International Journal of Engineering and Information Systems (IJEAIS)
ISSN: 2643-640X
Vol. 8 Issue 4 April - 2024, Pages: 39-45

Arms Race And Economic Growth, The Case Study Of Pakistan And India

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Abstract*: This study uses the Richardson model to investigate the presence of a arms race between Pakistan and India . Using the generalized method of moments, we find that the grievance term for the Pakistan model is positive, while that for India is negative. The defense spending of both countries in the previous period is negatively related to the change in their own defense spending due to the economic or administrative incidence of an arms race. Furthermore, the defense or reaction coefficients in the specified model determine the presence of an arms race between the two countries. The signs of these coefficients are positive according to the classical Richardson model, suggesting that an arm. In fact, there is a race between Pakistan and India.*

Keywords: arms race, defense spending, generalized method of moments, complaint term, reaction coefficients, Pakistan, India.

JEL classification: C45, H56.

1. Introduction

Countries allocate their defense budgets taking into account various considerations. Firstly, the resources spent on defense could be used to other purposes, such as education, health, infrastructure or social welfare.
Second, excessive defense spending can hinder economic growth by diverting resources or investments from potentially more productive uses.
Third, there are consequences for regional security: high defense spending and weapons acquisition in one country can provoke a similar response from its neighbors and rivals. Even neighbors who do not particularly fear an attack may find themselves pressured by their defense institutions to adopt new technologies for reasons of global prestige. Such pressures can lead to regional arms races.

These concerns have raised the issue of defense and arms spending races between academics and policymakers. The global arms race is the focus of considerable campaigning, tactical and legislative attention, and academic studies (see, for example, Anderton, 1989; Andreou & Zombanakis, 2010; Dalton & Tandler, 2012; Dunne, Nikolaidou, & Smith, 2005; Kollias and Paleologou, 2002; Mohammed, 1992 important role of the State to provide and maintain peace in the country by improving its defense capabilities to safeguard national interests, the question is what budget should the government allocate for the acquisition of weapons.Literature on international relations presents the phenomenon of the race arms control in the context of security dilemmas. An arms race is considered competition between two or more entities to accumulate weapons, armed forces, advanced military technology and military power.
It is the dynamic, competitive and resource-limited process of interaction between two states or coalitions of states in their acquisition of weapons (Brito and Intriligator, 1995).The issue of the arms race is of great importance for countries in development like Pakistan and India. Both allocate a large portion of their budgets to defense, given its threats to internal and external security. Over the years, the Indo-Pakistan arms race has become an important area of research (see Öcal, 2003; Phadke, 1988; Yildirim & Öcal, 2006). Both countries have nuclear capabilities with vital geopolitical and strategic positions, which, possibly, is a form of deterrence for both rivals. This makes it very important to investigate the arms race between two countries that also face very large budget deficits and considerable poverty.

2. Richardson's arms race approach

Richardson developed a mathematical model of the arms race in 1960, which showed the defense spending patterns of rival nations in an action-reaction framework. It was a seminal study investigating arms races between military rivals. Richardson used two differential equations to explain the arms race. In the classic arms race or Richardson model, each country's arms acquisition or defense spending is a function of both countries' arms acquisition or defense spending. The model assumes that each country is a single integrated actor and there is a single homogeneous weapon.

When applied to the data (see Sandler & Hartley, 1995). This is mainly because the model is theoretical and subject to problems

when applied empirically. When any theory is empirically measured to confirm its validity. They must take into account issues such as functional form, measurement of variables and lag length, etc., things that the theory itself does not have. Other problems may be related to the quality and reliability of the data and the results obtained may be ambiguous. Finally, various estimation techniques can present their own problems. The literature review below suggests that different studies on arms race models have used various estimation techniques, including game theory, dynamic models, prospective models, distributed lags or vector autoregression (VAR), error correction and systems of simultaneous equations (see Deger & Sen, 1990; Dunne & Smith, 2007; Georgiou, 1990; McGinnis, 1991; Öcal, 2003). New advances in econometrics make it possible to apply these techniques to arms race models and investigate why traditional arms race approaches have yielded disappointing results.

Consequently, we apply the generalized method of moments (GMM), which has not yet been used to reexamine the Richardson model.

3. Studies on the arms race in Pakistan and India: an empirical review

The ancient military rivalry between Pakistan and India makes them key areas of research in the arms race literature, although no study has reached a precise conclusion about the arms race between the two neighbors. Hollist (1977) applies the Richardson model and its variants to the arms race between Pakistan and India, using data for the period 1949 to 1973. The reaction coefficients are found to be negative rather than positive (as Richardson's model and its variants would suggest). Therefore, Hollist believes that domestic factors can better explain the two countries' defense spending.

