), and real perCapita GDP (Y) variableswere taken from World Bank, World Development Indicators. Petroleum consumption data are measured in thousands of metric tons oil equivalent. Defence expenditure and perCapita GDPwas measured in constant 2005 US dollars.

4.2. Econometric Methodology

In this paper, the estimation process was constructed in seven steps. First, unit root test was used to determine whether the variables are I(0), I(1) or combination of I(0) and I(1). Although ARDL is a highly important approach for cointegration, it poses two shortcomings. First, it fails to provide robust results in the presence of I(2) beyond variables. In the second, ARDL assumes the existence of a unique cointegration vector. To dispel any doubt about the possible existence of multiple cointegration vectors, F test was applied for every variables. The optimal lag order was chosen. The lag order must be high enough to reduce the residual serial correlation problems morever, it should be low enough so that the conditional ECM is not subject to over-parameterisation problems (Pesaran et al., 2001; Wolde-Rufael, 2010 for over-parameterisation problems). After, the parameters were estimated by using an error correction model. In the fourth step, to check the results of ARDL model was used FMOLS and DOLSmethods. The CUSUM and CUSUM-Q plots was used to check the stability. The Granger causality method was used to specify the causality. And lastly, it was used generalized forecast error variance decomposition technique proposed by Pesaran and Shin (1998) to test the strength of the causality test.

4.2.1. ARDL Method

The ARDL models for the standard log-linear functional specification of a long-term relationship between variables are as follows:

$$\Delta \ln y_t = \alpha_0 + \sum_{i=1}^{m} \beta_i \Delta \ln y_{t-i} + \sum_{i=1}^{n} \phi_i \Delta \ln c_{t-i} + \sum_{i=1}^{k} \phi_i \Delta \ln m_{t-i} + \delta_1 \ln y_{t-1} + \delta_2 \ln c_{t-1} + \delta_3 \ln m_{t-1} + \varepsilon_{1t} \quad (1)$$

$$\Delta \ln c_t = \alpha_0 + \sum_{i=1}^{m} \beta_i \Delta c_{t-i} + \sum_{i=1}^{n} \phi_i \Delta \ln y_{t-i} + \sum_{i=1}^{k} \phi_i \Delta \ln m_{t-i} + \delta_1 \ln c_{t-1} + \delta_2 \ln y_{t-1} + \delta_3 \ln m_{t-1} + \varepsilon_{2t} \quad (2)$$

$$\Delta \ln m_t = \alpha_0 + \sum_{i=1}^{k} \phi_i \Delta \ln m_{t-i} + \sum_{i=1}^{m} \beta_i \Delta c_{t-i} + \sum_{i=1}^{n} \phi_i \Delta \ln y_{t-i} + \delta_1 \ln m_{t-1} + \delta_2 \ln c_{t-1} + \delta_3 \ln y_{t-1} + \varepsilon_{3t} \quad (3)$$

where Δ *and* ε_{1t} are the first difference operator and the white noise term, respectively. An appropriate lag selection is based on the Schwartz Information Criterion (SIC). The bounds testing procedure is based on the joint F-statistic or Wald statistic that tests the null hypothesis of no cointegration. The null hypothesis of no cointegration among the variables in Equation 1, 2, and 3 is $H_0: \ \delta_1 = \delta_2 = \delta_3 = 0$, against the alternative hypothesis, $H_1: \ \delta_1 \neq \delta_2 \neq \delta_3 \neq 0$. When the computed test statistic exceeds the upper critical bounds value, the H_0 hypothesis is rejected. If the F statistic falls into the bounds, then the cointegration test becomes inconclusive. If the F statistic is lower than the lower bounds value, then the null hypothesis of no cointegration cannot be rejected regardless.

4.2.2. Granger causality

If the variables are cointegrated, then the standard Granger causality test results will be invalid. In this case, the vector error correction model (VECM) should serve as a starting point for causality analysis.

