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Military Expenditure and Economic Growth: A Panel Data Analysis

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Abstract

This paper seeks to reinvestigate the relationship between military expenditure and economic growth by making use of the augmented Solow growth model. It also tends to explore the combined effect of military spending and armed conflicts on growth rate. Since the literature pertaining to defense economics depicts no consensus over the effects of military expenditure on the economy, the ongoing debate still becomes a topic of interest for many economists. This study reviews the recent publications in this regard and aims to contribute to the existing literature by making use of the most recent data for a pool of 61 countries. The theoretical framework is based on the augmented Solow growth model introduced by Mankiw et al. (1992) and first applied by Knight et al. (1996). Incorporating the same model used by Dunne (2005), this paper endeavors to access the impact military expenditure exerts on growth. Data for the period of 1988-2015 is employed for a pool of countries and a well-known theoretical model, fixed effect estimator, also known as the Least Square Dummy Variable (LSDV) has been used as a robust econometric technique. Findings of our empirical estimation suggest that military expenditure and arms imports have a negative impact on GDP per capita but military expenditure in the presence of external conflicts also has a negative and significant impact on growth, which is contrary to most of the earlier findings in literature. Our results imply that while spending on military acts as a burden for the economic growth, frequent interstate conflicts make it crucial for countries to spend further on their military sector which can slow down the economic growth.

Keywords: Military Expenditure, Economic Growth, Panel Data Analysis

JEL Classification: C51, F51, H56, O47

1. Introduction

How military spending affects economic growth of a nation, it remains a contradictory question and a debatable issue among economic managers and

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policy-makers. Question regarding the nature of relationship between defense expenditures and economic growth in literature is still accountable. Since 1970s, advent of debate, there is lack of consensus, whether military expenditures impact growth and, if it so, whether it is direct or inverse (Benoit 1973, 1978; Sandler and Hartley, 2007). Signal of this disagreement is amplified due to differences in the theories, methodologies and estimation techniques used in the literature (Ram, 1995). In literature, supposition of negative relationship between defense spending and economic growth is based on crowding out effects, implies that there exists a tradeoff between productive and unproductive government expenditures. Proposition of positive effect considers the supply side spillovers and aggregate demand effects. It is also hypothesized that increase in defense spending is detrimental to growth in less developed nations. The existing literature failed to make it possible to accept or reject any of these propositions.

Literature has identified three channels through which military-growth relationship can be explained: demand, supply and security (Dunne et al., 2005). According to the demand channel, an increase in the military expenditure increases the aggregate demand and capital utilization, while decreases unemployment. Thus, an increase in military expenditure promotes growth due to improvement in infrastructure and human capital, but in developing countries, it depends on the availability of resources (Looney and Frederiksen, 1986). Resource rich nations have positive effect of military expenditure on growth and reverse is found in case of poor ones. However, an opportunity cost is also associated with military expenditure as it might crowd-out investment in human or physical capital. The extent of the crowding-out effect depends on how the additional military expenditures are financed, as stated by Dunne et al. (2005). In case of a limited government budget, military expenditure can only be increased at the expense of reducing budget for other social projects, increasing taxes, higher debt or some combinations of all these financing strategies. Thus, different financing strategies of military expenditure have different growth consequences. Therefore, the demand channel does not show whether the net effect of an increase in military spending on growth is positive or negative (Yakovlev, 2007). A meta-analysis of 32 empirical studies failed to support the proposition of negative defense-growth relationship for less developed countries but finds sufficient evidence to recommend a positive military-growth relationship for developed countries (Alptekin and Levine, 2012).

The supply channel involves opportunity cost of military expenditure in the form of fewer resources available for the civil purposes. Labor, physical capital or human capital used by defense is not available to civilians. Economies

with accelerating military burden have to pay opportunity cost in the form of crowding out of investment (both public & private), deficit in balance of payments due to arms import, limited services in the public sector, fewer research and development projects, and hence become inefficient economies (Mylonidis, 2006). On the contrary, research and development spending in the military sector might have some spill-over effects on civilian sector. Stroup and Heckelman (2001) explored another aspect of military-growth relationship that can be explained by a non-linear and concave function, if defense sector exhibits diminishing marginal productivity. This implies that growth tends to increase at initial lower level of military expenditures however, after reaching a maximum point; it starts declining with an increase in military spending and even become negative.