Deger and Sen (1990) investigate the arms race process in Pakistan and the India, using the augmented Richardson model for the period 1960-1985.The augmented variables include GDP, arms production, arms imports,and the ratio of central government expenditure to GDP to capture the economic drivers of defense spending. The study argues that the size asymmetry between the two countries implies that they face different threats and have different defense perceptions.

Furthermore, the study shows that the one-year delay in defense spending and arms imports from India are important factors in determining Pakistan's defense spending. The relationship between central government expenditure and GDP suggests that the government has a positive impact on defense budget allocations, while GDP has a smaller effect. In the case of India, the one-year delay in Pakistan's defense spending does not show any significant impact on Indian military spending. The two variables, arms production and arms imports, are not significant, but GDP is the main driver of defense spending in India. Overall, the study is inconclusive, implying that while Pakistan responds to Indian defense spending, India does not respond to Pakistan's defense spending.

Oren (1994) evaluates the arms race between Pakistan and India during the period 1947 to 1990. The study reveals that the defense spending of any of the countries depends not only on the defense spending of its rival, but also on the bellicosity of the latter. The latter becomes a stronger factor when the former country has lower defense expenditures or military power. The findings indicate that both countries' defense spending increases when their rival shows increasing aggression. However, both react negatively to their rival's defense spending.

Dunne et al. (1999) use the Richardson model to examine the arms race between Pakistan and India for the period 1962-1996 in a VAR framework. Using Johansen cointegration, the study suggests that there is a long-run relationship between the real defense expenditure (RDE) of both countries. The reaction coefficients are positive for both countries and there is bidirectional causality between their defense spending levels.

Öcal (2003) evaluates the Indo-Pakistan arms race during the period 1949-1999, including the asymmetric effects of defense spending of both countries, based on a non- linear smooth transition model. The study finds possible non-linear dynamics between the defense expenditures of the two countries. Yildirim and Öcal (2006) examine the causality between defense spending of Pakistan and India during the period 1949-2003. Based on seemingly unrelated regressions in a multivariate VAR model, the study applies the Granger causality test and finds bidirectional causality between the defense spending of both countries.

Dunne and Smith (2007) again investigate the arms race between Pakistan and India, using revised RDE data provided by SIPRI. They reestimate the Richardson model in a VAR framework for the same period as Dunne et al. (1999), but with slightly different results. Later, they extend the period from 1962 to 2003. The findings give some indication of a long-term relationship between two countries'

While, for various reasons, none , independent variables are uncorrelated with the error term, and a violation of this assumption

would mean that the ordinary least squares (OLS) estimators and weighted least squares estimators would be biased and inconsistent. When some of the independent variables are correlated with the disturbance term, become endogenous variables; those that are not correlated with the error term are exogenous variables.

Instrumental variables (IV) are used when there is a problem of endogeneity, especially in a system of simultaneous equations. Generally, three basic approaches (two-stage least squares (2SLS), limited information maximum likelihood, and GMM) are used when facing,

Figure 1: Trends in RDE, Pakistan and India
Figure 1: Real defense spending trends of Pakistan and India

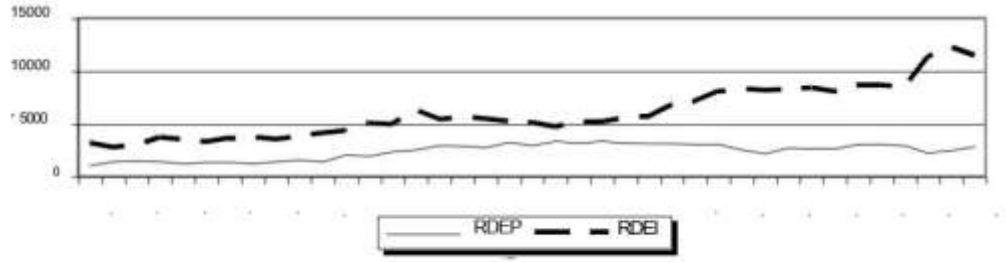

Table 1 summarizes the decadal averages and percentage changes in RDEP and RDEI. The general average of RD.EP and RDEI is 2,456.65 million dollars and 6,049.96 million dollars, respectively, the latter being more than double that of the former. The maximum value of the RDEP is US$3,440.833 million (in 1994) while the minimum value is US$1,139.37 million (in 1972). Likewise, the maximum value of the RDEI is US$ 12,239.39 million (in 2009) and the minimum value is US$ 2,773.41 million (in 1973).

Table 1: Pakistan and India, RDEP and RDEI

Period	RDEP % change		RDEI	% Change
1972–80	1.393,26		3.364,37	
1981–90	2.430,42	74,44	5.035,89	49,69
1991-2000	3.154,78	29,80	6.161,99	22.36
2001–10	2.741,78	-13.10	9.369,04	52.04
Maximum value	3.440,83		12.239,39	
Minimum value	1.139,37		2.773,41	
Media general	2.456,65		6.049,96	

The RDEP increases by 74.44 percent in the first decade of the period of the sample and 29.80 percent in the second decade. Then it falls 13.1 percent in the last decade. The RDEI increases by 49.69 percent in the first decade and 22.36 percent in the second decade. In the last decade, the RDEI increases dramatically by 52.04 percent in contrast to the RDEP.