The VECM used to analyze the relationships between the variables was constructed as follows:

$$\Delta \ln y = \alpha_0 + \sum_{i=1}^{m} a_{1i} \Delta \ln y_{t-i} + \sum_{i=1}^{n} a_{2i} \Delta \ln c_{t-i} + \sum_{i=1}^{k} a_{3i} \Delta \ln m_{t-i} + \zeta_{1i} ECM_{t-1} + e_t \quad (4)$$

$$\Delta \ln c = \alpha_0 + \sum_{i=1}^{m} h_{1i} \Delta \ln c_{t-i} + \sum_{i=1}^{k} h_{2i} \Delta \ln m_{t-i} + \sum_{i=1}^{p} h_{3i} \Delta \ln y_{t-i} + \zeta_{2i} ECM_{t-1} + e_t \quad (5)$$

$$\Delta \ln m = \alpha_0 + \sum_{i=1}^{m} b_{1i} \Delta \ln m_{t-i} + \sum_{i=1}^{p} b_{2i} \Delta \ln c_{t-i} + \sum_{i=1}^{n} b_{3i} \Delta \ln y_{t-i} + \zeta_{3i} ECM_{t-1} + e_t \quad (6)$$

where residuals e_t are independently and normally distributed (*i.i.d*) with zero mean and constant variance; $ECM_{t-1}$is the ECM term resulting from the long-run equilibrium relationship; and ζ is a parameter indicating the speed of adjustment to the equilibrium level after a shock. It shows how quickly variables converge to equilibrium and must have a statistically significant coefficient with a negative sign.

Granger causality can be examined in short-run Granger causalities by $H_0 : a_{2i} = a_{3i} = 0$ and $H_1 : a_{2i} \neq a_{3i} \neq 0$ in Equation (4) $H_0 : h_{2i} = h_{3i} = 0$ and $H_1 : h_{2i} \neq h_{3i} \neq 0$ in equation (5), $H_0 : b_{2i} = b_{3i} = 0$ and $H_1 : b_{2i} \neq b_{3i} \neq 0$ in equation (6) for all *i*.

5. Empirical Results

Table 1 gives unit root results obtained by PP and ADF. All variables were determined as I(1). In this condition, it can be mentioned from cointegration between variables

Table 1. The Results of Unit Root Test

	ADF		PP	
	Level	First Difference	Level	First Difference
Brazil				
Y	1.202	-5.045	1.334	-5.044
C	-1.7456	-3.104	-1.623	-3.101
M	-2.599	-5.398	-2.186	-14.094
Russian				
Y	-1.813	-5.112	-0.983	-5.103
C	-1.778	-4.950	-1.787	-4.988
M	-2.002	-3.701	-2.402	-4.819
India				
Y	1.302	-4.123	1.237	-4.1203
C	-1.028	-3.745	-1.026	-3.896
M	-2.114	-4.856	-2.102	-4.899
China				
Y	0.1392	-4.531	0.1389	-4.530
C	-0.178	-4.803	-0.416	-4.803
M	-1.106	-4.116	-1.684	-4.102
Turkey				
Y	-0.042	-5.669	0.1167	-5.714
C	-1.344	-5.758	-1.614	-5.654
M	-0.702	-4.927	-0.702	-4.927
S.Africa				
Y	1.380	-3.113	0.7304	-3.101
C	-2.226	-5.984	-2.340	-5.995

M	-2.106	-3.798	-2.408	-3.772
Mexico				
Y	1.118	-3.856	0.973	-3.9865
C	-1.008	-4.596	-1.263	-5.3896
M	-1.996	-5.423	-1.086	-6.9865

Table 2 shows the results of the ARDL bounds tests. Except Russian and Mexico, the null hypothesis can be rejected at the 1% and 5% level of significance when petroleum consumption is considered to be the dependent variable and other variables are the independent variables. In these countries if other variables are selected as dependent variables, the null hypothesis can be not rejected. In Russian, economic growth is determined as dependent variable and in Mexico, defence expenditure is behave as dependent variable. Other variables behave as independent.

ARDL results determined the existence of a unique long-term relationship among variables.

