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MILITARY EXPENDITURES AND ECONOMIC GROWTH IN SELECTED DEVELOPING COUNTRIES: CAUSALITY ANALYSIS USING PANEL ERROR-CORRECTION APPROACH

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Abstract: *This paper examines the causality between military expenditures and economic growth for twenty selecteddeveloping countries. In this paper we test for* Granger *long-run causality employing the Panel Error-Correction Model (ECM) framework using annual data for the period 1970 to 2005. Military expenditure is measured using the logarithm of the ratio of military expenditures to gross domestic product (*milex*); while economic growth is proxied by the logarithm of real GDP per capita (*rgdppc*). Causation (as well as cointegration) is inferred from* milex *to* rgdppc*, in a panel setting using the Pooled Mean Group (PMG) estimator proposed by Pesaran et al. (1999) when the Error-Correction (ECM) term is significant in an equation with* rgdppc *as dependent variable. On the other hand,* Granger *causality is said to run from* rgdppc *to* milex*, when the ECM term is significant in an equation with* milex *as dependent variable. However, before testing for cointegration or causality, the order of integration of both time-series in a panel setting was tested using the three standard panel unit root tests (Levin et al., 2002; Im et al., 1997; Maddala and Wu, 1999). Our PMG results suggest that the ECM term is significantly different from zero in a model when* milex *is the dependent variable but not otherwise. The result implies that there is cointegration between military expenditures and economic growth, on average, for all the selected developing countries. The result thus suggests that there is one-way* Granger *causality running from economic growth to military expenditure for the selected developing countries under study for the period 1970-2005.*

JEL Classification: H5, H56, O53, O54

Keywords: Military expenditures, Economic growth, Causality, Pooled Mean Group, Developing countries

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1. INTRODUCTION

Is defense spending related to economic growth? This question has important implication for policy makers and researchers. From the viewpoint of the researchers, the question of whether military spending causes economic growth or otherwise has important implication for empirical work. Nevertheless, the direction of causation between the defense spending and economic growth has no specific prediction. In general, studies have found that defense spending can influence an economy both negatively or positively. Defense spending can affect economic growth through a number of channels. For example, defense spending can affect an economy either positively as per the finding of Hassan *et al.* (2003), through an expansion of aggregate demand or through increase security, and negatively (Deger, 1986) through a crowding out of investment. On top of that, there are findings showing no meaningful relationship as found by Galvin (2003) and Yildirim *et al.* (2005). In some cases, the results are mixed as found by Kollias, Manolas and Paleologou (2004) and Dakurah *et al.* (2000).

For the policy makers, the impact of military expenditure on economic growth which can be positive or negative can have different ramification with respect to what strategy to take to foster growth. A positive relationship between defense spending and growth and the line of causation that runs from defense spending to economic growth implies that defense spending stimulate economic growth. In this respect defense spending enhances aggregate demand by increasing purchasing power and produces positive spin-off effect. DeGrasse (1993) argues that defense spending generates contract awards which generate jobs and increase purchasing power of workers. The increased purchasing power will lead to more demand. Thus, through this process of increasing aggregate demand and employment, defense spending helps economic growth. On the other hand, Deger (1986) points out that in the less developing countries (LDCs), military may help in creating a socioeconomic structure conducive to growth. In this aspect, military may engage in research and development, provide technical skills, educational training and create an infrastructure necessary for economic development. With respect to negative impact of military expenditure on growth, economists focus on the opportunity cost of military spending, that is military expenditures hinder economic development by reducing savings and misallocating resources away from more productive use in the public or private sector (see Deger, 1986; Deger and Smith, 1983).

The purpose of the present paper is to determine empirically whether military spending is related to economic growth in twenty (20) selected developing countries. The selected countries are Algeria, Benin, Burkina Faso, Cameroon, Egypt, Indonesia, Iran, Kuwait, Malaysia, Mauritania, Morocco, Nigeria, Pakistan, Saudi Arabia, Senegal Sudan, Syria, Togo, Tunisia, and Turkey. Our paper contributes to the present literature on defense spending-economic growth nexus by applying the panel error-correction model proposed by Pesaran *et al.* (1999) to concur causality in a panel data framework between military expenditure and economic growth. The plan of the paper is as follow. In the next section we review related empirical work on the defense spending-economic growth nexus. In section 3, we provide the method of estimation and in section 4, we discuss the empirical results. The last section contains our conclusion.

2. REVIEW OF RELATED LITERATURE

Since the early 1970s, numerous studies on causality between military spending and economic growth have been conducted. Benoit (1973, 1978) pioneered the empirical work on this issue. The author found that there is a positive correlation between military expenditure and economic growth in 44 less-developed countries that he studied. Since then, there are many studies attempting to evaluate the impact of military expenditure on economic growth, and most the results are often mixed and ambiguous.

