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The Relation between Military Expenditure & Economic Growth in Developing Countries: Evidence from a Panel of 41 Developing Countries

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Abstract: *A panel data model is estimated to examine the relationship between military expenditure and economic Growth (GDP) in developing world using annual data for 41 countries over the period 2001 to 2010. The estimated empirical panel model explaining GDP growth as a function of military expenditure, labor and capital variables suggests varying country-wise positive effects for military expenditure and, as might be expected, positive effects for labor and capital. We found that the Defense expenditure has either positive or negative effect on GDP growth for different countries. Therefore, country-specific effects are important in explaining the relation between military expenditure and GDP growth.*

I. Introduction

Military expenditure comprises an important portion in every nation's national budget. In economic terms, military expenditure is the government expenditure on national defense determined in national fiscal policies. The portion of national budget spent on military every year follows a pattern for each nation. There is a recognized pattern of military expenditure in developing countries. There is a tradeoff between production of military goods and civil goods since both use a country's factor endowment. As there is a tradeoff it is commonly thought that national income or GDP is inversely related to military expenditure. The pro-growth policy makers and welfare economists suggest a growth in military expenditure should be less than the growth of nonmilitary expenditure. On the other hand, some other experts suggest that there is positive external benefit of military expenditure that enhances production in an economy. Opposing views as such makes the theories relation between military expenditure and economic growth subject to controversies. Benoit (1973) reported that military expenditure exerts a positive external benefit absorbed by the economy. He produced evidence that shows in LDCs military expenditure is positively related to economic growth. The conceptual link that is thought reasonable in this research that military works more efficiently than bureaucracy in nonmilitary welfare activities focusing on poor people. Moreover, in conflict zones, deployment of military forces provides security for agricultural and nonagricultural production in LDCs.

At its time, and still today, these findings cause some controversy in the field and are partly responsible for the stream of research that has followed. From an economic point of view, and unlike most other forms of government spending, military expenditure has specific causes and consequences. The causes are manifestly exogenous to the domestic economy and are the result of political, economic, religious, or social interaction at an international level; whereas the consequences are more likely to be felt at the domestic level. The actual nature of these domestic consequences is theoretically intractable because of conflicting positive and negative transmission mechanisms from defense to the greater economy. These interrelationships also depend on the extent of a nation's economic development. Studies can be categorized into those that investigate impacts on growth for developing economies and those that investigate the impact on the developed world. These complicating factors have caused the issue of how defense interrelates to the economy to be an empirical rather than theoretical question.

This paper adds to the literature by investigating the impact of military expenditure over a broad range of countries, 41 in total, over the period 2001 to 2010 using annual military expenditure data provided by the Stockholm International Peace Research Institute (SIPRI). The SIPRI data set has the advantage that it has been collected, collated and examined by an internationally recognized research organization. Data on GDP growth, and the labor and capital stocks for each of the countries are also collected. A panel data model is then estimated to fully take advantage of the time and spatial characteristics of the data set. A range of specifications are implemented to investigate different functional forms for the data. The results suggest military has positive, negative and insignificant effects on GDP growth when the model estimated is allowed to have differential country effects. This avoids a serious shortcoming in the literature where some studies assume cross country homogeneity by pooling data over countries.

The outline of the paper is as follows. Section 2 reviews some theory concerning military spending and how it interacts with economic growth, presents a formal growth model that includes military as an explanatory variable and reports some recent empirical findings. Section 3 presents the empirical methodology and briefly outlines the pooled, fixed effects and random effects approaches to modeling cross section time series data. Section 4 discusses practical data considerations, presents the empirical results. Section 5 concludes.

