Using the Feder-Ram and Military Keynesian Models to Examine the Link between Defence Spending and Economic Growth in Sri Lanka

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This study uses the Feder-Ram, model in conjunction with the military Keynesian model to examine the nexus between defence spending and economic growth in Sri Lanka, which was embroiled in a vicious internal war with a formidable separatist movement for about three decades. We find that the Keynesian aggregate demand model is better suited to analyze the link than the Feder-Ram model for the case of Sri Lanka. Based upon our results we expect a higher economic growth rate in Sri Lanka if more public resources are diverted from the defence to civilian sectors of the economy, now that the war between the government and separatist group has come an end. However, recent post war events cast doubt upon whether a diversion of sources from military to non-military will actually occur. We conclude that the sanguine predictions of our economic analysis are entirely dependent upon the political decisions of the Sri Lankan government for their realisation.

JEL Codes: C23, O47

1. Introduction

Studies investigating the nexus between defence spending and economic growth have of late paid more attention to the case of Sri Lanka, a small island nation in the Indian Ocean, for a number of reasons. First, the government there recently won a civil war that had lasted for almost three decades against a formidable separatist guerrilla movement that possessed its own a naval and air wings in addition to a large number of dedicated, well-trained troops including hundreds of suicide bombers. Second, compared to other conflict-ridden developing countries, Sri Lanka possesses a reasonably long time series data set that can be used to estimate econometric models and make more valid statistical predictions concerning the relationship between defence spending and economic growth. Third, and finally, because Sri Lanka was able to maintain a healthy economic growth rate throughout its bloody separatist conflict, the advent of peace promises heightened economic growth following the reallocation of resources from the less productive defence sector to the more efficient civilian sector. Against this promise of a brighter economic future, however, the victorious government has opted to bolster its military capabilities by enlisting more army personal and signing a USD 300 million loan contract to purchase military hardware from Russia (BBC, 6 February 2010). In addition, violent protests between government and opposition party supporters have escalated after the recently concluded presidential election and arrest of the defeated presidential candidate. These events re-emphasise the question of exactly what effect the end of Sri Lanka's civil war will have upon its economic fortunes.

Several studies have attempted to unravel the relationship between defence spending and economic growth in Sri Lanka. However, only a handful of them have conducted a rigorous econometric analysis. Wijeweera and Webb (2009) for instance, employ a vector autoregression analysis to examine the link between the two variables and find that, compared to non-military spending, military spending exerts only a minimal positive impact

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on real GDP. Earlier studies (e.g. Arunatilake, Jayasuriya, & Kelegama, 2000; Kelegama, 1999; Ravano, 2001) examined the economic costs of the military conflict in Sri Lanka in descriptive terms but lack advanced statistical tests to support their findings. In contrast, other studies on the economic impact of defence spending in Sri Lanka (e.g. Adams, Behrman, & Boldin, 1991) focused upon only a limited period of the conflict.

This study differs from the existing literature on Sri Lanka for two reasons. First, it uses a supply side, or Feder-Ram, model in conjunction with a demand side, or Keynesian, model to estimate the relationship. While, Wijeweera and Webb (2009) use a demand side Keynesian income framework to examine the link between economic growth and defence spending in Sri Lanka, to our best knowledge the Feder-Ram model has not been used in the case of Sri Lanka. The Feder-Ram model uses an aggregate production function approach to estimate the transmission mechanism from defence spending to economic growth. This approach was first proposed by Feder (1983) and Biswas and Ram (1986) and has subsequently been utilized by several researchers (e.g. Wilkins, 2004). Second, no published studies have used both demand and supply frameworks for a single country for an identical time period to examine the relationship between military spending and economic growth. This unique feature allows us to explain whether the link between defence expenditure and economic growth is invariant to the choice of the model.

This paper consists of five main sections. After the introduction in Section 1, Section 2 briefly discusses the institutional framework in relation to Sri Lanka. Section 3 provides a review of the existing literature on the topic. Section 4, summarizes the economic modeling, data sources, and estimation techniques that we use to examine the defense spending and economic growth relationship in Sri Lanka. Section 5 then interprets the results of the estimations prior to some final concluding remarks in Section 6.