It cannot be denied that the result on how military spending influences growth lack of consensus. Empirical evidence tends to vary across countries and over time, and the results are sensitive to the underlying theoretical framework. Most common findings are that military spending has no significant impact, either positive or negative, on economic growth.

A new explanation of the Benoit hypothesis on endogenous growth and military expenditure is provided by Shieh *et al.* (2002). They develop an endogenous model to examine the linkage between economic growth and military expenditure. They implement the modeling strategy where both the demand side and supply side effects of national military are taken into consideration. They found that an increase in military expenditure has a tendency to stimulate the continuous growth rate and it is conforming to Benoit's famous empirical finding.

Deger (1986) found negative relationship between military expenditure and growth in the least developed countries (LDCs), citing that military expenditure takes resources away from productive investments and fails to mobilize and create additional savings. Other empirical studies that found insignificant relationship as well as the adverse effects of military spending on the economy include studies by Faini *et al.* (1986), Deger and Sen (1983) and Deger and Smith (1983).

Dakurah *et al.* (2000) studied 62 LDCs and found those 10 cases causality runs from growth to military; 7 countries suggesting bidirectional causality, 13 countries showed unidirectional causality from military expenditure to growth and 18 countries showing independencies. Studies by Kollias, Manolas and Paleologou (2004) on 15 EU countries suggest mixed results in term of causal direction. Most of the countries in EU showed unidirectional causality from growth to spending expenditure. They conclude that an EU government derives military expenditure based on the economic performance. Another study by Kollias, Naxakis and Zarangas (2004) suggest the presence of instantaneous bi-directional causality between military expenditure and growth for the case of Cyprus from 1964 – 1999. They used cointegration and causality test to analyze the causal relationship between the variables involved.

Galvin (2003) studies the defense spending and economic growth relationship using cross-section data for 64 developing countries. The author examines the impact of military expenditure on economic growth with a supply and demand side model. The author used simultaneous equation methodologies (2SLS and 3 SLS)in order to test the robustness of the results.The author intends to replicate the results of these conclusions to changes in model specifications and samples size that werefound previously. With three simultaneous equation models - the growth equation, the saving equation and the defense equation,their results show that, when taking all interdependent effect together, the impact of increases military burden reduce the growth rate within both income groups. The author concluded that wealthier countries have less to gain from the military because those countries have a more productive worker and have more developed infrastructure in terms of communications and domestic markets.

Hassan *et al.* (2003) examine the impact of the military expenditure on economic growth and FDI covering five of seven South Asian Regional Cooperation Council (SAARC) nations using panel data over the 1980-1999 periods. The result suggests that there is a positive relationship between military expenditure and economic growth, which support the view that military expenditure can bring positive impact on growth.

By extending Barro and Sala-i-Martin model to account for the impact of military expenditure on growth for a cross section of countries, Aizenman and Glick (2006) study the long-run impact of military expenditure on growth. They suggest that military expenditure induced by external threats should increase growth, while military expenditure induced by rent seeking and corruption should reduce growth.

India and Pakistan have been in constant conflict with each other since their separation in 1974. In 1974 the division of the country was mainly due to religious differences, breakdown in the political system, economic and social of the country. Yildirim and Ocal (2006) study the issue of arms race between Pakistan and India and their relations to each country's economic growth. The authors found that there is a unidirectional causal relationship between economic growth and military expenditure forPakistan and India. Reitchuler and Loening (2005) study on Guatemala using Feder-Ram model to investigate between linear versus non-linear function. The authors propose that the linear model show insignificant effect on growth. However the results were changes using non-linear model. They also found that at low threshold there is positive effect on growth and beyond the threshold, it turns negative. However, military is less productive than the civilian sector (non-military sector).

The intrinsic value of national security is perhaps the most important argument for military spending. Definitely, national security allows for productive economic activities to be carried out without fear of foreign appropriation. Thus, military spending is expected to provide national security and subsequently enhance economic growth in the long-run (Ram, 1996). Bader *et al.* (2003) found negative effect between military burden and economic growth in Egypt, Israel and Syria. They also found that civilian expenditure caused positive economic growth in Israel and Syria.

In the context of Asia, Moon and Hyun (1992) found through disaggregated analysis the effect of heavy military to have entailed negative implications for growth, distribution and economic stability. Chan (1992) suggests that military spending has not been the direct determinant of Taiwan's economic growth despite heavy burden on military. The study by Chowdhury (1991) on causal relationship between economic growth and military spending which covers 55 developing countries and by using the Granger causality test, found out that the relationships between military spending and economic growth cannot be generalized across the 55 developing countries.