Last channel through which defense-growth can be explained is security which is considered as a crucial factor for the survival and operation of any economy. This argument actually dates back to Adam Smith, that is, primary duty of any state is to ensure the protection of its citizens against any domestic or foreign threats. Therefore, wars and security threats have acted as major hindrance to development in many low-income countries. Thus, increase in military expenditures against war & security threat lead to higher economic growth. However, if this increase in spending is not driven by valid security concerns, rather are a result of rent-seeking behavior then the consequences might be adverse due to national involvement in arms race and destructive wars (Aizenman and Glick, 2003; Yakovlev, 2007). Literature concluded that military-growth relationship is positive in countries having significant external threats with good governance (Shikida and de Araujo, 2008; Yang et al., 2011), but higher military spending also reduces growth in the presence of corruption and rent-seeking behavior.

In conflictive framework of Greece and Turkey, literature argues that military spending augmented economic performance of Turkey, while failed to provide consensus on findings about Greece (Brauer, 2002). Turkish military spending are driven by NATO defense expenditures, whereas Greek defense budget is based on Turkish military budget (Kollias and Paleologou, 2003). Another finding regarding Turkey is the evidence of both linear and non-linear casual relationship between military expenditures and economic growth (Karagianni and Pempetzoglu, 2009). Lin and Lee (2012) examined the military-growth relationship using stochastic endogenous growth model by controlling the presence of external factors, and concluded that overall effect is vague.

Regardless of these varying perspectives, production and trade of arms has become a huge business with economic consequences that is extensively examined in literature, but the impact of ammunition's trade on an economy is a relatively untouched arena (Yakovlev, 2007). This provides motivation for empirical analysis and attempt is made to analyze the impact of both military expenditure and arms imports on economic growth.

The main focus of the study is to analyze the influence of military expenditure on economic performance of 61 countries (developed, developing and under-developed) for the period of 1988 to 2015. Study used the neoclassical growth model suggested by Dunne et al. (2005) which integrates the implications rooted in the defense economics literature. Besides, novelty of the study is to consider both the conflict and arms, as these are closely related to military expenditure and economic growth. It also extends the model suggested by Dunne et al. (2005) in the light of d'Agostino et al. (2010) to explore military-growth phenomenon.

The rest of the paper is organized as. Section 2 furnishes brief review of literature pertaining to military expenditure. Section 3 discusses the data set and methodology used. Section 4 presents the results of the regression model and analyzes the outcome. Section 5, being the final section of our research, draws conclusions from our research.

2. Literature Review

Literature pertaining to defense economics provides a plethora of studies that explore the relationship between military expenditure and economic growth, but still policy makers and economists have reached not to a definite and concrete conclusion over the issue (Benoit 1973, 1978; Alexander, 1990; Biswas and Ram, 1986; Hartley and Sandler, 2007). Empirical findings of major portion of the research studies to date follow the initial findings of Beniot which predicts a positive relationship between defense spending and economic growth. Prior to this study, economic managers believe that military spending divert national resources from productive (investment). The empirical findings of his study revealed that a country with a huge defense burden shows a rapid economic growth in general, whereas the country with a very low defense budget depicts a really slow growth rate. This result not only negated the popular perception but also lead to a controversy as Benoit himself accepted the possibility of spurious results in his study. Alexander (1990) points out that the variables used by Benoit (1978) are not based on any proper theory. Biswas and Ram (1986) also criticized the conclusions drawn by Benoit (1978) by stating that it was just a matter of

coincidence that he found a positive relationship between military expenditure and growth. They further imply that his results depended largely on the sample size and time period under consideration. Had he chosen a different sample, his results could have been much stronger. Another criticism on Benoit's work arises from the study by Landau (1993), who stated that without the inclusion of important variables like human capital, political conditions, technology or natural resources, results cannot be regarded as efficient. However, it was Benoit's work that paved way for future research. This made military expenditure a debatable topic for empirical research among many economists.