II. Military Expenditure and Economic Growth

2.1 Preliminary Issues

Military spending, being a component of fiscal policy has numerous possible theoretical impacts on the economy. These may be positive or negative depending on the specific argument. An increase in military spending may reduce unemployment caused by underconsumption or underinvestment. Military research and development (R&D) may have positive externalities on the civilian sector through spin-offs and technological transfers. Some arguments relate more to LDCs. Some examples are where military spending may help with the creation of social infrastructure and other forms of public goods. Military spending may increase the skill set of the population through training and education of military personnel. Military spending provides security which promotes a stable business environment encouraging foreign investment. On the negative side, it is possible that military spending crowds out private spending, where resources can be put to more productive use. Arms imports can have adverse balance of payments effects. Any R&D in the military sector may divert R&D from the private sector where it may receive more practical application. Revenue generation by the national government to enhance military spending in the form of higher taxation may limit growth. Military spending may also divert resources from the export sector of an economy where similar levels of technology may be put to use. Given the conflicting theoretical effects of military spending, much research has centered on the actual empirical findings.

There are various schools of thought on the nature of the relationship between the military or defense sector and economic growth. Military Keynesians contend military expenditure is a tool of fiscal policy and can therefore be increased to stimulate demand or decreased to dampen demand. Intrinsic to this view is that military expenditure has positive effects on the macro economy. This impact depends on the extent of the multiplier effect, assuming there is not a corresponding increase in taxation to pay for the spending and the extent, if any, of crowding out caused by the spending. The Marxist view is more extreme and contends that military spending is necessary because of underconsumption in advanced western capitalist economies. The opposing school of thought to that of the Military Keynesians is that military expenditure has negative effects and if used as a tool of fiscal policy would only make the situation worse. This is usually based on a type of supply side argument where resources used in military are more efficiently used elsewhere. This argument is considered stronger when used with respect to LDCs.

2.2 Economic Modeling of Military Expenditure Impact

Models for the transmission mechanism from military expenditure to economic growth are based either in the supply or demand side of the economy. Supply side models are based on an aggregate production function approach; demand side models are based on a variant of the Keynesian consumption function. The empirical model estimated in Section 4 is a variant of a military inclusive production function; commonly referred to as the Feder-Ram model. The model is based on the production function proposed in Feder (1983) when looking at how exports affect economic growth and then extended by Biswas and Ram (1986) to include a military expenditure variable.

Consider a two sector economy with a military (D) production function

$$D = D(L_D, K_D) \tag{1}$$

and a civilian (C) production function

$$C = C(L_C, K_C, D) \tag{2}$$

where the inputs L_D; L_C; K_D and K_C are labor and capital shares allocated to the military and civilian sectors respectively. The inclusion of D in (2) allows an externality effect from the military sector to the civilian sector. This can be either in the form of a positive marginal product for military in (2) or as a relative factor productivity differential for labor and capital in the two sectors. The latter effect can be a difficult one to identify in empirical application because of limited data availability, especially for LDCs. The aggregate labor and capital supplies are

$$L = L_C + L_D \tag{3}$$

and

$$K = K_C + K_D \tag{4}$$

and Y is total national income or output

$$Y = D + C \tag{5}$$

Given the relationships above, taking the total differential of (5) and dividing by Y gives

$$\frac{dY}{Y} = \frac{\partial C}{\partial L}\frac{dL}{Y} + \frac{\partial C}{\partial K}\frac{dK}{Y} + \frac{\partial C}{\partial D}\frac{dD}{Y} \tag{6}$$

Multiplying the first term on the right hand side of (6) by L/L and the third by D/D allows (6) to be written in terms of growth rates

$$\dot{Y} = F_L\,\dot{L}\,\frac{L}{Y} + F_K\frac{dK}{Y} + F_D\,\dot{D}\,\frac{D}{Y} \tag{7}$$

where the variables in (7) have the obvious interpretation with respect to (6) and where " ˙ " denotes relative derivative and F partial derivative. Equation (7) is the simple form of the Feder-Ram model and shows how economic growth depends on labor and capital growth and military all weighted by their relative shares in output. The addition of a constant (reflecting technological change) and an uncorrelated error process allows the model to be empirically tested. The partial derivatives, F, are then found as estimated coefficients.