Narayan *et al.* (2007) select Fiji Islands to examine the nexus between military expenditure and GDP. They investigate Fiji Island because Fiji's is unique for a numbers of reasons: (1) Fiji have a small open economy with0.8 million of population; and (2) despite facing minimum threat from external military forces Fiji has the largest military force in the South Pacific Island region. Their study covers the period from 1970 and 2001. In this study, they use several estimators; (1) the ordinary least squares, the autoregressive distributed lag (ARDL); (2) the dynamic ordinary least squares (DOLS) and fully modified (FMOLS) ordinary least squares approach to determine the robustness of the long-run results. They predict that military expenditure might enhance Fiji's economic growth. When using the bound test, they found one cointegration relationship between variables when GDP was the endogenous variable.Based on the long-run elasticitiesresultsboth military expenditure and exports had a positive impact on Fiji's GDP. They also found that exports Granger cause GDP and military expenditure Granger cause export positively.

They further suggest three policy implications in their findings. First, they found different results compared with the volume of the literature on developing countries which military expenditure has positive impact on economic growth, the results are consistent with the Keynesian school of thought. Second, they found in the short-run, military expenditure Granger cause exportspositively. Which in turn positively Granger cause GDP, implies that Fiji provides significant military services at overseas missions given that defense spending makes upon only 2.3% of GDP. Third, they found that both export and military expenditure Granger-cause GDP implies that increasing Fiji's export and securing overseas missions will enhance economic growthin the long-run.

Lee and Chen (2007) re-investigate the long-run co-movements and the causality between military expenditure and GDP in a multivariate model with real military expenditure per capita (ME), real GDP per capita (GDP) and real capital stock per capita (K). They were using data for 27 OECD countries and 62 non-OECD countries for the period of 1988 - 2003. Using aggregate production function, they create the empirical model and combined the cross-sectional and time-series data to re-examine the relationship between military expenditure and GDP. Their result suggests positive relationship between GDP and military expenditure for OECD countries, where a negative relationship from military expenditure to GDP exist in non-OECD countries under examination. They also determine that military expenditure and GDP need short-run causality but do show long-run bidirectional causalities in both OECD and non-OECD countries by employing the dynamic panel-based error correction model.

Before 1980s, the long separation of Taiwan from China bred hostility, which led to a significant increase in military expenditure to GDP. Lai *et al.* (2005) examine the relationship between national military expenditure and economic growth for China and Taiwan by employing both non-linear and linear models. They were using data from 1953 to 2000 on GDP, capital, military expenditure, GDP, import and export. They found that the results of the linear models shows1) China's spending growth leads economic growth, 2) Economic growth and Taiwan's spending display feedback relations and 3) Granger cause was found from China's spending growth to Taiwan's spending. They also use rival's spending growth as the threshold variable to look at the causal relationship. They found that there exists feedback relation (an arms race) when China's spending growth exceed the 3% threshold values.

Stroup and Heckelman (2001) estimate the influence of military expenditure on growth in African and Latin American countries. They employed panel data analysis for 44 countries in African and Latin American countries from 1975 to 1989. They found low levels of military expenditure increasing economic growth but higher levels of military expenditure decreasing growth, the defense burden on economic growth is non-linear, and found empirical evidence that the defense burden in these two country has a non-linear influence on economic growth, changing from positive to negative as military expenditure represent an ever-higher proportion of GNP. They also found that the influence of military labor use on growth is similarly non-linear and depends upon the level of male education attainment in a country. They used Barro's neoclassical model for economic growth as a starting point because the model on growth specification includes variables designed to control for differences in institutional influences across countries.

Study by Cuaresma and Reitschuler (2003),discuss the impact of military expenditure on GDP growth in the US by estimating two fairly general models that had been discussed in Deger (1986) and Biswas and Ram (1986). They present evidence of a level dependent effect of military expenditure on growth using longitudinal data for the US economy. They used yearly frequency data and spanningfrom 1929-1999 for all variables. The variables are growth rate of saving, growth rate of the labor force, growth rate of export and the growth rate of military expenditure. There is a positive externality effect and a negative size effect for low levels (relative to the estimated threshold) of defense spending based on the non-linear generalization results and they indicated that there is a positive externality effect, and the externality effect sign and the size effect disappears for high levels. Using linear methods tends to show exclusively one distorted "side of the coin" of the defense-growth nexus based on the quantitative results. The data strongly rejected the linear specification, taking account the lack of uniformity of the effect of military expenditure on GDP growth and approaching the problem using non-linear methods.

Yildirim *et al.* (2005) investigate the effects of military expenditures on economic growth for Turkey and Middle Eastern for the time period, 1989 to 1999. They used cross-sectional and dynamic panel estimation techniques to investigate the relationship between military expenditure and economic growth. They also investigated the income growth-military expenditure relationship for low, middle and high income countries to see if this relationship differs with the income level of the countries.Their analysis indicated that military expenditure boost economic growth in the Middle Eastern countries and Turkey. They also suggest that the factor productivity differentials are positive, that means it implies that the military sector is more productive than the civilian sector. Thisis becausethe military sector uses high technology compared with the rest of economies in the Middle East. Overall, their conclusions are consistent with the related literature which uses the Feder model, finding no effect of military expenditure on economic growth or positive effect.

