Defense spending and economic growth in Asian economies: A panel error-correction approach

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5 January 2008

DEFENSE SPENDING AND ECONOMIC GROWTH IN ASIAN ECONOMIES: A PANEL ERROR-CORRECTION APPROACH

by

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ABSTRACT

Hoping to contribute to the existing pool of literature, this paper examines the relationship between military expenditure and economic growth in selected Asian countries for the period 1989 to 2004. Our panel unit root test suggests that real GDP per capita and military expenditures are $I(1)$ processes, while the Larsson et al. (2001) panel cointegration test indicates that economic growth and military expendirues are cointegrated. Finally, applying the panel error-correction technique proposed by Pesaran et al. (1999), our empirical results show that defense spending and economic growth in the Asian countries under the period of study are not related.

Keywords: Military expenditure; Economic growth; Panel unit root; Panel cointegration; Panel error-correction; Asian economies

JEL Classification Code: H56; O10; O40

INTRODUCTION

Is defense spending related to economic growth? This question has important implication for policy makers and researchers. 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

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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).

From the viewpoint of the researchers, the question of whether military spending Granger cause economic growth or otherwise has important implication for empirical work. Using annual data on 57 LDCs, Joerding (1986) found out that economic growth Granger cause military spending but found no evidence that military spending Granger cause economic growth. Joerding (1986) conclude that military spending potentially is an endogenous variable and consequently this has important econometric implication when estimating an equation with military spending as one of the independent variable. Ades and Chua (1997) provides a good example for the endogeneity of military expenditure. Ades and Chua

(1997) argue that regional instability has a strong positive influence on military spending and they found that military outlays respond more to outside rather than to inside threats. Countries devoting large resources to military buildup are likely to force a similar response among its neighbours, a reaction necessary to deter potential future military aggressions. Examples of this "ratcheting effect" abound among countries in the Middle East, between North and South Korea, and among Argentina, Chile and Brazil during the 1970s and 1980s.

The purpose of the present paper is to determine empirically whether military spending is related to economic growth in selected Asian economies. The Asian countries selected are Bangladesh, China, India, Indonesia, Japan, Malaysia, Pakistan, Philippines, Singapore, South Korea, Sri Lanka and Thailand. Our paper contributes to the present literature on defense spending-economic growth 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.

REVIEW OF RELATED LITERATURE

Since the pioneering seminal work by Benoit (1973, 1978), the results of a large volume of empirical work on the military expenditure-economic growth nexus is at best mixed. In contrast to the popular notion that military spending retard growth, the results of a positive impact of military spending on economic growth in developing countries found by Benoit (1978) has resulted in an explosion of research interest in this topic. Numerous studies has been conducted on both the developed and developing countries, and using both cross-section and time-series data and various techniques from simple OLS to more sophisticated VECM approach (see for example Benoit, 1978; Deger, 1986; Karagol and Palaz, 2004; Dakurah et al., 2001; Kollias et al., 2004).

Nevertheless, the discussions and empirical evidence on the causal link between defense spending and economic growth has resulted into several competing hypotheses. First, is the bi-directional causal relationship between military spending and economic growth. The feedback relationship implies that defense spending causes economic growth and economic growth causes higher defense spending (Kusi, 1994). Second, is unidirectional causality running from military expenditure to growth. This relationship indicate the presence of aggregate demand and employment effects that to a large extent may be attributed to domestic arms production and spin-offs from military research and development (Benoit, 1973, 1978; Deger, 1986). Third, is unidirectional causality running from economic growth to military spending. This relationship can be interpreted as an indication that countries are trying to protect their wealth and people from external threats (see Kollias et al., 2004). Finally is the view that indicates that there is no relationship between defense spending and economic growth (Biswas and Ram, 1986; Grobar and Porter, 1989).

There are numerous studies that commensurate to the above four possible outcomes. For example Dakurah et al. (2001) show that unidirectional causality running from military expenditure to growth was found in 10 countries, from economic growth to military expenditure in 13 countries, while bi-directional causality existed in 7 countries. Causality did not exist in 18 countries that were integrated of the same order, while in 14 countries the data were integrated of differing orders. On the other hand, a study by Joerding (1986) on 57 LDCs found Granger causality that runs from economic growth to spending expenditure but not otherwise. Study on the Arab Gulf region by Al-Yousif (2002) show mixed results. For Saudi Arabia, the causality is positive and runs from defense spending to economic growth. By contrast in Iran and Kuwait, defense spending leads to lower economic growth. The results for Bahrain indicate that defense spending leads to economic growth, while in the UAE, there is a bi-directional causality between defense spending and economic growth. However, in Oman, defense spending and economic growth do not seem to be related.