Next, we applied the augmented Dickey-Fuller test to check the stationarity of the two data series. In both cases, the RDE is made up of sort one, i.e. I(1). This indicates that both variables are non-stationary or have a unit root, but their linear combination becomes stationary.

Multivariate analyzes use variables of the same order of integration (Sims, 1980). Stock and Watson (1996) argue against differentiation even if variables contain a unit root because they can still be used to estimate structural equations. The main argument against differentiation is that it "wastes" information about any co-movement in the data (such as the possibility of cointegration). Similarly, it is not necessary to detrend the data (Enders, 2009). Therefore, we use non-stationary variables in the GMM.

3.1. Richardson model GMM results

The intercept value (the complaint 10 term) is 217.24. Since this is positive, it suggests that Pakistan and India are rivals rather than allies. 1
Pakistan's defense expenditure in the previous period is negatively related to the change in its own defense spending. The value of parameter 11 (the fatigue coefficient) is –0.1969, which is negative (as the theory suggests). and very significant. This implies that Pakistan's defense spending falls due to an increase in its defense spending from the previous period, which is consistent with Richardson's theory: the rate of change in the level of defense spending or in the stock of weapons of a country is negatively related to its own defense or arms spending. acquisition, and reflects the economic or administrative impact of an arms race.

In the context of positive terms of grievance, Sandler and Hartley (1995) observe that "a nation can increase its armament even if the other nation does not pose a threat. "Grievances may arise from past defeat (Germany after World War I or Iraq after the Gulf War) or from territorial or religious disputes." Choucri and North (2001) hold
"the constants in the empirically estimated equations to suggest that a given nation may desire a certain amount of weapons even if its opponents do not have them."
2 Sandler and Hartley (1995) comment on the term negative fatigue as follows: "Nation A decreases its rate of weapons expansion in proportion to its existing forces. This expression reflects economic considerations or limitations that limit the nation's ability to redirect resources from civilian uses.
Furthermore, the fatigue term may also reflect the depreciation of the existing weapons stockpile, as resources must be allocated to maintain current stockpiles."

Table 2: GMM estimates of the Richardson model (equations 5 and 6)

	Pakistan			India	
Dependent variable = ÿ	Dependent variable = ÿ	Est. GMM regressors			
MCO is.	Regresores GMM is.	MCO is.			
Intercept 206.9299	217.2413	272.8579	Intercept	-480.1526	
	(0.0728)	(0,0780)		(0,0728)	(0,5805)
	-0.1969	-0.120464		-0.0687	0.012339
	(0,0061)	(0,0822)		(0,1317)	(0,8103)
Ÿ	0.4524	-0.167691	ÿ	2.2102	-0.940983
	(0,0000)	(0,0164)		(0,0000)	(0,0164)
	0.0311	0.017700		0.4352	-0.007359
	(0,1317)	(0,4127)		(0,0061)	(0,9650)
Diagnostic tests					
Determinant residual covariance			0.4720		
J statistic			0.0111		
DW	2.03	2.26	DW	2.03	2.14

Note: p values in parentheses.
Source: Authors' calculations.

Defense or reaction coefficients.12 and13 in the model specified are 0.4524 and 0.0311, respectively. Its coefficients are positive, indicating that there will be a positive change in Pakistan's defense spending in response to India's defense spending. According to the Richardson model, the reaction coefficients y 13 are assumed to be positive and show that the level of defense spending or stocks12 of a country's weapons increases.
When his opponent's also increases. Of the two reaction coefficients, the the change in India's defense spending is very significant; the other, India's defense spending in the previous period, is not significant.
In the model specified for India, the dependent variable is ÿ and the variables ÿ

The fact that the grievance term is negative suggests that Pakistan and India have friendly relations with each other . This makes it difficult to establish the nature of relations between the two countries on the basis of their terms of grievance.

India's defense spending in the previous period is inversely related to the change in its own defense spending. The value of parameter 22 (the fatigue coefficient) is –0.0687. Although statistically insignificant, its sign is compatible with the classical arms race theory. The values of the reaction or defense coefficients and 23 are 2.2102 and 0.4352, respectively. Both variables have the correct signs and are highly s21 insignificant as proposed by the Richardson model. The positive sign implies that India's defense spending will increase in response to an increase in Pakistan's defense spending.

However, they contradict studies that find negative reaction coefficients for Pakistan and India (see Hollist, 1977; Oren, 1994; Öcal, 2003). Furthermore, some studies do not provide evidence of an arms race between Pakistan and India (see Deger and Sen, 1990).