2.3 Literature Review

Given the relatively simple nature of the question, most studies trying to find an answer can be classified into those that find positive benefits and therefore support the military Keynesian point of view, those that find negative benefits refuting the Keynesians and those that conclude there are insignificant linkages between military and economic growth. The following is a short summary of some of the empirical literature that has emerged since the beginning of the last decade; see Sandler and Hartley (1995a, 1995b) for a more comprehensive review.

Studies that find a positive impact

- Atesoglu and Mueller (1990) use a two sector Feder-Ram model for the US over the period 1949 to 1989. They find a positive effect from the military sector to the civilian sector.
- Stewart (1991) applies a Keynesian demand function to a group of LDCs. He finds that both military and nonmilitary expenditures have positive effects on growth, but that the effect of non-military spending is stronger.
- Ward, Davis, Penubarti, Rajmaira and Cochran (1991) use a three sector Feder-Ram model with separate externality and productivity effects for India over the period 1950 to 1987. Military expenditure is found to have a positive effect on growth.
- Mueller and Atesoglu (1993) incorporate technological change into a two sector Feder-Ram model using US data for the period 1948 to 1990. They find a significant relationship from military to growth.

Studies that find a negative impact

- Scheetz (1991) uses pooled cross section time series data for four Latin American countries (Chile, Argentina, Peru and Paraguay) over the period 1969 to 1987. He finds military expenditure has a negative effect on investment.
- Ward and Davis (1992) use a three sector Feder-Ram model for the US over the period 1948 to 1990. They separate the effects of military spending into productivity and externality effects. Overall, they find military spending has a negative effect on economic growth, with a negative productivity effect but a positive externality effect.
- Galvin (2003) uses 2SLS and 3SLS to estimate a demand and supply side model for 64 LDCs using cross section data. He concludes that military spending has negative effects for both economic growth and the savings income ratio.
- Mintz and Huang (1990) using a three-equation model for the US, find military expenditure negatively impacts on investment and therefore growth.

Studies that find a positive and negative impact

- Chowdhury (1991) undertakes Granger causality testing using military burden time series for 55 LDCs. He finds positive causality from military to growth for seven countries, negative causality for 15 countries, no causality for 30 countries and bi-directional causality for three countries.

Studies that find no impact

- Huang and Mintz (1990) estimate a three sector Feder-Ram model using ridge regression techniques to overcome multicollinearity problems using annual data for the US over the period 1952 to 1988. They do not find any relationship between military and growth.
- Huang and Mintz (1991) extend their earlier model by separating the military effect into productivity and externality effects. The same data and estimation technique is used. Once again, they find no relationship.
- Alexander (1990) uses a four sector Feder-Ram model for nine developed countries over the period 1974 to 1985 using cross section time series data. He finds no effect of military spending on economic growth.
- Adams, Behrman and Boldin (1991) use a three sector model (military, nonmilitary and export) with cross section and time series data for a group of LDCs over the period 1974 to 1986. They find military spending has no effect on growth, whereas exports have a positive effect.
- Gerace (2002) uses a spectral analysis type methodology to investigate movements in US military expenditure, US non-military expenditure and US GDP. He finds evidence that non-military expenditure is used as a counter-cyclical stabilization tool, but that military expenditure is not.

III. Empirical Methods

The typical availability of only a limited time series for military expenditures and the vastly different military budgets of nations around the world suggest some difficulty in determining time periods and developing countries to investigate. Using the panel data methodology is a natural way of overcoming this problem as it allows joint estimation using cross section time series data without the necessity of pooling and the associated strong assumptions invoked. The equation estimated is derived from the Feder-Ram model.

$$y = \alpha + \beta_l l + \beta_k k + \beta_d d + \varepsilon \qquad (8)$$

where the standardized growth variables for income (y), labor (l), capital (k) and military (d) are

$$y = \frac{\Delta Y}{Y},\ l = \frac{\Delta L}{L}\frac{L}{Y},\ k = \frac{\Delta K}{Y} = \frac{I}{Y} \text{ and } d = \frac{\Delta D}{D}\frac{D}{Y} \qquad (9)$$