Other studies that contribute to the above debate on military spending-economic growth nexus include among others; Kusi (1994), Chowdhury (1991), Frederiksen and LaCivita (1987), Frederiksen (1991), Rahman (2000), Lai et al. (2005), Khilji and Mahmood (1997), Chang et al. (2000), LaCivita and Frederiksen (1991), and Chen (1993). Since the present paper addressed the issue of the presence and direction of causality between military expenditure and economic growth in the case of selected Asian countries, we show in Table 1 the results of the four outcomes of the above literature with respect to the Asian countries under study.

[insert Table 1 about here]

Several interesting observation we can derive from Table 1. First, only in the cases of Indonesia and Bangladesh that we found that the results are consistent. Bangladesh indicate economic growth causal effect military expenditure, while on the other hand, Indonesia suggest that military expenditure causal effect economic growth. Second, for other countries, result of direction of causation differs with different studies. The lack of consensus on the direction of causation between defense spending and growth can be due to the non-stationary of the time-series variables used in the analysis. According to Granger and Newbold (1974), both the use of non-stationary variables and the neglect of possible long-run relationships make regression results biased and reliable. Despite one addressed the issue of stationarity, one common criticism raised in the literature is that of the low testing power of the conventional unit root and cointegration tests. Therefore, in this study, to overcome the shortcomings of the conventional unit root and cointegration tests, we advocate in using the Panel Autoregressive Distributed Lag (PARDL) framework in line with Pesaran et al. (1999) to infer the direction of causation between military expenditure and economic growth in a group of Asian countries. Two recently developed methods for statistical analysis of dynamic panel data, namely the Mean Group (MG) and the Pooled Mean Group (PMG) estimations were employed in this study.

METHODOLOGY

Since the annual data available in our study ranges from 1989 to 2004 (16 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, $Growth_t$ denotes economic growth and $MExp_t$ denotes military expenditures

$$Growth_{it} = \theta_{0i} + \theta_{1i}\, MExp_{it} + \mu_{it} \tag{1}$$

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

$$Growth_{it} = \mu_{it} + \delta_{10i}\, MExp_{it} + \delta_{11i}\, MExp_{i,t-1} + \lambda_i\, Growth_{i,t-1} + \varepsilon_{it} \tag{2}$$

The subscripts $i = 1, 2, ..., 12$ stand for 12 Asian countries, the subscripts $t = 1989, 1990, ..., 2004$ for the years 1989 to 2004, 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 coefficients of the lagged dependent variable.

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

$$\Delta Growth_{it} = \phi_i\,(Growth_{i,t-1} - \theta_{0i} - \theta_{1i}\, MExp_{it}) - \delta_{11}\, \Delta MExp_{it} + \varepsilon_{it} \tag{3}$$

where $\theta_{0i} = \frac{\mu_i}{1-\lambda_i}$, $\theta_{1i} = \frac{\delta_{10i} + \delta_{11i}}{1-\lambda_i}$, 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 $\chi^2(p)$, 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 1989 to 2004. The Asian countries included in the study are Bangladesh, China, India, Indonesia, Japan, Malaysia, Pakistan, Philippines, Singapore, South Korea, Sri Lanka and Thailand. Data on share of military expenditure to gross domestic product and real gross domestic product per capita are collected the World Development Indicator database. All variables were transformed into natural logarithm.

DISCUSSION OF EMPIRICAL RESULTS

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 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

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

where α_i, β_i *and* γ_{ij} are parameters and the error terms ε_{it} are uncorrelated across regions. 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

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

and $t_{i,T}(p_i,\beta_i)$ is the individual $t-$statistic for testing $\beta_i = 0$ for all *i*. $E\left[t_{i,T}(p_i,0) \mid \beta_i = 0\right]$ and $Var\left[t_{i,T}(p_i,0) \mid \beta i = 0\right]$ are reported in Table 2 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, $\varepsilon_{it} = \delta_t + v_{it}$ where v_{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 β_i) of N independent ADF regressions. The test statistic (the Fisher test $P(\lambda)$) is as follows

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

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 $2N$ degree of freedom.

The result for the panel of unit root test for GDP and Military Expenditures are presented in Table 2. We report the estimated *t*-star statistics of the Levin-Lin-Chu (LLC) test, $t-$bar statistics for the Im-Pesaran-Shin (IPS) test and λ-values for the Fisher $P(\lambda)$ 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 $\psi_{\bar{t}}$ over Levin-Lin-Chu's t^*, 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 $I(1)$ as a group. The null hypothesis of unit root in levels cannot be reject at the 5 percent level of significance, while the null hypothesis of a unit root at in first difference can be reject at the 5 percent level of significance.

