Bangladesh-Myanmar Military Buildup: A One-sided Arms Race

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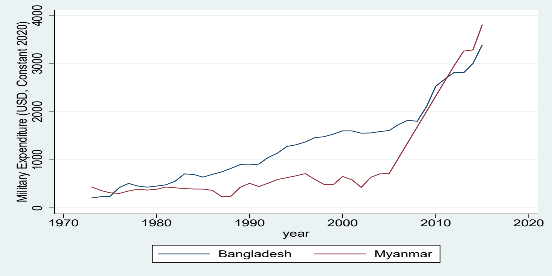
- The neighboring countries with a shared border, Bangladesh and Myanmar, have, in general, a cold relationship between them. Bangladesh, born in 1971, inherited the shared border with Myanmar from Pakistan (Ullah 2011). The hostile relationship between the countries goes back as early as the 1970s.
- The relationship between the countries is defined by the sea border dispute (Shah 2013), Rohingya genocide (Parnini 2013), and drug trafficking (Rezvi 2019).
- The bilateral relationship between Bangladesh and Myanmar is marred with border clashes and long-standing issues relating to the Rohingya refugee crisis spillover to Bangladesh. A simple observation of the rising trend of military expenditures by the two countries indicates a common trend in military expenditure between the two countries.

Introduction II

Figure 1: Military Expenditure Between Bangladesh and Myanmar



- This trend (figure 1) is highly suggestive of the presence of an arms race as the classical Richardson arms race model (Lewis Fry Richardson 1939; Lewis F Richardson 1960) postulates the presence of an arms race between countries if the military burdens of two countries cause each other.

- The origin of arms race modeling is credited to the seminal works (Lewis Fry Richardson 1939; Lewis F Richardson 1960). The system of differential equations with military budgets for two countries proposed by (Lewis Fry Richardson 1939; Lewis F Richardson 1960) has gone through major criticisms over time (Gleditsch 2020).
- As the classical model and starting point for studying arms race, the model modified to difference equations (Wagner, Perkins, and Taagepera 1975), error correction specification (Dunne and R. P. Smith 2007), and stochastic versions (Fricks and Swift 2001) point to the strong relevancy of Richardson model in recent times. Despite several criticisms of the Richardson model of an arms race, as an approach in peace research to stop wars (R. P. Smith 2020) contrary to the contemporary (Lanchester 1916) model, it continues to lend theoretical support for modern studies of arms race resulting in a large portion, if not the largest, of empirical arms race studies.
- (Bae* 2004) studies the existence of an arms race between North and South Korea using Richardson-styled two-equation models.

Literature Review II

- (Levine and R. Smith 1997) models interaction between two hostile nations, Greece and Türkiye, and established the price of arms as a major variable impacting system stability. A few other papers study the arms race between Greece and Türkiye. The artificial neural network approach to study the Greco-Turkish arms race by (Andreou and Zombanakis 2011) provides that Türkiye is leading the arms race with significant financial and demographic advantages.
- (Amir-ud-Din, Waqi Sajjad, and Aziz 2020) studies the arms race between India and Pakistan. The study finds asymmetric causality from India's military expenditure to Pakistan's. For India and Pakistan's case, (Öcal 2003) finds an asymmetrical causality from Indian military expenditure to Pakistan's military expenditure, larger and deeper in effects. (Yildirim and Öcal 2006), deploying VAR approach finds a bi-directional causal relationship between the military expenditure of both countries.
- (Dunne, Nikolaidou, and R. Smith 2003) studies both Greco-Turkish and Indo-Pak arms races and finds an arms race in the Indo-Pak case with a stable equilibrium.
- In short, there is a large body of works relating to arms race modeling. As for other South Asian or Southeast Asian countries, namely Bangladesh and Myanmar, no possible arms race cases have been studied till now.

Variables & Model I

- We consider a Richardson (Lewis Fry Richardson 1939; Lewis F Richardson 1960) styled two-equation model to test the existence of an arms race between Bangladesh and Myanmar.
- We select a number of variables, including the military expenditures for the respective countries, real GDP according to national accounts, age dependency ratio, and political regimes of the respective countries in our model specification in the lights of (Amir-ud-Din, Waqi Sajjad, and Aziz 2020) to minimize any risk of specification bias.
- Here in these two models, Polity2 (polity2) variable data has been extracted from (Marshall and Gurr 2020). Military expenditures (Milex) for both countries are collected from (Tian et al. 2020). Real GDP (Rgdp) and Age Dependency ratio (AgeDep) data have been collected from (World Bank 2010). Besides Polity2, all other variables are transformed to their natural logarithmic form. Polity2 gives the governance indicator in our model. Its value ranges from "-10 (hereditary monarchy) to +10 (consolidated democracy)" (Marshall and Gurr 2020). The military expenditure data of Myanmar containing missing values have been filled with linear interpolation with the time variable.