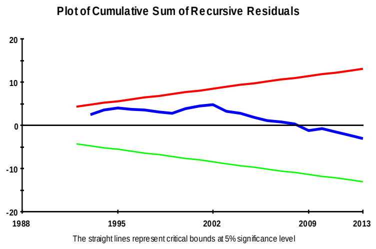
Table 2. Bounds Testing for Cointegration

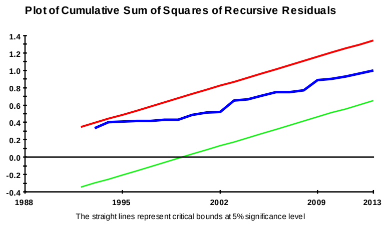
	F_y (y;c,m)	F_c (c;y,m)	F_m (m;c,y)
Brazil	0.8136	4.9905*	0.7129
Russian	7.3984*	2.5218	2.1602
India	1.1360	12.8677*	2.059
China	0.5682	8.5763*	0.8541
Turkey	0.3249	5.3322*	2.4876
S.Africa	0.5962	5.6347*	1.0973
Mexico	1.30689	2.9268	9.4685*

Stability of the Cointegration and Causality

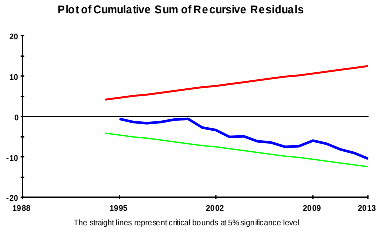
CUSUM and CUSUM-Q tests were implemented to determine whether the parameters in the models are stable. These tests do not require prior knowledge about the time of the structural breaks. Lines show the boundaries of 5% significance levels. The figures show that the parameters are stable; the sum of the squared residuals is inside of the critical bounds of 5% significance level.

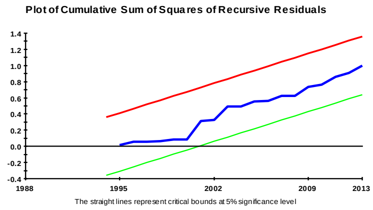
Figure 1: CUSUM and CUSUM-Q Stats





Brazil





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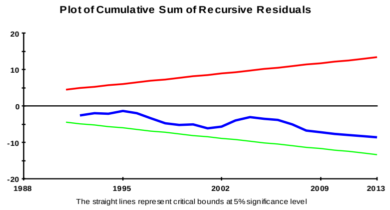
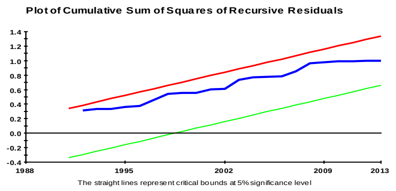
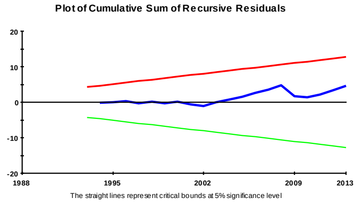
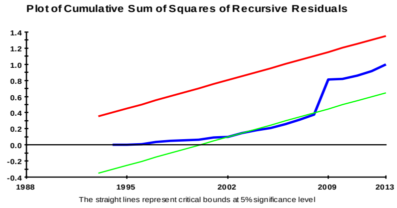