The econometric challenge facing this type of analysis is how to optimally combine the cross section of N = 42 countries with the time series of T = 10 annual observations for each country. The naïve approach of combining all observations into one sample of N$\times$T observations requires invoking strong assumptions. Another approach that has been taken is to actually average the time series data for each country and then use this averaged number as one observation for each country. The panel data methodology allows the relaxation of these assumptions by allowing country-specific effects, and therefore a more realistic framework. The most general specification for the panel data approach is

$$y = \alpha_{i,t} + \beta_{i,l}\, l_{i,t} + \beta_{i,k}\, k_{i,t} + \beta_{i,d}\, d_{i,t} + \varepsilon_{i,t} \qquad (10)$$

where i = 1, 2,….. N indexes country and t = 1,2,…… T indexes year. This specification allows the constant and coefficients to vary not only over country but also year. Practical considerations require certain restrictions to be imposed to allow estimation.

3.1 Fixed Effects

Fixed effects involve the constant in (10) being different for each panel member. This is done by incorporating N = 41 dummy variables into the model; one for each developing country. This approach is sometimes called the least squares dummy variable (LSDV) model. The equation estimated becomes

$$y_{i,t} = \sum_{i=1}^{N} \alpha_i D_i + \beta_{i,l}\, l_{i,t} + \beta_{i,k}\, k_{i,t} + \beta_{i,d}\, d_{i,t} + \varepsilon_{i,t} \qquad (11)$$

where the constant in (10) has been omitted and where each dummy variable corresponds to one country. When using this model there is a potential degrees of freedom problem in estimating, at least in this case, 85 dummy variables in addition to the three explanatory variables. The fixed effects method has the advantage in that it allows estimation of β_d for each country.

3.2 Random Effects

If it can be assumed that there is an α in the model that has a true (population) value that is constant across countries, and that the estimated value of this constant only differs because of random chance, then it is possible to consider the random effects model

$$y_{i,t} = \alpha + \beta_{i,l}\, l_{i,t} + \beta_{i,k}\, k_{i,t} + \beta_{i,d}\, d_{i,t} + \omega_{i,t} \qquad (12)$$

where the error term has the property

$$\omega_{i,t} = u_i + \varepsilon_{i,t} \qquad (13)$$

and where the $u_i \sim (0, \sigma_u^2)$ reflects the error component unique to a specific country and

$\varepsilon_i \sim (0, \sigma_\varepsilon^2)$ reflects a combined cross section time series error component. The model in (13) is sometimes referred to as an error components model (ECM) because of this. Under random effects, the constant term for country i is

$$\alpha + u_i \qquad (14)$$

for $i = 1, 2, \ldots\ldots N$. The weakness involved in applying this model in a cross country study is that it requires assuming the underlying transmission mechanism from military to the greater economy is the same for all countries.

3.3 Feasible Generalized Least Squares

Feasible Generalized Least Squares uses Park method for FGLS in Panel data. The Parks method is FGLS for pannel models where the errors show panel heteroskedasticity, contemporaneous correlation, and unit specific serial correlation. The Parks method consists of two sequential FGLS transformations, first eliminating serial correlation of the errors then eliminating contemporaneous correlation of the errors. The Panel model with contemporaneously correlated errors is then exactly $y = \alpha_{i,t} + \beta x_{i,t} + \varepsilon_{i,t}$ with the variance covariance matrix of the errors having zeros for all non-contemporaneous observations and free parameters allowing for contemporaneous pair wise correlation of the errors and panel heteroskedasticity.

The Parks correction for serially correlated errors assumes the errors follow a unit-specific first-order autoregressive (AR1) process. The FGLS correction for a single P requires estimating one extra, unaccounted-for parameter. This is unlikely to cause FGLS standard errors to estimate variability inaccurately in the typical cross-national panel situation.

3.4 Prais-Winsten Method

Prais–Winsten estimation is a procedure meant to take care of the serial correlation of type AR(1) in a linear model. It is a modification of Cochrane-Orcutt estimation in the sense that it does not lose the first observation and leads to more efficiency as a result.