- Before we specify our two-equation model, we consider the unit-roots testing process of the selected variables. According to (Dickey and Fuller 1979; Phillips and Perron 1988). The results show that the variables are integrated of different orders and are not trend stationary in their levels and first differences.
- Lag selection according to selection order criteria gives minimum values in the SBIC (Gideon et al. 1978) criteria in both. So the optimum lag for equation 1 is one and for equation 2 is two.
- Next, we move to test any long-run cointegrating relationship among the variables. Before testing the cointegrating rank in the two models with the help of the (Johansen 1988; Johansen 1991) process.
- The testing process indicate a single cointegrating relationship in the model for Bangladesh (equation 1) and three cointegrating relationships in the model for Myanmar (equation 2).

Variables & Model III

- So, we specify our two models as a restricted vector autoregressive model with a linear trend in the cointegrating equations and a quadratic trend in the undifferenced data. So, the specification of the targets models similar to (Amir-ud-Din, Waqi Sajjad, and Aziz 2020) are as follows,

Model Specification

$$\begin{aligned}\Delta lnMilexBD_t &= \Omega_{BD} + \sum_{h=1}^{k-1} \vartheta_h \Delta lnMilexBD_{t-h} + \sum_{i=1}^{k-1} \iota_i \Delta lnMilexMM_{t-i} \\ &+ \sum_{j=1}^{k-1} \phi_j \Delta lnRgdpBD_{t-j} + \sum_{m=1}^{k-1} \varphi_m \Delta lnAgeDepBD_{t-m} + \sum_{n=1}^{k-1} \Phi_n \Delta polity2^{BD}_{t-n} \\ &+ \lambda_{BD} ECT_{t-1} + \mu_{BD} \end{aligned} \tag{1}$$

$$\begin{aligned}\Delta lnMilexMM_t &= \Omega_{MM} + \sum_{h=1}^{k-1} \vartheta_h \Delta lnMilexMM_{t-h} + \sum_{i=1}^{k-1} \iota_i \Delta lnMilexBD_{t-i} \\ &+ \sum_{j=1}^{k-1} \phi_j \Delta lnRgdpMM_{t-j} + \sum_{m=1}^{k-1} \varphi_m \Delta lnAgeDepMM_{t-m} + \sum_{n=1}^{k-1} \Phi_n \Delta polity2^{MM}_{t-n} \\ &+ \lambda_{MM} ECT_{t-1} + \mu_{MM} \end{aligned} \tag{2}$$

Variables & Model IV

- In equations 1 and 2, Ω is the constant term for each models. ϑ, ι, ϕ, φ and Φ are short-run coefficients. They serve as dynamic coefficients for model adjustment long-run coefficients. Due to restricted VAR specifications, all the variables are endogenous in these two models. λ is the error correction parameter or the speed of adjustment for the ECT, the error correction term. μ is the error term in each model.

Estimation & Results I

- We estimate both models with one additional lag to retain the original lag structure since the restricted vector autoregressive estimation technique estimates the model parameters with the loss of one lag. At first, the long run estimation of Bangladesh model (equation 1) are reported in table 1. To allow for testing a bi-directional causality, we estimate the model with lnMilexMM as the dependent variables in table 2. Due to Johansen restrictions imposed on the coefficients so they must be interpreted in their opposite arithmetic signs.
- Table 1, the long-run results for Bangladesh suggest that lnMilExMM is statistically significant (p-value is 0.006). Similarly, in table 2, lnMilexBD is the only significant dependent variable in the long-run equation.