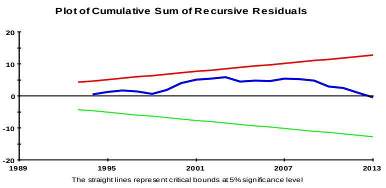


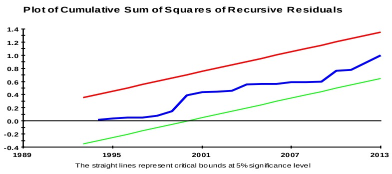
China



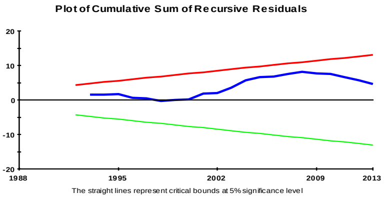


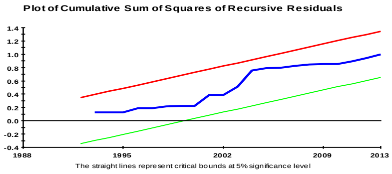
Russian



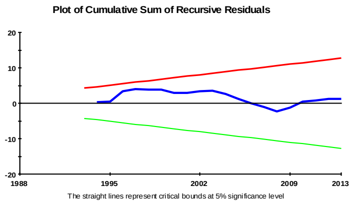


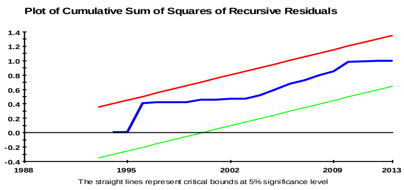
Turkey





S.Africa





Mexico

Long-run results

Table 3 displays the long-run elasticities. For countries except Turkey and China, ARDL, FMOLS and DOLS models gave similar results in sign and magnitude of coefficient for income elasticity.

The elasticities are interpreted as usual. For Brazil, India and China, the income elasticity of petroleum consumption was found ase> 1 in ARDL test (but for China and Brazil in all test), and income elasticity of petroleum consumption was determined as e<1 for Turkey and South Africa. Militarism elasticity of petroleum consumption was found as e <1 with positive sign in Brazil, China, Turkey and South Africa but negative sign in India. In Mexico, and income elasticity of military was determined as negative.

Table 3. Long-run Coefficients for ARDL

	ARDL			FMOLS			DOLS		
	y	c	m	y	c	m	y	c	m
Brazil	1.02 (2.2)	-	0.77 (1.87)	1. 23 (3.17)	-	0.55 (1.69)	1.07 (2.53)	-	0.99 (1.99)
Russian		-5.29 (3.3)	0.062 (3.54)	-	-2.263 (4.65)	0.04 (4.9)	-	-2.69 (4.9)	0.05 (5.04)
India	1.78 (2.16)	-	-0.123 (1.97)	1.57 (10.5)	-	-0.17 (2.9)	1.63 (9.8)	-	-0.16 (1.61)
China	1.13 (2.6)	-	0.65 (2.87)	0.85 (23.8)	-	0.03 (1.7)	0.86 (19.8)		0.019 (1.66)
Turkey	0.88 (1.7)	-	0.13 (2.6)	1.55 (7.87)		0.16 (1.9)	0.77 (2.5)		0.06 (1.91)
S.Africa	0.73 (3.1)	-	0.12 (1.89)	0.88 (4.9)	-	0.02 (3.5)	0.85 (4.9)	-	0.034 (2.7)
Mexico	5.21 (17.5)	-9.26 (2.5)	-	4.88 (5.8)	-9.05 (3.47)	-	5.2 (8.6)	-9.01 (2.5)	-

***The Error-Correction* Model**

ECM coefficients indicated a mechanism to correct the disequilibrium among variables are negative and change between -0.1447 and -0.753 to provide stability for the model. The ECM term showed a slow speed of adjustment to any disequilibrium toward long-run equilibrium in Russia, India, and China.

Table 4. The error-correction representation

	dy	dc	dm	ECM
Brazil	-0.5187 (2.871)	-	-1.5718 (2.0095)	-0.6817 (3.566)
Russian		0.0282 (2.199)	.0971 (2.102)	-0.1447 (2.332)
India	1.3251 (2.36)	-	0.1053 (2.896)	-0.2023 (3.85)
China	0.1658 (2.76)	-	0.2216 (2.103)	-0.1826 (3.07)
Turkey	0.3142 (1.874)	-	0.2051 (1.917)	-0.4107 (2.877)
S.Africa	0.5071 (1.978)	-	0.03142 (1.987)	-0.512 (2.228)
Mexico	2.929 (2.265)	-6.97 (2.16)	-	-0.753 (7.698)

Granger Causality Results

Table 5 summarizes the causality relationships between petroleum consumption, militarism and economic growth. The results of the Granger causality test determined the evidence of uni-directionalGranger causality from petroleum consumption to GDP in Russia and South Africa, and bi-directional causality in Brazil, China, India, Mexico and Turkey. In Russia, India, and South Africa. Unidirectional and bidirectional causality results , the energy conservation policies which reduce petroleum consumption adversely affect economic growth. Moreover bidirectional causality sign such fluctuations in economic growth will be transmitted back to petroleum consumption.