3. METHODOLOGY

Since the annual data available in our study ranges from 1970 to 2005 (35 observations), the short time dimension of the available data on a country level hinders robust estimates with classical time-series econometrics. Panel econometrics are said to allow a substantial gain in power and furthermore, panel estimators are proven to deal better with the problem of measurement bias (Baltagi *et al.*, 1995). Pesaran *et al.* (1999) propose the Pool Mean Group (PMG) estimator which is essentially a dynamic error-correction model that allows the short-run parameters to vary across countries (Groups), while restricting long-run elasticities to be identical across countries. An alternative technique, the Mean group (MG) estimator, also discussed in Pesaran *et al.* (1999) involves simply the estimation of separate equations for each country and the computation of the mean estimates, without imposing any constraint on the parameters. However, if some parameters are the same across groups, efficiency gains are made by taking this into account.

To illustrate the method, we start with the following long-run relationship with say, $rgdppc_t$ denotes economic growth and $milex_t$ denotes military expenditures

$$rgdppc_{it} = \theta_{0i} + \theta_{1i}\, milex_{it} + \epsilon_{it} \tag{1}$$

For simplicity, assuming a maximum lag order of one, we can re-write Equation (1) as an autoregressive distributed lag (ARDL) (1,1) as follows

$$r\,gdppc_{it} = \mu_{\mathrm{i}} + \delta_{1i}\, milex_{it} + \delta_{2i}\, milex_{it-1} + \lambda_i\, r\,gdppc_{it-1} + \varepsilon_{it} \tag{2}$$

The subscripts i = 1, 2, ..., 20 stand for 20 developing countries, the subscripts t = 1970, 1971,..., 2005 for the years 1970 to 2005, μ_i represent the fixed effects due to the parameter θ_{0i}, and δ_i are the coefficients of the explanatory variables and λ_i the coefficient of the lagged dependent variable.

Rewriting Equation (2) in an error-correction form yields

$$\Delta r\,gdppc_{it} = \phi_i (r\,gdppc_{it-1} - \theta_{0i} - \theta_{1i}\, milex_{it-1}) + \delta_{1i}\, \Delta milex_{it} + v_{it} \tag{3}$$

where $$\theta_{0i} = \frac{\mu_i}{1-\lambda_i},\ \theta_{1i} = \frac{\delta_{1i} + \delta_{2i}}{1-\lambda_i},\ \text{and}\ \phi_i = -(1-\lambda_i).$$

Imposing the same long-run coefficients in Equation (1) implies that in the long-run the elasticities of economic growth with respect to military expenditures will be the same across countries. The long-run causality between defense spending and economic growth can be infer from the sign and the significant of the error-correction term ϕ_i. A significant and negative sign of ϕ_i suggest that military expenditures causal effect economic growth. Country heterogeneity is accounted for by allowing different short-run dynamics in each cross sectional unit.

Pesaran *et al.* (1999) point out that three econometric techniques seem to be suitable to estimate ARDL models such as Equation (2): Mean Group (MG), Pooled Mean Group (PMG) and Dynamic Fixed effects (DFE). With both *T*, the number of time-series observations, and *N*, the number of groups, quite large, all three methods produce consistent estimates of the coefficients, though these estimates will be inefficient (and biased) when specific homogeneity assumptions hold. The MG estimator is consistent and imposes no restrictions at all, and thus provides a standard of comparison. The traditional pooled estimators such as the DFE constraint the coefficients and the error variances to be the same across groups. Only the intercepts are allowed to differ from group to group. These estimators may cause substantial efficiency losses when only long-run homogeneity assumptions are valid. The PMG has the advantage over the DFE and the MG model in that the short-run dynamics (and the error variances) are allowed to differ freely while the long-run slope coefficients are assumed to be equal across groups.

The test of the homogeneity of the long-run coefficients is provided by a Hausman test. This is based on the null hypothesis that the two set of coefficients generated by the PMG and MG estimators are not statistically different. Under the null hypothesis this statistic is asymptotically distributed as a χ^3 (p), where p is the number of parameters. The lag order of the ARDL model for each country covered is selected by the Schwarz Bayesian Criterion (SBC) subject to a maximum lag of two. Based on these SBC determined lag orders long-run homogeneity is imposed.

Sources of data

In this study we use annual data that span from 1970 to 2005. The developing countries included in the study are Algeria, Benin, Burkina Faso, Cameroon, Egypt, Indonesia, Iran, Kuwait, Malaysia, Mauritania, Morocco, Nigeria, Pakistan, Saudi Arabia, Senegal Sudan, Syria, Togo, Tunisia, and Turkey. Data on the share of military expenditure to gross domestic product and real gross domestic product per capita are collected from various issues of the Stockholm International Pearce Research Institute (SIPRI, 1975, 1977, 1985, 1990, 2006, 2008) Yearbook published by Oxford University Press. All variables were transformed into natural logarithm.