There are few studies in literature that support the view that there exists a positive relationship between military expenditure and economic growth. Studies like Atesoglu (2002, 2009), Khan (2004) and Yildirim et al. (2005) have made conclusions that are in line with those of Benoit (1978). The channel through which military spending exerts a positive influence on economic growth is explicitly highlighted by Sandler and Hartley (1995). An increase in the military expenditure stimulates aggregate demand which in turn leads to a higher utilization of capital stock and increased employment. Due to the higher utilization of capital, profit rate is likely to increase, thus, encouraging investment. This generates short-run multiplier effects which lead to a higher economic growth. Apart from this, military expenditure also improves the quality of human capital through the provision of education and training (Sandler and Hartley, 1995).

On the other hand, there are a number of studies that provide evidence of the existence of a negative relationship between military expenditure and economic growth. This view is supported by Shahbaz et al. (2013), Dunne (2012), Hou and Chen (2013), Dunne and Tian (2015) and most recently by d'Agostino et al. (2017). Sandler and Hartley (1995) highlight that the more resources diverted towards the military might mean lesser resources available for the public and the private sector. By crowding-out investment in these sectors, it deteriorates economic growth (Sandler and Hartley, 1995). Shahbaz et al. (2013) contributed to the existing literature by making use of Keynesian hypothesis to conclude that military expenditure proves to be anti-growth for the economic growth of Pakistan. Dunne (2012) also provides an interesting insight into the ongoing debate by suggesting that military expenditure deteriorates the economic growth, especially in case of poor countries.

Insight to yet another perspective has been provided by Dunne *et al.* (2005) and Aizenman and Glick (2003), who imply in their respective studies that

military expenditure boosts growth only in the presence of a security threat. According to Aizenman and Glick (2003), an increase in military expenditure instigated by an external threat would eventually lead to increased output. However, military expenditure induced by either rent seeking behavior or corruption, is very likely to cause a decline in output. This is why countries with high corruption usually experience a negative growth rate when their military expenditure is raised. This relatively new aspect in the defense economics literature has been supported by Dunne et al. (2005). While critically analyzing different empirical models employed by defense economists in their studies, Dunne et al. (2005) states that the Barro model used by Aizenman and Glick (2003) is quite an effective way of taking into account the effects of security on output.

Followed by Aizenman and Glick (2003), the study by Goel and Saunoris (2015) is one of the few studies to formally examine the impact military spending might have on corruption. While comparing military spending with non-military spending, the findings reveal that expenditure made for military purposes tends to give a rise to corruption, whereas expenditure for the non-military sectors helps diminish the corrupt activities. This suggests that all expenditures by government do not have similar impacts on corruption. Hence, countries with high military burdens need to strengthen their institutions in order to tackle the issue of corruption.

A review of literature explicitly depicts that despite being a topic of interest for many economists, there is a lack of consensus in literature about the economic effects of military spending.

3. Theoretical Framework, Model and Data Sources

In order to overcome the limitations of both time-series and country-specific effects mentioned in literature, this study used panel data modeling approach to explore the relationship between military spending and economic growth. Panel of 61 countries that include developed, developing and less-developed for the time period of 1988 to 2015.

3.1. Theoretical Framework

Prior to Yildrim et al. (2005), mostly studies were based on the frameworks devised by Feder (1983) and Ram (1986, 95). But an extensive analytical survey of Dunne et al. (2005) revealed that Feder-Ram models suffer from serious econometric as well as theoretical problems; Barro model is too complex for an explicit estimation; however, its theory is quite useful to suggest

variables. Atesoglu (2002) derived an alternative theoretical model, based on the Keynesian-cross model considering the work of Romer (2000) and Taylor (2000). This approach divides government expenditures into non-military government expenditure and the real military expenditure. Relevant literature depicts few instances where it has been used. Since these concerns could affect the reliability of the empirical analysis, and hence use of Keynesian-cross model is not widely accepted for research work. Alternatively, augmented Solow growth model, though suffering from a few theoretical weaknesses; widely used and contains very less empirical limitations as compared to the other models, e.g. Feder-Ram model. The most basic advantage that the augmented Solow growth model possesses in defense economics is its dynamic nature, which enables it to clarify the causes and direction of relationship. This property enables the researcher to test for any current or lagged effects arising from military expenditure for growth (Yildrim and Ocal, 2014).