In a model $y = \alpha_t + \beta x_t + \varepsilon_t$ we consider error term ε_t to be serially correlated over time:
$\varepsilon_t = \rho\, \varepsilon_{t-1} + e_t$, $|\rho|<1$ and e_t is white noise. In addition to the Cochrane-Orcutt procedure transformation, which is $y_t - \rho y_{t-1} = \alpha(1-\rho) + \beta(x_t - \rho x_{t-1}) + e_t$ *for* $t = 2,3,\ldots,T$, Prais-Winsten procedure makes a reasonable transformation for t = 1 in the following form
$\sqrt{1-\rho^2}\, y_1 = \alpha\sqrt{1-\rho^2} + \beta(\sqrt{1-\rho^2}\, x_1) + \sqrt{1-\rho^2}\, e_t$
Then the usual least squares estimation is done.

3.5 Model Postestimation methods

3.5.1 Hausman test for Fixed Effects

Hausman test for fixed effects shows if FE estimators have more consistency than RE estimators. The null hypothesis is that more systematic and consistent estimators are generated by random-effects model. The test statistic developed by Hausman has an asymptotic χ^2 distribution.

3.5.2 Breusch and Pagan Lagrangian multiplier test for random effects

This test produces Breusch-Pagan statistic for cross-sectional independence in the residuals of a fixed effect regression model or a GLS model estimated from cross-section time-series data. It estimates fixed-effect model assuming independence of the errors. A likely deviation from independent errors in the context of pooled cross-section time-series data (or panel data) is likely to be contemporaneous correlations across cross-sectional units. The null hypothesis in the LM test is that variances across entities are zero. That is no significant difference across units (i.e. no panel effect) is found. If null cannot be rejected we conclude that random effects are inappropriate for estimation.

3.5.3 Modified Wald Test for groupwise heteroskedasticity

Modified Wald test for groupwise heteroskedasticity in fixed effect regression model will be run. Its null hypothesis is homoskedasticity; if it is rejected then heteroskedasticity will be controlled with estimation of robust fixed-effects regression.

3.5.4 Wooldridge Test for Autocorrelation

To check autocorrelation in the model Wooldridge test for autocorrelation will be run. It is convenient to solve both problems of heteroskedasticity and serial correlation (if there are any) by producing a cluster-robust estimate of the variance-covariance matrix of the estimator (VCE).

3.5.5 Unit root test: Augmented Dickey-Fuller Test (ADF)

Augmented Dickey–Fuller test (ADF) is a test for a unit root in a time series sample. It is an augmented version of the Dickey–Fuller test for a larger and more complicated set of time series models. The augmented Dickey–Fuller (ADF) statistic, used in the test, is a negative number. The more negative it is, the stronger the rejections of the hypothesis that there is a unit root at some level of confidence.

$$\Delta y = \alpha + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \ldots\ldots + \delta_{p-1} \Delta y_{t-p+1} + \varepsilon_{i,t} \tag{15}$$

The unit root test is then carried out under the null hypothesis $\gamma = 0$ against the alternative hypothesis of $\gamma < 0$. Once a value for the test statistic

$$DF\tau = \hat{\gamma} \big/ SE\hat{\gamma} \tag{16}$$

is computed it can be compared to the relevant critical value for the Dickey-Fuller Test. If the test statistic is less (this test is non symmetrical so we do not consider an absolute value) than (a larger negative) the critical value, then the null hypothesis of is rejected and no unit root is present.