[insert Table 2 about here]

Test for panel cointegration

Having determined that both series are integrated of order one, that is, they are $I(1)$ processes; we proceed for the testing of panel cointegration. In this study we employ Larsson et al. (2001) panel cointegration test approach. Larsson et al. (2001) develop the test based on Johansen's (1988) multivariate cointegration framework. Given N countries with time dimension T and a set of $p\,I(1)$ variables, we estimate the Johansen heterogenous vector error-correction model (VECM) for each country N, using the maximum likelihood method and then the trace statistic LR_i, is calculated. The null hypothesis for heterogenous panels is that all N countries have the same number of cointegrating vectors (r_i) among the p variables, that is, $H_0 : rank(\Pi_i) = p$, for all $i = 1,\ldots,N$ (where Π_i is the long-run matrix of order $p\,x\,p$).

The panel cointegration rank trace test, γ_{LR}, is obtained by calculating the average of the N individual trace statistics LR_{NT} and then standardizing it:

$$\gamma_{LR} = \frac{\sqrt{N[LR_{NT} - E(Z_k)]}}{\sqrt{\operatorname{var}(Z_k)}} \Rightarrow N(0,1) \qquad (10)$$

where $E(Z_k)$ and $\operatorname{var}(Z_k)$ are respectively the mean and variance of the asymptotic trace statistic obtained by Larsson et al. (2001). The results of the Larsson et al. panel cointegration test are given in Table 3. The estimates of the trace statistics indicate that nine countries reject the null hypothesis of no cointegration. However, the panel cointegration rank trace statistic shown at the bottom of Table 3, strongly rejects the null of no cointegration and suggest that $r = 1$ is the largest rank in the panel. Therefore the Larsson et al. panel test favours the existence of one common cointegrating vector among the variables in the panel; it suggests that there appears to be a long-run equilibrium relationship relating economic growth and military expenditures in all countries.

[insert Table 3 about here]

Test for long-run causality

Our main purpose is to determine the causal direction between defense spending and economic growth in the Asian countries. 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 (except for Japan), but differences in institutional infrastructure and cultural, we expected that the long-run equilibrium relationships between fundamental variables is similar across the Asian 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 4 presents the estimates of the long-run coefficients 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 1. Then, using these SBC – determined lag orders, 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.

[insert Table 4 about here]

In Table 4, in order to test for the robustness of the estimates, we have presented the estimates of PMG and MG with and without Japan. The economic rational doing this is that Japan is a developed nation and therefore, we expect that Japan behave differently from the rest of the developing countries in the sample. In Panel A, we present the results where economic growth act as the dependent variable, while in Panel B, military expenditures act as the dependent variables. Under each panel, the first estimated equation is where we estimate all country, while in the second equation we exclude Japan. In Table 4 we also show 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 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 estimated equation with economic growth as dependent variables for both samples – with and without Japan; and the sample without Japan for estimated equation with military expenditures as dependent variable. This indicates that the difference between MG and PMG estimates is not significant. This implies that the long-run relationship between economic growth and defense spending is equal across the Asian countries. However, only in the case of estimated equation without Japan with military expenditures as the dependent variable that the Hausman test is statistically significance at the 5 percent level.

Next we observe for the significance of the error-correction term to infer long-run causality between the two variables. As shown in Table 4, our results strongly suggest that the null hypothesis that there is no long-run causality in either direction cannot be rejected at the 5 percent level. This implies that defense spending and economic growth in the Asian countries are independent. Our result is consistent with earlier finding in Biswas and Ram (1986) and Chowdhury (1991). Biswas and Ram (1986) found 80 percent of the countries in their study does not show any present of statistical significant relationship between defense spending and economic growth, while Chowdhury (1991) found 55 percent of the countries show no relationship between the two variables.

CONCLUSION

This study made an attempt to examine the long-run relationship and the causal direction between military expenditures and economic growth in twelve Asian countries, namely; Bangladesh, China, India, Indonesia, Japan, Malaysia, Pakistan, Philippines, Singapore, South Korea, Sri Lanka and Thailand. We use annual data for the period 1989 to 2004. We applied the 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; using the Larsson, Lyhagen and Lothgren (2001) panel cointegration test for the testing of long-run relationship between defense spending and economic growth; and we employed the Pesaran, Shin and Smith (1999) panel error-correction model to infer long-run causality between the two variables.

Our results clearly indicate that time-series defense spending and economic real GDP per capita are integrated of order one as a group. Our panel cointegration result suggest that the two macro-variables are cointegrated that is there is long-run relationship between military expenditures and economic growth. Lastly, our panel error-correction model indicates strongly that defense spending and economic growth is not related in the Asian countries under study, although the sample has been test for the absence/present of Japan.