Meanwhile, there is the evidence of bidirectional causality between economic growth and militarization for Brazil, Russia, China, Mexico and India but there is the evidence of uni-direcional causality from economic growth to militarization in Turkey, and South Africa. In Russian, China, Mexico and South Africa, it was found the evidence of bi-directional causality between petroleum consumption and militarization but uni-directional causality from militarization to petroleum consumption in Brazil, India and Turkey.

Table 5. Results of Granger Causality for Oil Consumption and Economic Growth

	$\Delta y \to \Delta c$ $\Delta c \to \Delta y$	Direction of Causality	$\Delta y \to \Delta m$ $\Delta m \to \Delta y$	Direction of Causality	$\Delta c \to \Delta m$ $\Delta m \to \Delta c$	Direction of Causality
Brazil	8.1847* 5.4228*	Y ↔ C	3.1716* 2.5198*	Y ↔ M	0.7116 3.1227*	M→ C
Russian	1.0029 3.5969*	C→ Y	6.7642* 6.1921*	Y ↔ M	6.9976* 5.1983*	C ↔ M
India	3.105* 2.586*	Y ↔ C	6.8342* 3.8756*	Y ↔ M	0.5898 8.1763*	M→ C
China	3.2546* 3.1348	Y ↔ C	2.5618* 2.7642*	Y ↔ M	6.4652* 10.8342*	C ↔ M
Turkey	7.6957*	Y ↔ C	7.643*	Y→ M	0.401	M→ C

	2.9209*		0.7476		2.6987*	
S.Africa	0.5178 2.8186*	C→ Y	4.7282* 0.2642	Y→ M	6.0780* 5.7742*	C ↔ M
Mexico	33.114* 8.786*	Y ↔ C	11.03 33.56	Y ↔ M	22.56 12.82	C ↔ M

The causality results do not allow to gauge the relative strength of the Granger causality between the series beyond the sample period (Shan, 2005, Wolde-Rufael:2010). For this reason, it was decomposed the forecast-error variance of economic growth into proportions attributed to shocks in all variables in the system as suggested by Pesaran and Shin (1998). So it was obtained to the contributions of militarization and petroleum consumption to economic growth and the contributions of economic growth and militarization to petroleum consumption and the contributions of economic growth and petroleum consumption to militarization.

The causality results between GDP and militarization for Brazil, Russian, China and India were confirmed by the results of forecast-error variance.

Table 6. Forecast-Error Variance Decomposition Results

Brazil Dependent variable Δ lny				Dependent variable Δ lnc			Dependent variable Δ lnm		
Horizon	Δ y	Δ lnc	Δ lnm	Δ y	Δ lnc	Δ lnm	Δ y	Δ lnc	Δ lnm
0	1.00	.347	.204	.347	1.00	.018	0.203	0.017	1.0
1	.873	.218	.318	.485	.896	.321	0.598	0.202	0.99
5	.909	.305	.471	.496	.986	.485	0.607	0.398	0.981
10	.890	.241	.509	.124	.875	.428	0.510	0.297	0.851
Russian Dependent variable Δ lny_t				Dependent variable Δ lnc				Dependent variable Δ lnm	
Horizon	Δ y	Δ lnc	Δ lnm	Δ y	Δ lnc	Δ lnm	Δ y	Δ lnc	Δ lnm
	1.00	.387	.118	.039	1.00	.053	.118	.052	1.00
1	.984	.401	.373	.062	.993	.246	.227	.251	.929
5	.827	.214	.347	.093	.868	.321	.361	.346	.919