Table 1: Bangladesh restricted VAR Long Run Coefficients (equation 1); lnMilexBD as Dependent Variable

beta	Coef.	Std. Err.	z	$P > \|z\|$	[95% Conf.	Interval]
_ce1						
lnMilexBD	1	.	.	.	.	.
lnMilexMM	-.1580818	.0575286	-2.75	0.006	-.2708359	-.0453278
lnRgdpBD	.7332764	.6948317	1.06	0.291	-.6285688	2.095122
lnAgeDepBD	-.0871419	.9925072	-0.09	0.930	-2.03242	1.858137
polity2_BD	.001121	.0040414	0.28	0.781	-.0068	.009042
_trend	-.0987087	.	.	.	.	.
_cons	-12.19412	.	.	.	.	.

Table 2: Bangladesh restricted VAR Long Run Coefficients (equation 1); lnMilexMM as Dependent Variable

beta	Coef.	Std. Err.	z	$P > \|z\|$	[95% Conf.	Interval]
_ce1						
lnMilexMM	1	.	.	.	.	.
lnMilexBD	-6.325837	.6773795	-9.34	0.000	-7.653477	-4.998198
lnRgdpBD	-4.638587	3.195181	-1.45	0.147	-10.90103	1.623853
lnAgeDepBD	.5512452	6.109683	0.09	0.928	-11.42351	12.526
polity2_BD	-.0070911	.0246177	-0.29	0.773	-.0553409	.0411586
_trend	.6244153	.	.	.	.	.
_cons	77.13801	.	.	.	.	.

Estimation & Results IV

Table 3: Bangladesh (equation 1) Short-run Coefficients; lnMilexBD as Dependent Variable

	D_lnMilexBD	D_lnMilexMM	D_lnRgdpBD	D_lnAgeDepBD	D_polity2_BD
L._ce1	-0.490*** (0.0759)	-0.0831 (0.268)	0.0547*** (0.0153)	-0.0234** (0.00845)	2.036 (4.843)
LD.lnMilexBD	0.297*** (0.0858)	0.314 (0.303)	-0.000736 (0.0173)	0.000394 (0.00955)	-3.273 (5.472)
LD.lnMilexMM	-0.142** (0.0498)	0.162 (0.176)	0.0304** (0.0100)	0.00157 (0.00554)	1.385 (3.178)
LD.lnRgdpBD	-3.031*** (0.492)	-1.776 (1.740)	-0.531*** (0.0992)	0.0498 (0.0548)	-13.26 (31.41)
LD.lnAgeDepBD	-1.777 (1.639)	-3.025 (5.795)	0.563 (0.330)	-0.222 (0.182)	-17.90 (104.6)
LD.polity2_BD	0.00412 (0.00267)	0.00168 (0.00942)	-0.000164 (0.000537)	0.000221 (0.000297)	0.0690 (0.170)
_trend	-0.00717*** (0.00198)	-0.0000818 (0.00702)	0.00254*** (0.000400)	-0.00105*** (0.000221)	-0.00181 (0.127)
_cons	0.476*** (0.0504)	0.0833 (0.178)	0.00599 (0.0101)	0.0101 (0.00561)	-0.0953 (3.213)

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: Bangladesh (equation 1) Short-run Coefficients; lnMilexMM as Dependent Variable

	D_lnMilexMM	D_lnMilexBD	D_lnRgdpBD	D_lnAgeDepBD	D_polity2_BD
L._ce1	0.0131 (0.0424)	0.0775*** (0.0120)	-0.00865*** (0.00242)	0.00370** (0.00134)	-0.322 (0.766)
LD.lnMilexMM	0.162 (0.176)	-0.142** (0.0498)	0.0304** (0.0100)	0.00157 (0.00554)	1.385 (3.178)
LD.lnMilexBD	0.314 (0.303)	0.297*** (0.0858)	-0.000736 (0.0173)	0.000394 (0.00955)	-3.273 (5.472)
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_trend	-0.0000818 (0.00702)	-0.00717*** (0.00198)	0.00254*** (0.000400)	-0.00105*** (0.000221)	-0.00181 (0.127)
_cons	0.0833 (0.178)	0.476*** (0.0504)	0.00599 (0.0101)	0.0101 (0.00561)	-0.0953 (3.213)

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Estimation & Results VI

Table 5: Myanmar restricted VAR Long Run Coefficients (equation 2)

beta	Coef.	Std. Err.	z	$P > \|z\|$	[95% Conf. Interval]	
_ce1						
lnMilexMM	1	.	.	.	.	.
lnMilexBD	-1.67e-16	.	.	.	.	.
lnRgdpMM	-1.11e-16	.	.	.	.	.
lnAgeDepMM	-38.45647	12.02173	-3.20	0.001	-62.01863	-14.8943
polity2_MM	.2704389	.0992983	2.72	0.006	.0758179	.4650599
_trend	-.8130362	.	.	.	.	.
_cons	169.9851	.	.	.	.	.