3.2. Model Specification

Considering the benefits that many researchers have previously acquired from using it, this research specified the following model based on the augmented Solow growth model to analyze the military-growth relationship.

$$\ln y_{i,t} = \gamma \ln y_{i.t-1} + \sum_{j=1}^{4} \beta_j \ln x_{j,i,t} + n_t + \mu_i + v$$

Given that i = 1,2,....,N; t = 1,2,....,T; where $x_1 is\ s$ (gross investment / GDP), $x_2 is\ n + g + d$ (labor force growth rate + exogenous rate of the Harrod-neutral technical progress + constant rate of depreciation of capital = 0.05), $x_3 is\ m$ (military expenditure/GDP), $x_4 = m_{t-1}$; $n_t =$ Time specific effects and $\mu_i =$ group specific effects.

Study used panel data modeling, as it provides various benefits over cross-sectional and time series analysis. Due to the availability of cross-country time series data, fixed effect estimator, also known as the Least Square Dummy Variable (LSDV) model, seemed to be appropriate. While using country level panel data, we often come across the problem of omitted variable bias followed by unobserved country and time effects. In this case, the use of fixed effect estimation is preferred over pooled or random effects. While analyzing the suitability of LSDV fixed effects for panel data, Islam (1995) states that this technique allows the individual country effects to be correlated with the explanatory variables included in the model.

By making use of the Solow-growth model, the following fixed effects regression equation is used in the study.

$$\Delta \ln GDP_{it} = \beta_{o} + \beta_{1} \ln GDP_{it-1} + \beta_{2} \Delta \ln ME_{it} + \beta_{3} \Delta \ln K_{it} + \beta_{4} \Delta \ln GE_{it} + \beta_{5} T_{it} + \beta_{6} \Delta \ln POP_{it} + \beta_{7} \ln H_{it} + \beta_{8} \ln FDI_{it} + \beta_{8} m\_c_{it} + \beta_{10} A_{it} + \varepsilon_{it}$$

Where

$\ln GDP_{it}$ = Natural log of real GDP per capita

$\ln ME_{it}$ = Natural log of military expenditure as share of GDP

$\ln GE_{it}$= Natural log general government final consumption expenditure

$\ln K_{it}$ = Natural log of capital

$\ln H_{it}$ = Natural log of school enrollment rate

$\ln FDI_{it}$ = Natural log of foreign direct investment

T_{it} = Trade as percentage of GDP

$\ln POP_{it}$= Natural log of total population

m_c_{it}= Interaction term for military expenditure and conflict indicator

A_{it} = Arm imports as % of total imports

i = Cross Sectional data

t =Time series data

All the variables except for trade as percentage of GDP and arms imports as percentage of total imports are transformed to natural logarithm. Previously, literature that made use of this approach suggests that the empirical results are much more consistent and also enable us to estimate the coefficients in terms of elasticity which makes it easier to interpret the findings (Kalim & Hassan 2014). Therefore, the present study undertakes this approach to investigate the question posed.

3.3. Variables and Data Sources

Table 1 lists all the dependant and independent variables with their description and relevant data source. Data is collected from various sources as mentioned in the table for 61 countries[2] for the time period 1988-2015.

[2] List of the countries is available on request.