2. Institutional Framework

Sri Lanka was embroiled in a vicious civil war with a formidable separatist movement for more than three decades from the late 1970s to May 2009. During this time military expenditure as well as the role of the military in the governance of the country expanded due to the need to confront the separatist *Liberation Tigers of Tamil Eelam* (LTTE) who sought to partition the country to create an ethnic homeland in the north-east. As a percentage of GDP, military spending in Sri Lanka increased from 1.6% in 1989 to 5.3% in 1995 before declining to 2.9% in 2006, or from 4.1 billion Sri Lankan rupees in 1989 to 105 billion in 2007 (Stockholm International Peace Research Institute, 2008). With this increase in spending came a corresponding increase in mobilization as the number of defense personnel rocketed from 22,000 in 1990 to 152,000 in 2003 (SIPRI, 2008) as the government battled the well-equipped and trained LTTE. Despite this increasing military expenditure, Sri Lanka nonetheless averaged a very respectable growth rate of about 4.5 percent per annum during this same period (O'Sullivan, 2001) raising the questions of to what degree this growth was related to the government's program of military spending and whether this money might have been better spent.

3. Literature Review

Numerous studies have investigated the link between military spending and economic growth with mixed results. Benoit (1973; 1978) suggested that they are positively related with other researchers using similar methodologies largely concurring with his findings. This positive link is attributed to improved infrastructure, enhanced aggregate demand, and decreased unemployment (Chletsos & Kollias, 1995; MacNair, Murdoch, & Sandler, 1995; Mueller & Atesoglu, 1993). In contrast to these positive 'spillover' theories, other analysts argue that the comparatively high opportunity cost of military spending renders it sub-optimal

as a driver of economic growth (Galvin, 2003; Ward, Davis, Penubarti, Rajmaira, & Cochran, 1991). For example, it has been suggested that direct government investment in education, infrastructure and health may be more productive in terms of wealth creation than military spending (Dunne, Nikolaidoua, & Vougas, 2001; Mintz & Huang, 1990; Scheetz, 1991). Military spending may also crowd out private investment and have adverse implications on the balance of payments that are exacerbated where military expenditure is financed via increases in taxation (Cappelen, Gleditsch, & Bjerkholt, 1984; Deger & Smith, 1983; Dunne et al., 2001; Faini, P. Annez, & Taylor, 1984; Lim, 1983; R. Smith, 1980; R. P. Smith, 1977).

Conversely, other studies have claimed that the relationship between military spending and economic growth may be bi-directional or ambiguous (Chowdhury, 1991; Lai, Shieh, & Chang, 2002; Madden & Haslehurst, 1995; Wilkins, 2004) or non-existent (Adams et al., 1991; Alexander, 1990; Biswas & Ram, 1986; Chen, 1993; Gerace, 2002; Grobar & Porter, 1989; C. Huang & Mintz, 1990; Chi Huang & Mintz, 1991; Kollias & Makrydakis, 1997; Ram, 1995). The multiplicity of often conflicting results in the literature is in part due to the variety of methodologies employed as well as the wide range of countries studied. Complicating matters further is the difficulty of isolating the effects of military spending on economic activity from other national and international developments that may also impact economic growth. For example, positive and negative effects may operate simultaneously (Dakurah, Davies, & Sampath, 2001; Lai et al., 2002), and causality may be bi-directional, i.e. while defense spending may boost economic growth, economic growth may also cause defense spending to rise. For instance, countries experiencing higher growth may increase military spending in response to a perception that their relative economic prosperity makes them a more likely target of hostile intentions from neighbouring countries (Cappelen et al., 1984; Chowdhury, 1991; Joerding, 1986; Kusi, 1994). Finally, in the case of countries such as Sri Lanka where increases in military spending occur in a time of war, additional complexities such as the length and severity of the conflict and the degree to which economic agents are able to predict these factors and alter their behaviour accordingly may also affect the economic impact of military spending (Schneider & Troger, 2003).