4. EMPIRICAL RESULTS AND DISCUSSIONS

Test for Panel Unit Root

Before testing for causality between economic growth and military expenditure using the panel error-correction approach, it is essential to determine the order of integration for each of the series. The popular single equation standard ADF tests used to test for the presence of unit roots has been criticised for lack of power. Some authors recognised that the power could be significantly improved if panel data are used instead of a univariate time-series (Levin *et al.,* 2002; Im *et al.,* 1997). Furthermore, the panel approach appears extremely appealing because the inclusion of a limited amount of cross-sectional information induces significant improvement in term of power. For the panel unit root test procedures, Levin *et al.* (2002) proposed to perform the augmented Dickey-Fuller tests based on the following regression model. For a sample of N groups observed over T time periods, the panel unit root regression of the ADF test is written as

$$\Delta y_{it} = \alpha_i + \beta_i y_{it-1} + \sum_{j=1}^{p_i} \gamma_{ij} \Delta y_{it-j} + \varepsilon_{it}, \qquad i = 1,\ldots,N, \qquad t = 1,\ldots,T \tag{4}$$

where α_i, β_i and γ_{ij} are parameters and the error terms ε_{it} are uncorrelated across regions. y_{it} = rgdppc or milex. The Levin-Lin-Chu tests for the $H_0 : \beta_i = 0$ against $H_a : \beta_i < 0$. Under the null hypothesis, they show that the test statistics, t^* is asymptotically distributed according to the standard normal distribution.

On the other hand, Im *et al.* (1997) extent the work of Levin et al. (2002) to allow for heterogeneity in the value of β_i in Equation (4). Im et al. (1997) proposed a *t*–bar statistic, which is based on the average of the individual ADF *t*–statistics.

The null hypothesis of a unit root in the panel data is defined as

$$\beta_i = 0, \text{ for all } i \tag{5}$$

against the alternatives that all series are stationary processes

$$\beta_i < 0,\ i = 1,2,\ldots,N_1;\ \beta_i = 0,\ i = N_1 + 1, N_2 + 2,\ldots, N. \tag{6}$$

This equation of the alternative hypothesis allows for $\beta_i = \beta < 0$ for all i. To test the hypothesis, Im et al. (1997) propose a standardised *t*–bar statistic given by

$$\Psi_{\bar{t}} = \frac{\sqrt{N}\left\{\bar{t}_{NT} - (1/N)\sum_{i=1}^{N} E\left[t_{i,T}(p_i,0) \mid \beta_i = 0\right]\right\}}{\sqrt{(1/N)\sum_{i=1}^{N} Var\left[t_{i,T}(p_i,0) \mid \beta_i = 0\right]}} \tag{7}$$

where

$$\bar{t}_{NT} = \frac{1}{N} \sum t_{i,T}\left(p_i, \beta_i\right) \tag{8}$$

and $t_{i,T}\left(p_i, \beta_i\right)$ is the individual t–statistic for testing $\beta_i = 0$ for all i. $E\left[t_{i,T}\left(p_i, 0\right) \middle| \beta_i = 0\right]$ and $Var\left[t_{i,T}\left(p_i, 0\right) \middle| \beta i = 0\right]$ are reported in Table 1 of Im *et al.* (1997). Under the null hypothesis, the standardised t–bar statistic $\Psi_{\bar{t}}$ is asymptotically distributed as a standard normal distribution ($\Psi_{\bar{t}} \sim N(0,1)$). The Im *et al.* (1997) panel unit root test is derived assuming that the series are independently generated, and they suggested subtracting cross-sectional means to remove common time specific effects. This assumes the error term in Equation (8) consists of two random components, $\varepsilon_{it} = \delta_t + \nu_{it}$ where ν_{it} is the idiosyncratic random component, and δ_t is a stationary time-specific effect that accounts for correlation in the errors across economies.

Another commonly used panel unit root test is the one based on Fisher (1932). Maddala and Wu (1999) propose the test statistic which is based on combining the *p*-values of the test statistics (of $?_i$) of *N* independent ADF regressions. The test statistic (the Fisher test *P*(*?*)) is as follows

$$P(\lambda) = -2\sum_{i=1}^{N} \log\left(\pi_i\right) \tag{9}$$

where π_i is the *p*-value of the test statistic for unit *i*. The Fisher test statistic $P(\lambda)$ is distributed as a chi-squared distribution with 2*N* degree of freedom.

The results of the panel unit root tests for and are presented in Table 1. We report the estimated *t-star* statistics of the Levin-Lin-Chu (LLC) test, bar statistics for the Im-Pesaran-Shin (IPS) test and -values for the Fisher test with their accompanying *p*-values. Despite study by Im *et al.* (1997) that have demonstrated by Monte Carlo simulations that their panel test suggest better finite sample performance of the over Levin-Lin-Chu's , and a study by Breitung (1999) that has showed the Maddala and Wu (1999) panel unit root tests have considerable more power relative to the IPS test, in all cases the three panel unit root test results are consistent indicating that real GDP per capita and military expenditures are as a group. The null hypothesis of unit root in level cannot be reject at the 5 percent level of significance, while the null hypothesis of a unit root in first difference can be reject at the 5 percent level of significance.