Table 1: Variables Description and Data Sources

Variable Name	Type of Variable	Definition of Variable	Data Source
Log real GDP per capita	Dependant Variable		World Development Indicators
Log military expenditure (% of GDP)	Independent Variable	Expenditure on armed forces (including peacekeeping troops), defense ministries, military agencies, paramilitary forces and all military related space activities.	Stockholm International Peace Research Institute (SIPRI)
Log of capital	Independent Variable	Capital stock is usually considered as an engine of economic growth.	Calculated by author
General government final consumption expenditure	Independent Variable	Government expenditure on goods and services including expenditures on national security, but excluding government military expenditures.	World Development Indicators
Trade as % of GDP	Independent Variable	Trade as a percentage of GDP is the sum of exports and imports of goods and services measured as a share of GDP.	World Development Indicators
Log school enrollment (Proxy for Human capital)	Independent Variable	Secondary education consists of the total number of pupils who are enrolled at secondary level in both public and private schools.	World Development Indicators
Log FDI (net inflows, as % of GDP)	Independent Variable	Foreign direct investment is referred to the net inflows of investment.	World Development Indicators
Total Population (Proxy for Labor force)	Independent Variable	Total population includes all residents in a country regardless of their legal status or citizenship.	World Development Indicators
(Conflict Indicator) * (military expenditure)	Interaction term	A country experiencing conflict during the given year has the value of 1 and otherwise. The product of conflict dummy variable and military expenditure is used as an interaction	Uppsala Conflict Data Program and International Peace Research

		term.	Institute Oslo (UCDP/PRIO) database used for conflict data.
Arms Imports[3] (as % of total imports)	Independent Variable	Arm imports include the supply of military weapons such as aircrafts, artillery, radar systems, armoured vehicles, missiles, and ships specially designed for military purpose.	Data for arms imports has been collected from various editions of WMEAT (World Military Expenditures and Arms Transfers)

4. Results and Discussion

Before employing the seemingly appropriate fixed effect estimator or Least Square Dummy Variable (LSDV) model, we run Hausman test to confirm its empirical significance. This test checks whether the error terms are correlated with the regressors or not. The result of Hausman test indicates that a random effects model is rejected at 5% significance level[4], hence fixed effects is an appropriate model to analyze the miltary-growth relationship. Table 2 depicts the results contained by estiamting Solow style regression model using Fixed effects estimator. Vrious specification forms are used to explore the impact of military expenditure on growth and results are reported in Table 2.

Model 1 shows the impact of some of the major determinants of economic growth without introducing variable of military expenditure in the equation in order to analyze and compare the pre and post-military growth rates. Lag of the dependant variable, natural logarithm of GDP per capita, has been used as an independent variable to tackle the issue of serial correlation in our model. The coefficients of general government final consumption, trade as % of GDP, total population, capital stock, secondary school enrollment and FDI have expected signs and a significant impact on GDP per capita as indicated by the t-values (indicated in parenthesis). However, the coefficient of lagged real GDP per capita is significant with a negative sign.

Model 2 includes military expenditure as percentage of GDP in the regression in order to analyze the impact of military burden. The results indicate that military expenditure has a negative and significant impact on real GDP per

[3] Natural log of arm imports is not taken as some of its values are negative or near to zero.
[4] Results are available on request.

Table 2: Military Expenditures and Economic Growth

Variable	Model 1	Model 2	Model 3	Model 4
lagged ln GDP per capita	-.0506*** (-8.7)	-.0504*** (-8.9)	-.053*** (-9.2)	0.0526*** (-7.9)
Δln Government Expenditure	.1244*** (10.96)	.1304*** (11.6)	.1313*** (11.7)	0.1319*** (9.67)
Trade as % of GDP	.0003** (4.55)	.0003** (4.8)	.0003** (5.03)	.0003** (4.43)
Δln Capital Stock	.834*** (10.5)	.85*** (11.02)	.8446*** (10.9)	.8557*** (8.5)
Δln Total Population	-.9788* (-5.8)	-1.05** (-6.4)	-1.060** (-6.5)	-1.011*** (-4.92)
ln Secondary School Enrollment	.011* (2.8)	.0112* (2.9)	.0121* (3.1)	.0121* (3.03)
ln FDI	.003** (3.7)	.003** (3.7)	.0031** (3.8)	.0027** (3.1)
Δln Military Expenditure as % of GDP	-	-.047*** (-6.9)	-.0444*** (-6.4)	-.0434*** (-4.85)
(Military)x(Conflict)	-	-	-.0029* (-2.3)	-.0028* (-2.16)
Arm Imports as % of Total Imports	-	-	-	-0.00007 (-0.89)
Constant	.224** (3.8)	.222*** (3.8)	.238*** (4.1)	.223*** (3.86)
Observations	1218	1218	1218	1206
F-Statistic	13.9	15.9	14.8	14.8
P-Value	0.00	0.00	0.00	0.00
R^2	0.33	0.36	0.36	0.3653
Adjusted R^2	0.29	0.32	0.32	0.3262
Root MSE	0.027	0.027	0.026	0.02701