4. Economic Modelling, Data Source and Estimation Technique

As noted before, we employ the Feder-Ram aggregate production function approach to model the relationship between defence expenditure and economic growth in Sri Lanka. Following Wilkins (2004), we assume a two sector economy with a military (M) production function:

$$M = M(L_M, K_M) \tag{1}$$

This is coupled with a civilian production function:

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

In addition, the inputs, L_M, K_M, L_C, K_C are labour and capital shares in the military and civilian sectors respectively. Following Wilkins, we include *M* in equation (2) to allow an externality effect from the military sector to civilian sectors. Aggregate labour (*L*), capital (*K*) and national income (*Y*) are given in equation (3), (4), and (5) respectively:

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

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

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

Considering the above relationships, and taking the total differential of equation (5) and then dividing by *Y* we obtain equation (6):

$$\frac{\partial Y}{Y} = \frac{\partial C}{\partial L}\frac{dL}{Y} + \frac{\partial C}{\partial K}\frac{dK}{Y} + \frac{\partial C}{\partial M}\frac{dM}{Y} \tag{6}$$

We then multiply the first term of (6) by *L/L* and the third term by *M/M*:

$$\frac{\partial Y}{Y} = \frac{\partial C}{\partial L}\frac{dL}{Y}\frac{L}{L} + \frac{\partial C}{\partial K}\frac{dK}{Y} + \frac{\partial C}{\partial M}\frac{dM}{Y}\frac{M}{M} \tag{7}$$

Then growth variables for national income (y), labour (l), capital (k), and military spending (m) are defined as in equation (8):

$$y = \frac{\partial Y}{Y}, \qquad l = \frac{dL}{L}\frac{L}{Y}, \qquad k = \frac{dk}{Y}, \qquad m = \frac{dM}{M}\frac{M}{Y} \tag{8}$$

Noting that slope coefficients can be estimated, equation (9) produces the version of the Feder-Ram model that we use to estimate the relationship between defence spending and economic growth:

$$y = \beta_0 + \beta_l l + \beta_k k + \beta_m m + \varepsilon \tag{9}$$

Data that we need to estimate equation (9) are obtained from several sources. Labour and national income data are from the *World Bank Development Indicators* data base. Our principle data source for military spending is the Stockholm International Peace Research Institute (SIPRI). Since SIPRI provides data only after 1988, we also use various issues of the *Central Bank of Sri Lanka* annual reports to collect pre-1988 defence spending data. As these publications produce data in raw form, in order to carry out the estimation we transform the data using the relationships given in equation (8) before running a regression analysis.

In contrast, the demand side model is derived from augmenting a Keynesian cross model by incorporating defence spending as an additional explanatory variable. The structural form of the Keynesian model is used to derive the reduced form. The derivation from the structural to reduced model is shown in Atesoglu (2002) and Halicioglu (2004). To conserve space, we omit the structural equations here and show only the reduced form of the national income equation (10) that we use to estimate the relationship between military spending and economic growth in Sri Lanka where LRGDP is the log of real gross domestic product, LMEX is the log of military expenditure, LNMEX is the log of non-military expenditure and RIR is the real interest rate. With the exception of RIR, all other variables are expressed in terms of constant USD millions at year 2000 exchange rates:

$$LRGDP_t = \beta_0 + \beta_1 LMEX_t + \beta_1 LNMEX_t + \beta_1 IRR_t + u_t \quad (10)$$

5. Discussion of Results

Turning first to the Feder-Ram model, we employ the ordinary least squares (OLS) method to estimate the model shown in equation (9). As is customary, we begin by conducting a unit root test for each series. The results suggest that the series does not contain a unit root and therefore no transformation is necessary to conduct the estimation. To improve upon the results, a time trend is included in the specification. We also incorporate an AR(2) term in the final specification to control for serial correlation because Q-statistics suggest that serial correlation in errors is a problem in the initial specification of a model that omits an AR(2) term. The final results are shown in Table 1.

Table 1: OLS Regression Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000474	0.069015	0.006872	0.9946
L	0.008114	0.006949	1.167591	0.2549
K	0.377969	0.20385	1.854155	0.0766
M	0.914392	0.969566	0.943095	0.3554
@TREND	0.001331	0.00133	1.000733	0.3274
AR(2)	-0.3383	0.199873	-1.692554	0.104
R-squared	0.17641	Mean dependent var		0.145192
Log likelihood	52.41368	Durbin-Watson stat		1.95887

The results show that t-statistics for each of the main coefficients (L, K, M) are positive, but statistically significant (at a 10 percent level) only for the growth rate of capital. Our main variable of interest is the estimated coefficient of military expenditure (M). Since it is statistically insignificant, we cannot comment on whether military spending exerts a positive impact on economic growth in Sri Lanka. Not only are the coefficients statistically insignificant, but also the R^2 is quite low which means that the model is not strong enough to explain the variation of economic growth. This casts doubt on the suitability of a Feder-Ram model to examine the link between military spending and economic growth in the case of Sri Lanka.