Table 1
Results of Panel Unit Root Tests

Series	*Levin-Lin-Chu test,* t^{*a}		*Im-Pesaran-Shin test,* ψ^{ia}		*Maddala-Wu test,* $P(?)^{b}$	
	Intercept	*Intercept & trend*	*Intercept*	*Intercept & trend*	*Intercept*	*Intercept & trend*
A. Level						
rgdppc	-2.74 (0-5) [0.003]**	-1.23 (0-5) [0.107]	-0.49 (0-5) [0.309]	-0.83 (0-5) [0.200]	48.56 (0-5) [0.168]	47.21 (0-5) [0.201]
milex	-0.31 (0-2) [0.377]	-0.881 (0-8) [0.188]	-0.105 (0-2) [0.457]	0.809 (0-8) [0.791]	35.75 (0-2) [0.661]	31.92 (0-8) [0.815]
B. First difference						
Δ *rgdppc*	-21.66 (0-2) [0.000]**	-20.23 (0-2) [0.000]**	-21.99 (0-2) [0.000]**	-20.46 (0-2) [0.000]**	422.0 (0-2) [0.000]**	409.8 (0-2) [0.000]**
Δ *milex*	-24.09 (0-2) [0.000]**	-20.43 (0-7) [0.000]**	-22.41 (0-2) [0.000]**	-19.53 (0-7) [0.000]**	439.0 (0-2) [0.000]**	355.5 (0-7) [0.000]**

Notes: [a]Under the null hypothesis, the standardised t–bar statistic ψ_t (the IPS test statistic) is asymptotically distributed as a standard normal distribution. Lag length chosen is based on SIC which is automatically selected by EViews5.1. The numbers in parentheses denote the range of lag length and those in square brackets are p-values. The p-values are estimated from the one-tail test of the standardised normal distribution. [b]Under the null hypothesis, the Fisher test statistic $P(?)$ is distributed as a chi-squared distribution with $2N$ degree of freedom. Lag length chosen is based on the basis of SIC automatically selected by EViews5.1. The p-values are estimated from a chi-squared distribution with $2N$ degree of freedom. Asterisk (**) denotes statistically significance at 5% level.

Test for Granger Long-run Causality

Our main purpose is to determine the causal direction between defense spending and economic growth in the 20 selecteddevelopingcountries. In a panel setting we have employed the Pesaran et al. (1999) panel error-correction model approach which uses two estimators, that is the PMG and MG estimators. One important advantage of PMG over MG or the traditional dynamic fixed effect model is that the short-run dynamics (and the error variances) are allowed to differ freely while the long-run slope coefficients are assumed to be equal across groups. Due to similar levels of economic and technological development, but differences in institutional infrastructure and cultural, we expected that the long-run equilibrium relationships between fundamental variables are similar across the developing countries, with the speed of adjustment to the long-run equilibrium values differing freely country by country. Using the panel error-correction model, the cultural and institutional specifics of a country which usually drive short-term dynamics can be properly accounted for.

Table 2 presents the estimates of the long-run coefficient of Equation (3) based on the estimators PMG and MG. The results are based on lag orders for each country chosen by the Schwarz-Bayesian information criterion (SBC) subject to a maximum lag of 3. Then, using these SBC – determined lags order, and after imposing homogeneity restriction, the dynamic heterogenous panel Equation (3) was estimated using maximum likelihood. The estimates are computed with the Newton-Raphson algorithm, which uses both the first and the second derivatives of the likelihood function.

Table 2
Panel ECM Results of Military Expenditure (*milex*) - Economic Growth (*rgdppc*) in Selected Developing Countries from 1970 – 2005

	PMG Estimates			*MG Estimates*			*Hausman Test*	
	Coef.	*s.e*	*p-value*	*Coef.*	*s.e*	*p-value*	$\chi^2(1)$	*p-value*
Long run coefficient:								
	0.6774	0.2493	0.007**	1.4714	1.3349	0.270	0.37	0.5449
Error Correction Coefficient:								
	-0.1208	0.0288	0.000**	-0.2220	0.0256	0.000**		

Note: Asterisk (**) denotes statistically significant at 5% level.

In Table 2, we present the results where military expenditures act as the dependent variable, while in Table 4, economic growth act as the dependent variables. In each of Table 2 and Table 4 we also show the result of the Hausman test for determining any statistical differences between PMG and MG.In this study, we are interested in determining the significance of the error-correction term in order to infer cointegration as well as *Granger*long-run causality between economic growth and defense spending. First, the joint Hausman test statistics clearly indicate that the restriction of long-run homogeneity of all long-run coefficients cannot be rejected at the 5 percent level of significance for the estimated equation with military expenditure as dependent variable. This implies that the long-run relationship between defense spending and economic growth is equal across the 20 developing countries.