3.2. Empirical results in reduced form

The empirical results in reduced form of the Richardson model (equations 7 and 8) are given in Table 3. These equations show that a change in a country's defense spending depends on its own defense spending from the previous period and that of its rival. Since reduced form equations do not have inherent simultaneity, they do not violate the classical assumption that all explanatory variables are uncorrelated with the error term.

Therefore, they can be estimated using OLS.

Eq. (7) is specified for Pakistan and has two independent variables: its own expenditure in defense of the previous period and that of its rival, India.
in addition to the term of interception or tort. The sign of the complaint term is positive as found in the GMM estimates. The estimated value of the defense spending parameter of the Pakistan itself in the previous period (1 ÿ1) is –0.1416. As Richardson's theory would suggest.
This is negative and very significant. The result shows that Pakistan's defense expenditure in the previous period is negatively related to its own defense expenditure.

Table 3: Reduced form estimates of the Richardson model (equations 7 and 8)

Pakistan		India	
Dependent variable = y		Dependent variable = y	
Returners	Dear	Returners	Dear
Intercept	282.7885	Intercept	-59.1599
	(0.0441)		(0, 4389)
	-0.1416		-0.0051
	(0,0281)		(0,4627)
	0.0186		0,1259
	(0,2120)		(0,2317)
Diagnostic tests			
DW	2.17	DW	2.06
bpg test	0.5386	bpg test	0.2788
Jarque-Bera (prob.) 0.9141		Jarque–Bera (prob.) 0.0000	

Note: p values in parentheses.
Source: Authors' calculations.

The second variable is India's defense spending in the previous period.
(2-1). The estimated value of the reaction coefficient is 0.0186, which is positive as theory suggests, but not significant in our model. The results correspond to those obtained from the GMM model. The values of the DW and Breusch-Pagan-Godfrey (BPG) statistics suggest that we cannot reject the null hypothesis of absence of autocorrelation or heteroskedasticity of the residuals, respectively. The probability value of the Jarque-Bera test statistic shows that the residuals are normally distributed.
Eq. (8) is specified for India with similar variables. The sign of the term complaint is negative, similar to the GMM model. The estimated value of India's defense spending parameter in the previous period (2 ÿ1) is –0.0051, which is negative but not significant.

This shows that India's defense spending in the previous period is negatively related to its own defense spending.

The second variable is Pakistan's defense expenditure in the previous period (1 ÿ1). The estimated value of the reaction coefficient is 0.0126, which is positive but not statistically significant. The DW and BPG values suggest that we cannot reject the null hypothesis of no autocorrelation and heteroskedasticity of the residuals, respectively. The probability value of the Jarque-Bera test shows that the residuals are not normally distributed. However, since the sample is small, this is not a serious problem.

In general, the reduced form estimates of the Richardson model are poor in terms of statistical significance, although their signs are compatible with classical arms race theory. Many of these studies do not yield good results (see, for example, Isard & Anderton, 1988; Deger & Sen, 1990; Georgiou, 1990; Kollias, 1991; McGinnis, 1991;
Sandler & Hartley, 1995; Georgiou, Kapopoulos, & Lazaretou , 1996; Kinsella and Chung, 1998).
However, the structural parameters, which researchers are more likely to consider, are better than the reduced form estimates.

4. Conclusion

This study has attempted to assess the presence of an arms race between Pakistan and India. To overcome the problems of simultaneity and endogeneity, we have applied a GMM model to the Richardson arms race model for data spanning the period 1972-2010. The Richardson model predicts that a change in a country's defense spending is a function of its defense spending in the previous period, a change in its rival's defense spending, and its rival's defense spending in the previous period. .

We have specified structural parameter equations for both countries. The grievance term in the Pakistan model is positive, indicating that Pakistan and India have hostile relations. The economic or administrative impact of a career armaments is reflected in Pakistan's previous period defense spending or fatigue coefficient, which is highly significant and negatively related to changes in Pakistan's own defense spending, as suggested by Richardson's theory. The reaction coefficients are positive, indicating that there will be a positive change in Pakistan's defense spending in response to India's defense spending.

However, the value of the intercept in the Indian model is negative, which It implies that the two countries have friendly relations. This contradicts the results for Pakistan and makes it difficult to draw conclusions based on the terms of the grievance. Our findings also show that India's defense spending in the previous period is statistically insignificant and inversely related to changes in India's own defense spending. The reaction coefficients are positive and very significant.

We have also estimated reduced form equations that show that a change in a country's defense spending depends on its own and its rival's defense spending levels in the previous period.
Although these estimates are statistically deficient, their signs are compatible with classical arms race theory. Finally, the overall analysis indicates that there is an arms race between Pakistan and India.

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