With respect to the Keynesian Model, following the time series literature, we conduct unit root tests in each series. The test results show that we cannot reject the null hypothesis of a unit root at a 5 percent level of significance, which means that all four series (LRGDP, LMEX, LNMEX, and RIR) do contain a unit root and, hence, are non-stationary. Consequently, it now becomes necessary to check for cointegration or long run relationships because it is possible to have a linear combination of the four variables that *is* stationary (Enders, 2004). We employ the Engle and Granger (1987) two-step cointegration approach as the primary test for estimating long-run relationships. This requires two steps: (a) the best possible linear regression equation is estimated and the residuals are saved; and (b) a unit root test such as the Philips-Perron (1988) is used to test whether the residual series is stationary. The results of these tests provide strong evidence for the existence of a long-run equilibrium relationship with LRGDP and LMEX, LNMEX, IRR. Therefore, we may proceed to use the OLS method to estimate equation (10) to examine military spending and economic growth. The results are shown in Table 2.

Table 2: Long-Run Equilibrium Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.008346	0.130404	53.74353	0
LMEX	0.019425	0.01775	1.094407	0.2828
LNMEX	0.323127	0.028519	11.33035	0
IRR	-0.00753	0.00215	-3.50181	0.0015
R-squared	0.989472	Sum squared resid	0.06583	9.311652
Adjusted R-squared	0.988382	Log likelihood	55.75853	0.442035
F-statistic	908.482	Prob(F-statistic)		0

The results show that a demand side model is considerably better in explaining the nexus between military spending and economic growth in Sri Lanka. According to the adjusted R^2 value, about 99 percent of the variation of economic growth can be explained via the Keynesian model. The overall strength of the model also carries to the individual parameters. For instance, estimate coefficients of all three explanatory variables have an expected sign with two of them statistically significant at a 5 percent of level of significance. Similar to the Feder-Ram model results given earlier, the demand side long-run relationships based upon the Keynesian model show that there is no statistically significant impact of military spending upon economic growth in Sri Lanka. While the coefficient is positive (0.019425), it is not statistically significant at a conventional level of significance and is so small as to be almost negligible. In contrast, non-military government expenditure exerts a significantly positive impact upon economic growth with a coefficient of 0.323127. Put simply, this suggests that a one percent increase in non-military expenditure increases real GDP by about one third of a percent (0.3%).

6. Conclusion

In this paper we examine the relationships between defence expenditure and economic growth in Sri Lanka over the period 1976-2007 employing both supply and demand side models to estimate the relationship. The supply side model is given by the Feder-Ram model and the demand side by an augmented Keynesian model. We find that the Keynesian type aggregate demand model is better suited to analyze the link than the Feder-Ram supply side for the case of Sri Lanka. Results based on both models suggest that the impact of military spending on growth is positive but insignificant. However, the results from the demand side model suggest that other explanatory variables, such as non-defence spending and interest rates exert a significant impact on economic growth in Sri Lanka. According to our analysis, therefore, the demand side model seems far superior to the supply side model to examine linkages between the two variables.

Based upon these results we expect a higher economic growth rate in Sri Lanka if more public resources are diverted from the defence to civilian sectors of the economy now that the war between the government and separatist LTTE has come to an end. This prediction is further strengthened by Sri Lanka's impressive economic performance during the war years when, despite maintaining a relatively high level of military spending, Sri Lanka nonetheless managed a very respectable rate of economic growth. Therefore, if the Sri Lankan economy was capable of such a robust performance during the war years, when up to 152,000 Sri Lankans were serving in the military (SIPRI, 2008), one might reasonably expect economic growth to rise substantially when these resources were directed to the more productive civilian sector. However, recent post war events such as the signing of a 300 USD million weapon purchase agreement with Russia, continuing to increase the number of

military personnel, worsening conflicts between pro-government and opposition supports and the arrest of journalists and opposition supporters cast doubt whether a diversion of resources from military to non-military will actually occur. In conclusion, therefore, the sanguine predictions of our economic analysis are entirely dependent upon the political decisions of the Sri Lankan government for their realisation.

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