Notes: *denotes significance at 10%; **at 5%; and***at 1% respectively. All time dummies have been included in the regression and results are available on request. T-values are in parenthesis.

capita. The overall significance of the model also increases as the variable of military expenditure is added in the equation, but the coefficients of the other variables only experience a slight change. The negative and significant impact of military expenditure implies that after controlling for general government final consumption, trade, population, capital stock, human capital and FDI measurement, military spending has a direct negative effect in 61 countries. These findings support the earlier findings of Hou and Chen (2013) and Yakovlev (2007).

Model 3 contains an interaction term (military expenditure×conflict) in addition to the previously included variables. This approach was also used by Aizenman and Glick (2003) who used the interaction term of military expenditure and threat variable to test for a non-linear relationship between military spending and economic growth. The results show a negative and significant relationship between the interaction term and growth rate, while maintaining a negative and significant relationship between military expenditure and growth. This suggests that military expenditure in the presence of external conflicts has a negative and significant impact on growth. This finding is in contradiction to that of Aizenman and Glick (2003) that found a positive impact of interaction between military and threat on growth while maintaining a negative impact of military expenditure and threat variable separately on economic growth. The results suggested that military spending and an external threat to the country individually reduce economic growth, but military expenditure in the presence of threats tend to have a positive impact on the economy. The negative sign of interaction term predicts that frequent interstate conflicts make it crucial for county to spend more on their military projects. Hence, conflicts together with higher military expenditure can slow down the economic growth. Including the military spending variable and the interaction term corrects the sign for lagged real GDP per capita. Hence, lagged GDP per capita now has a positive and significant impact.

In model 4, we introduced arms imports as a percentage of total imports as another important variable in the regression equation. The coefficient of arms imports as a percentage of total imports is found to be negative but has insignificant impact on GDP per capita as shown in Table 2. This finding is in line with that of Yakovlev (2007). The negative impact is because of the fact that importing arms and weapons for military purposes is very expensive. Some countries even have to take loans from other countries or are bound to utilize a large portion of their military budget to pay for these weapons. This can even lead to indebtedness in many low-income countries as pointed out by Looney (1989). Another reason could be that it is a politically unpopular choice for nations to be

dependent on the arms provided by other nations for their own defense. Yalovlev (2007) suggests that it is economically efficient to produce arms domestically instead of importing them that is why countries producing arms are able to reduce their military burden by exporting weapons. Model 4 also makes use of the robust regression which reduces the standard errors and automatically resolves the problem of heteroskedasticity.

5. Conclusions

Literature pertaining to defense economics contains a number of studies debating over the issue of military expenditure and its impacts on economic growth. Despite the extensive research, no concrete conclusion has been reached. The empirical results provide conflicting results based on the countries undertaken, the time span covered, the theoretical model employed and the estimation technique used. This study estimated four models to investigate the relationship between military spending and economic growth using least square dummy variables fixed effect panel data methodology for sixty one countries. The results of fixed effect estimator or Least Square Dummy Variable indicate that the population, capital stock, secondary school enrolment and FDI have positively and significantly affected the economic growth (model 1). Military spending has negative and significant impact on economic growth (model 2) and interaction between military expenditure and conflict also exerts a negative impact on growth. Model three results suggest that military spending and an external threat to the country individually reduce economic growth, which implies that frequent interstate conflicts make it crucial for county to spend more on their military projects. Hence, conflicts together with higher military expenditure can slow down the economic growth. This means that military expenditure in the presence of interstate conflicts further adds to the burden of economy. Inclusion of military spending variable and the interaction term corrects the sign for lagged real GDP per capita. Hence, lagged GDP per capita now has a positive and significant impact. Hence, the empirical results of the study support the evidence negative impact of military expenditure on growth.

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