10	.655	.106	.209	.054	.585	.229	.193	.244	.906
India Dependent variable Δ lny_t				Dependent variable Δ lnc			Dependent variable Δ lnm		
Horizon	Δ y	Δ lnc	Δ lnm	Δ y	Δ lnc	Δ lnm	Δ y	Δ lnc	Δ lnm
0	1.00	.052	.011	.152	1.00	.198	.169	.002	1.00
1	.987	.089	.207	.183	.956	.207	.269	.002	.999
5	.934	.074	.346	.263	.742	.309	.365	.006	.997
10	.911	.016	.260	.353	.652	.110	.165	.012	.991
Chına Dependent variable Δ lny_t				Dependent variable Δ lnc				Dependent variable Δ lnm	
Horizon	Δ y	Δ lnc	Δ lnm	Δ y	Δ lnc	Δ lnm	Δ y	Δ lnc	Δ lnm
0	1.00	.016	.231	.117	1.00	.014	.230	.013	1.0000
1	.999	.017	.319	.213	.997	.308	.231	.213	.999
5	.994	.023	.386	.306	.972	.384	.333	.310	.999
10	.984	.032	.258	.204	.940	.222	.234	.209	.997
Turkey Dependent variable Δ lny_t				Dependent variable Δ lnc			Dependent variable Δ lnm		
Horizon	Δ y	Δ lnc	Δ lnm	Δ y	Δ lnc	Δ lnm	Δ y	Δ lnc	Δ lnm
0	1.00	.1068	.011	.069	1.00	.174	.211	.174	1.00
1	.996	.295	.095	.124	.979	.373	.253	.001	.994
5	.972	.357	.051	.337	.809	.417	.405	.025	.908
10	.953	.287	.025	.488	.660	.119	.526	.061	.767
S.Africa Dependent variable Δ lny_t				Dependent variable Δ lnc				Dependent variable Δ lnm	
Horizon	Δ y	Δ lnc	Δ lnm	Δ y	Δ lnc	Δ lnm	Δ y	Δ lnc	Δ lnm
0	1.000	.0149	.006	.014	1.00	.047	.069	.047	1.00
1	.947	.180	.017	.029	.991	.233	.205	.233	.995
5	.696	.279	.013	.104	.928	.319	.303	.319	.963
10	.567	.349	.022	.185	.866	.116	.202	.202	.941
Mexico Dependent variable Δ lny_t				Dependent variable Δ lnc			Dependent variable Δ lnm		
Horizon	Δ y	Δ lnc	Δ lnm	Δ y	Δ lnc	Δ lnm	Δ y	Δ lnc	Δ lnm
0	1.00	.243	.000	.243	1.00	.003	.000	.000	1.00

			1			5	1	4	
1	.994	.283	.001 2	.363	.936	.024 4	.032 8	.048 6	.839
5	.983	.341	.001 4	.558	.815	.038 4	.103	.093 0	.613
10	.976	. 371	.000 9	.671	.735	.029 5	.151 1	.085 6	.554

The results of variance decomposition analysis were given in Table 6. Almost a quarter of the forecast-error variance of economic growth is explained by petroleum consumption's forecast-error variance in Brazil, Russian, Turkey, South Africa and Mexico. In 5th period, around 42% of the forecast-error variance of petroleum consumption is explained by the forecast-error variance of militarization in Turkey and 31% for India, 38.4% for China and 49% for Brazil. On the other hand, around 39.8% of the forecast-error variance of militarizationis explained by the forecast-error variance of petroleum consumption in Brazil and31.9% of South Africa and 34.6% in Russian.

6. Conclusion

The ARDL approach was employed to examine the relationship between economic growth, militarization and petroleum consumption in BRICTSM countries. The long-run elasticities were used to fourth different method: ARDL, FMOLS and DOLS models.

There is the evidence of bi-directional causality between economic growth and militarization for Brazil, Russia, China, Mexico and India but there is the evidence of uni-direcional causality from economic growth to militarization in Turkey, and South Africa. In Russian, China, Mexico and South Africa, it was found the evidence of bi-directional causality between petroleum consumption and militarization but uni-directional causality from militarization to petroleum consumption in Brazil, India and Turkey.

Our results determined that the impact of militarization on energy consumption and economic growth is very important.

The results obtained from forecast-error variance supported to the contribution of militarization and petroleum consumption to economic growth and the contribution of economic growth and militarization to petroleum consumption and the contribution of economic growth and energy consumption to militarization.

The results of this paper imply that militarization are very important to sustain economic growth and petroleum consumption. Furthermore petroleum consumption and militarization play a crucial role on the economic growth as a key factor. BRICTSM countries must have the right balance between economic growth, militarization and petroleum consumption. Since petroleum consumption is an important factor in these countries, they must strive to substitute for other cheaper and clean indigenous sources.

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