Next we observe for the significance of the error-correction term to infer cointegration (long-run relationship) as well as *Granger* long-run causality between the two variables – *milex* and *rgdppc*. As shown in Table 2, our results strongly suggest that the null hypothesis that there is no *Granger* long-run causality in running from economic growth to military expenditures can be rejected at the 5 percent level. This implies that economic growth "drives" military expenditures in these developing countries. Our long-run estimated equation suggests that a 1 percent increase in economic growth will lead to a 0.7 percent increase in military expenditures, on average, among the 20 developing countries.

The error correction term suggest the speed of adjustment when *milex* and *rgdppc* is not in equilibrium. The estimated error correction term of 0.12 would suggest that the speed of adjustment is slow in such that when in disequilibrium, it took about more that 10 month to achieve equilibrium. Table 3 indicates various speed of adjustment for each of thecountry, ranging from 0.01 for Indonesia to 0.45 for Sudan. In other words, the rate of adjustment is faster for Sudan than for Indonesia.

Table 3
Individual Results of PMG and MG estimate of Military Expenditure (*milex*) – Economic Growth (*rgdppc*) in Selected Developing Countries from 1970-2005

Countries	*MG*		*PMG*	
	ECT	*rgdppc*	*ECT*	*rgdppc*
Turkey	-0.2403	-0.7213	-0.0265	0.6774
	(0.065)*	-0.131	-0.745	(0.007)**
Malaysia	-0.2969	-1.0944	-0.0218	0.6774
	(0.012)**	(0.000)**	-0.661	(0.007)**
Indonesia	-0.2048	-1.3045	-0.01	0.6774
	(0.023)**	(0.000)**	-0.745	(0.007)**
Saudi Arabia	-0.3794	0.9162	-0.4054	0.6774
	(0.002)**	(0.057)*	(0.000)**	(0.007)**
Iran	-0.3357	2.8267	-0.1458	0.6774
	(0.004)**	(0.000)**	(0.080)*	(0.007)**
Nigeria	-0.1808	4.2265	-0.1309	0.6774
	(0.037)**	-0.125	(0.065)*	(0.007)**
Egypt	-0.435	-2.1262	-0.045	0.6774
	(0.003)**	(0.000)**	-0.399	(0.007)**
Algeria	-0.0849	-3.1576	-0.0673	0.6774
	-0.297	-0.468	-0.384	(0.007)**
Pakistan	-0.1183	-1.6032	0.0443	0.6774
	-0.138	-0.129	-0.421	(0.007)**
Morocco	-0.246	-0.7511	-0.1687	0.6774
	(0.015)**	-0.294	(0.075)*	(0.007)**
Tunisia	-0.1893	-0.8023	-0.1301	0.6774
	(0.021)**	-0.34	(0.076)*	(0.007)**
Kuwait	-0.2329	-2.276	-0.0135	0.6774
	(0.087)*	(0.035)**	-0.874	(0.007)**
Syria	-0.0951	-2.6288	-0.0239	0.6774
	-0.238	-0.25	-0.698	(0.007)**
Sudan	-0.446	1.2967	-0.4544	0.6774
	(0.001)**	(0.082)*	(0.000)**	(0.007)**
Cameroon	-0.2517	0.5849	-0.2423	0.6774
	(0.030)**	-0.221	(0.017)**	(0.007)**
Senegal	-0.0264	16.0533	-0.0498	0.6774
	-0.679	-0.706	-0.397	(0.007)**
Mauritania	-0.1379	19.3676	-0.1457	0.6774
	(0.039)**	-0.119	(0.032)**	(0.007)**
Togo	-0.2026	0.8736	-0.2105	0.6774
	(0.024)**	-0.49	(0.003)**	(0.007)**
Benin	-0.7346	3.3692	-0.1183	0.6774
	-0.29	-0.694	-0.103	(0.007)**
Burkina Faso	-0.2378	-3.6212	-0.0505	0.6774
	(0.006)**	(0.004)**	-0.493	(0.007)**

On the other hand, Table 4 clearly suggests that homogeneity should be imposed among the 20 developing countries when we run a regression with economic growth as the dependent variable. The Hausman test is not significantly different from zero at the 5 percent level, thus implies that the Pooled Mean Group model is to be chosen. Nevertheless, our results suggest that the null of non-cointegration cannot be rejected at the 5 percent level of significance as shown by the insignificant of the error correction term. This would suggest that there is no long-run relationship between economic growth and military expenditures (when economic growth as dependent variable) and therefore implies that there is no *Granger* long-run causality running from military expenditures to economic growth. As shown in Table 4, the error correction term is close to zero (i.e. 0.002) and as presented in Table 5, many of the developing countries registered a very low value for the error correction term with for example, Mauritania registered an error correction term of 0.0002 while Burkina Faso with 0.0008. In other words, we can infer that economic growth do not react to military expenditures in those 20 developing countries.