IV. Data and Estimation Results

4.1 Data

Major world bodies and global research organizations typically have varying definitions of what constitutes military expenditure. NATO, the IMF and the UN have formal, but inconsistent definitions. The IMF definition, for example, does not allow the inclusion of military pensions while the NATO and the UN definitions do. Principal data sources include the Stockholm International Peace Research Institute (SIPRI), the US Arms Control and Disarmament Agency (ACDA), the International Institute for Strategic Studies (IISS) and the International Monetary Fund Government Finance Statistics Yearbook (IMF-GFSY). All four data sources provide legitimate military expenditure estimates, but use different definitions and therefore give different estimates. The data used in this study is sourced from SIPRI. The SIPRI definition is

“. . . SIPRI military expenditure include all current and capital expenditure on: the armed forces, including peace keeping forces; military ministries and other government agencies engaged in military projects; paramilitary forces when judged to be trained, equipped and available for military operations; and military space activities. Such expenditures should include: personnel - all expenditures on current personnel, military and civil, retirement pensions of military personnel and social services for personnel and their families; operations and maintenance; procurement; military research and development; military construction; and military aid (in the military expenditures of the donor country) excluded military related expenditures: civil military; current expenditure for previous military activities, veteran benefits, demobilization, and conversion of arms production facilities and destruction of weapons."

The data has the normal cautions attached to its implementation, with some observations in the individual time series estimated by SIPRI. Military expenditure, more so than other government expenditure has the increased potential to be affected by issues such as political reality and credibility. Sourcing the data from a military related research organization, rather than the IMF-GFSY for example, suggests the issue of data integrity can be mitigated to some extent. The data is available for download from the SIPRI website and consists of annual observations on military expenditure in the local currency at current prices, military expenditure in constant (2001) US dollars and military expenditure as a percentage of gross domestic products (GDP).

The SIPRI reports the data for up to 74 developing countries but only 41 of these are used in this study because of missing observation; Mauritania, for example, does not have a military expenditure estimate for 1988 so it had to be excluded. The countries chosen allow the use of relatively reliable data and are also representative of the different regions of the world.

The data on GDP and relative shares of GDP were obtained from the World Bank Databank on World Bank website. As a proxy for the labor variable, estimates of each country's population were obtained from the International Labor Organization (ILO) website. It was not possible to obtain a complete time series of labor force estimates for all countries in the panel so general population numbers were used instead. Data on capital were obtained from the IMF-World Economic Outlook (WEO) website.

4.2 Empirical Results

Feder-Ram model is estimated with fixed effects by Ward and Davis (1992) and Huang and Mintz (1992). To ensure the use of appropriate panel model we run two tests:

(i) Hausman test for fixed effects and
(ii) Breush and Pagan LM test for random effects.

(i) Hausman test for fixed effects

Hausman test gives us χ^2 value of 0.90 with probability 0.3429. Therefore, and the probability that χ^2 value exceeds 0.90 is 34%; in this case 'H$_0$: Random Effects model provides consistent estimator' is rejected. Therefore, Fixed-effects model should be used to produce efficient estimators in this analysis.

(ii) Breusch and Pagan LM test

Breusch and Pagan LM test gives χ^2 value of 65.11 with probability 0.00. Here we reject the null and conclude that random effects is appropriate. There is evidence of significant differences across countries.

These two tests reveal that according to Hausman test fixed effects are preferable to random effects and according to Breusch & Pagan LM test random effects are preferable to OLS.

To check for heteroskedasticity and serial correlation in fixed-effect model we run two more tests:

(iii) Modified Wald Test for Fixed-effect Panel Model
(iv) Wooldridge Test for Serial Correlation

(iii) Modified Wald Test Fixed-effect Panel Model

The null hypothesis is no heteroskedasticity or homoskedasticity (constant variance). The calculated test statistic χ^2 is 20089.04 with probability 0.0000. Therefore, we reject null hypothesis and conclude that there is presence of heteroskedasticity.

(iv) Wooldridge Test for Serial Correlation

The null hypothesis is no serial correlation. The calculated test statistic F is 20.945 with probability 0.0000. Therefore, we reject the null hypothesis and conclude the data has first-order autocorrelation.

At this point we choose a model that is controlled for heteroskedasticity and serial correlation. Several fixed-effects models that could be used for this purpose are FGLS model, Prais-Winsten method, Newy-West method, Driscroll-Kraay method, etc.