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Table 1: Summary of Results of Causation between Military Expenditure (Mexp) and Economic Growth (Growth) for Selected Asian Countries

Author(s)	Direction of causality			
	Mexp → Growth	Growth → Mexp	Mexp ↔ Growth	Independent
Chen (1993)	-	-	-	China
LaCivita and Frederiksen (1991)	Thailand	Sri Lanka	Pakistan	Philippines India
Khilji and Mahmood (1997)	-	-	Pakistan	-
Chang et al. (2000)	-	China	-	-
Rahman (2000)	-	Bangladesh	-	-
Frederiksen (1991)	Indonesia Singapore	Malaysia	Thailand	South Korea Philippines
Frederiksen (1987)	-	Philippines	-	-
Chowdhury (1991)	Indonesia South Korea Philippines Thailand		-	Malaysia
Lai et al. (2005)	China	-	-	-
Kusi (1994)	Indonesia South Korea Malaysia Pakistan	Bangladesh	-	India Philippines Singapore Sri Lanka Thailand

Notes: Symbols → and ↔ denote unidirectional and bi-directional respectively.

Table 2: Results of Panel Unit Root Tests

Series	Levin-Lin-Chu test , t^{*} [a]	Im-Pesaran-Shin test, $\psi_{\bar{t}}$ [a]	Maddala-Wu test, $P(\lambda)$ [b]
A. Level			
GDP	-1.50 (0-2) [0.06]	2.02 (0-2) [0.97]	20.63 (0-2) [0.66]
MExp	-0.99 (0-2) [0.16]	0.79 (0-2) [0.78]	20.69 (0-2) [0.65]
B. First difference			
GDP	-7.84 (0-3) [0.00]*	-6.54 (0-3) [0.00]*	85.71 (0-3) [0.00]*
MExp	-8.94 (0-1) [0.00]*	-6.93 (0-1) [0.00]*	88.17 (0-1) [0.00]*

Notes: [a]Under the null hypothesis, the standardised $t-$ bar statistic $\psi_{\bar{t}}$ (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 $P(\lambda)$ 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 1% level.

Table 3: Larsson et al. (2001) Panel Cointegration Tests

Country-by-country tests				
	$LR_{CT}\left[H(r)\middle|H(2)\right]$			
Country	*lag*	$r=0$	$r=1$	$Rank\,(r)$
Bangladesh	1	16.17*	0.74	1
China	1	16.32*	0.46	1
India	2	21.44*	0.26	1
Indonesia	3	11.71	0.49	0
Japan	1	16.18*	1.83	1
South Korea	1	16.26*	0.00	1
Malaysia	1	10.47	3.57	0
Philippines	1	16.73*	2.52	1
Pakistan	1	7.88	0.05	0
Singapore	1	16.64*	2.49	1
Sri Lanka	3	18.46*	0.39	1
Thailand	3	17.48*	2.42	1
Avg(TR)		15.47	1.26	
$E(Z_k)$		6.08	1.13	
$\text{var}(Z_k)$		10.53	2.21	
γ_{LR}		3.77*	0.97	

Notes: Trace statistics (with unrestricted intercepts and no trend in the vector autoregression) are reported for individual countries. The 5% critical values are 15.49 for r=0 (against the alternative $r \geq 1$) and 3.84 for $r \leq 1$ (against the alternative r=2). The critical values for $E(Z_k)$ and $\text{var}(Z_k)$ are obtained from Larsson et al. (2001: Table 1). The panel rank test has a critical values of 1.645 (5%) and 2.326 (1%).

Table 4: PMG and MG Estimates for Causality between Growth and Military Expenditures

	Pooled MG			MG			Joint Hausman test	
	Coef	St. Er	*t*-ratio	Coef	St. Er	*t*-ratio	*h*-test	*p*-values
A. Dependent variable: Economic growth								
1. Long-run coefficient (All Asian countries)								
MExp	0.084	0.184	0.456	0.487	0.608	0.802	0.48	0.49
Error Correction Coefficient								
Phi	-0.039	0.023	-1.711	-0.049	0.028	-1.740		
2. Long-run coefficient (Asian without Japan)								
MExp	0.123	0.196	0.628	0.594	0.656	0.906	0.57	0.45
Error Correction Coefficient								
Phi	-0.033	0.023	-1.394	-0.047	0.031	-1.526		
B. Dependent variable: Military expenditures								
1. Long-run coefficient (All Asian countries)								
Growth	-2.886	0.293	-9.864*	-1.439	0.766	-1.877	4.18*	0.04
Error Correction Coefficient								
Phi	-0.154	0.089	-1.734	-0.264	0.080	-3.316*		
2. Long-run coefficient (Asian without Japan)								
Growth	-2.899	0.295	-9.841*	-1.555	0.830	-1.874	3.00	0.08
Error Correction Coefficient								
Phi	-0.166	0.096	-1.728	-0.279	0.086	-3.255*		

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