Table 4
Panel ECM Results of Economic Growth (*rgdppc*) - Military Expenditure (*milex*) in Selected Developing Countries from 1970 – 2005

	PMG Estimates			*MG Estimates*			*Hausman Test*	
	Coef.	*s.e*	*p-value*	*Coef.*	*s.e*	*p-value*	$\chi^2(1)$	*p-value*
Long run coefficient:								
	2.2616	1.1372	0.047**	2.4784	2.2448	0.270	0.01	0.9108
Error Correction Coefficient:								
	0.0024	0.0037	0.516	-0.1298	0.0412	0.002**		

Note: Asterisk (**) denotes statistically significant at 5% level.

Table 5
Individual Results of PMG and MG estimate of Economic Growth (rgdppc) - Military Expenditure (milex) in Selected Developing Countries from 1970 -2005

Countries	*MG*		*PMG*	
	ECT	*milex*	*ECT*	*milex*
Turkey	-0.038	-1.9198	0.0102	2.261
	-0.416	-0.365	-0.323	(0.047)**
Malaysia	-0.0435	-0.468	-0.0026	2.261
	-0.18	-0.178	-0.455	(0.047)**
Indonesia	-0.0681	-0.3939	-0.0065	2.261
	-0.104	(0.080)*	(0.095)*	(0.047)**
Saudi Arabia	0.0218	5.777	0.0608	2.261
	-0.666	-0.655	(0.070)*	(0.047)**
Iran	-0.2154	0.2384	-0.0014	2.261
	-0.139	(0.039)**	-0.889	(0.047)**
Nigeria	-0.0857	-0.0411	0.004	2.261
	-0.459	-0.872	-0.418	(0.047)**
Egypt	-0.0248	0.1578	-0.0041	2.261
	-0.457	-0.836	-0.126	(0.047)**

contd. table 5

Countries	*MG*		*PMG*	
	ECT	*milex*	*ECT*	*milex*
Algeria	-0.0316	1.0845	-0.014	2.261
	-0.621	-0.647	-0.108	(0.047)**
Pakistan	-0.0121	0.5324	-0.008	2.261
	-0.473	-0.779	(0.078)*	(0.047)**
Morocco	-0.07	-0.2318	-0.0054	2.261
	-0.212	-0.66	-0.427	(0.047)**
Tunisia	0.0005	44.6862	0.0098	2.261
	-0.978	-0.978	(0.049)**	(0.047)**
Kuwait	-0.1193	0.125	-0.0182	2.261
	(0.089)*	-0.698	(0.094)*	(0.047)**
Syria	-0.2288	-0.1548	-0.0093	2.261
	(0.012)**	-0.154	-0.255	(0.047)**
Sudan	-0.0079	1.1808	-0.0028	2.261
	-0.919	-0.909	-0.804	(0.047)**
Cameroon	-0.1142	0.0447	-0.008	2.261
	(0.099)*	-0.938	-0.744	(0.047)**
Senegal	-0.2867	-0.1128	0.016	2.261
	(0.044)**	-0.319	-0.155	(0.047)**
Mauritania	-0.8294	0.036	0.0002	2.261
	(0.000)**	(0.003)**	-0.934	(0.047)**
Togo	-0.1217	-0.5565	0.0204	2.261
	-0.157	(0.298)**	-0.235	(0.047)**
Benin	-0.1644	-0.1739	0.0074	2.261
	-0.117	-0.145	-0.206	(0.047)**
Burkina Faso	-0.1572	-0.2405	0.0008	2.261
	(0.040)**	(0.022)**	-0.814	(0.047)**

Note: Figures in parentheses are *p-value*. Asterisk (*) and (**) denote statistically significant at 10% and 5% level respectively.

5. CONCLUSION

This study made an attempt to examine the long-run relationship and the causal direction between military expenditures and economic growth in twenty developing countries, namely; Algeria, Benin, Burkina Faso, Cameroon, Egypt, Indonesia, Iran, Kuwait, Malaysia, Mauritania, Morocco, Nigeria, Pakistan, Saudi Arabia, Senegal Sudan, Syria, Togo, Tunisia, and Turkey. We use annual data for the period 1970 to 2005. We applied three panel unit root test due to Levin, Lin and Chu (2002), Im, Pesaran and Shin (1997) and Maddala and Wu (1999) for the testing of the order of integration in the panel setting; and we employed the Pesaran, Shin and Smith (1999) panel error-correction model to infer panel cointegration as well as *Granger*long-run causality between the two variables.

Our results clearly indicate that time-series defense spending and real GDP per capita are integrated of order one as a group. Our panel error-correction model indicates strongly that there is long-run relationship between military expenditures and economic growth in the developing countries for the period under study. However, the long-run causality only runs from economic growth to military expenditures. Thus, this implies that on average, economic growth stimulates the growth of the defense sector in the twenty selected developing countries but not otherwise.

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