We select FGLS and Prais-Winsten method to compare with fixed-effects model because their properties serve our purposes of controlling for heteroskedasticity and serial correlation. It was found that both FGLS and Prais-Winsten produce same standard errors which are smaller than those of fixed-effects. Moreover, these two methods produce standard error estimates that are robust to heteroskedastic, contemporaneously crosssectionally correlated, and autocorrelated of type AR(1) disturbances. But FGLS is not feasible when N>T[1]. So, we carry on with Prais-Winsten estimation of our panel data model.

Table 1: Prais-Winsten Fixed-effects Model

GDP Growth Rate $\Delta Y/Y$	Coefficients	Robust Standard Errors	z	P < | Z |
Growth of Labor Force with respect to GDP $\frac{\Delta L}{L}\frac{L}{Y}$	3856.652	1555.829	2.48	0.013
Ratio of Investment in Capital to GDP I/Y	.0879805	.027505	3.20	0.001
Growth Military Expenditure with respect to GDP $\frac{\Delta D}{D}\frac{D}{Y}$	.1983482	.0702982	2.82	0.005
Constant	1.8208	1.081142	1.68	0.092
		R-sq	**= 0.0497**	
	Number of groups = 41	Observation per group = 10	Wald χ^2 (3) =	19.43
			$P > \chi^2$ =	0.0002

Joint Significance: Wald test statistic for joint significance is 19.43 with probability 0.0002. Therefore, this model is jointly significance.

Significance of Variables: Standard errors are associated with Z values and their probabilities. All four p values are below 0.05. Therefore, the coefficients are individually significant.

R^2: The value of this statistic is 0.0497. That is variations in explanatory variables explain only 4.97% of the variations in dependent variable.

We can see that the variables are positively related to dependent variable. Growth of military expenditure with respect to GDP or Income is positively related to GDP growth rate.

The variable growth of labor with respect to GDP or Income has a very large coefficient than other variables. It is understandable that the industry and other sectors in developing countries are highly labor-intensive than they are capital-intensive. That is why the coefficient of labor variable is very large. But still the magnitude of labor variable's contribution expressed in the coefficient may be questioned which should be answered by country-specific coefficients.

The military expenditure variable is positively related to the dependent variable which confirms its conceptual relation with Income or GDP.

Country-specific Coefficients of the Military Expenditure Variable:

The country-specific military expenditure coefficients were also calculated. Many countries are found to be having negative coefficients, such as Kuwait, Bahrain, Egypt, Nigeria, Czech Republic and South Africa. It means for those countries, military expenditure is inversely related to growth. On the other hand, countries like Kenya, Algeria, Morocco, Indonesia are found to be having positive coefficients. In South Asia, military expenditure coefficients for Bangladesh, India and Sri Lanka are negative but that for Pakistan is positive.

We interpret this relation between growth of military expenditure and income growth as they are positively related when military is contributing to the production of civil goods and they are negatively related when military 'grows' at the cost of growth of real sectors. The coefficients for Mexico, Jamaica, Peru, Guatemala, South Africa, etc. are found insignificant.

(v) Unit-root Test:

We run the unit root test for GDP and Military Expenditure variables. The null hypothesis is that there is unit root of the series confirming stationarity. We find that for GDP growth rate the χ^2 statistic is 200.7816 with probability 0.0000 and for Growth of Military Expenditure with respect to GDP are 273.5092 with probability 0.0000. Therefore, these two series are not stationary.

[1] Blackwell (2005)

V. Conclusion:

Our findings prove the relation between factors of production, military expenditure and GDP in growth terms. Growth of Military Expenditure with respect to GDP and GDP growth rate are positively related as is found by the estimated model. But at country level, country-specific coefficients have positive and negative signs and some of them are insignificant. The Paris-Winsten estimation of our model is useful to draw conclusions on the nexus between GDP and Military expenditure but little room there is left to generalize this relation upon every developing country. It is seen that less industrialized developing countries have a positive relation between GDP and Military expenditure and highly industrialized developing countries have a negative relation between these two variables. This is a 'safe' generalization for developing countries.

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