Estimation & Results VII

beta	Coef.	Std. Err.	z	$P > \|z\|$	[95% Conf.	Interval]
_ce2						
lnMilexMM	1.39e-17	.	.	.	.	.
lnMilexBD	1	.	.	.	.	.
lnRgdpMM	0	(Omitted)	.	.	.	.
lnAgeDepMM	-1.505508	.8953545	-1.68	0.093	-3.260371	.2493543
polity2_MM	.0013595	.0073955	0.18	0.854	-.0131355	.0158545
_trend	-.057956	.	.	.	.	.
_cons	1.02302	.	.	.	.	.

beta	Coef.	Std. Err.	z	$P > \|z\|$	[95% Conf.	Interval]
_ce3						
lnMilexMM	-1.11e-16	.	.	.	.	.
lnMilexBD	-5.55e-17	.	.	.	.	.
lnRgdpMM	1	.	.	.	.	.
lnAgeDepMM	-17.92828	5.304975	-3.38	0.001	-28.32584	-7.530725
polity2_MM	.1244425	.0438185	2.84	0.005	.0385597	.2103252
_trend	-.4640653	.	.	.	.	.
_cons	71.83312	.	.	.	.	.

Table 6: Myanmar (equation 2) Short-run Coefficients

	D_lnMilexMM	D_lnMilexBD	D_lnRgdpMM	D_lnAgeDepMM	D_polity2_MM
L._ce1	-0.171 (0.116)	0.204*** (0.0395)	-0.00565 (0.0156)	-0.0128** (0.00476)	1.514 (0.990)
L._ce2	-0.219 (0.298)	-1.003*** (0.102)	0.0370 (0.0402)	-0.00942 (0.0123)	0.888 (2.547)
L._ce3	0.168 (0.272)	-0.410*** (0.0930)	0.0210 (0.0367)	0.0379*** (0.0112)	-2.780 (2.328)
LD.lnMilexMM	-0.0539 (0.170)	-0.192*** (0.0580)	-0.0365 (0.0229)	0.0280*** (0.00700)	0.513 (1.453)
L2D.lnMilexMM	-0.0726 (0.203)	-0.189** (0.0692)	0.0306 (0.0273)	0.000479 (0.00834)	-2.404 (1.733)
LD.lnMilexBD	0.311 (0.235)	0.406*** (0.0805)	-0.0171 (0.0318)	0.00470 (0.00970)	1.072 (2.015)
L2D.lnMilexBD	0.410 (0.263)	0.0493 (0.0898)	0.00572 (0.0355)	0.00268 (0.0108)	-0.00448 (2.248)
LD.lnRgdpMM	6.095*** (1.453)	-0.151 (0.497)	1.359*** (0.196)	-0.187** (0.0599)	-40.64** (12.43)
L2D.lnRgdpMM	-5.138** (1.639)	0.392 (0.560)	-0.642** (0.221)	0.150* (0.0675)	17.79 (14.02)
LD.lnAgeDepMM	-4.540 (3.833)	-0.820 (1.310)	0.369 (0.518)	-0.429** (0.158)	55.91 (32.80)
L2D.lnAgeDepMM	0.749 (3.674)	-0.922 (1.255)	-0.157 (0.496)	-0.171 (0.151)	94.75** (31.44)
LD.polity2_MM	0.0316 (0.0213)	-0.00204 (0.00728)	0.00245 (0.00288)	-0.00259** (0.000878)	-0.163 (0.182)
L2D.polity2_MM	-0.0299 (0.0249)	-0.00114 (0.00851)	-0.00699* (0.00336)	-0.000941 (0.00103)	-0.269 (0.213)
_trend	0.000356 (0.0146)	0.0000155 (0.00497)	0.00159 (0.00197)	0.00249*** (0.000600)	0.0000652 (0.125)
_cons	0.0746 (0.0893)	0.0828** (0.0305)	0.00306 (0.0121)	-0.00605 (0.00368)	0.00810 (0.764)

Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Estimation & Results IX

Table 7: Linear Test of Hypothesis

Equation 1			
Statement	chi2 (1)	Prob > chi2	Decision
[D_lnMilexBD]LD.lnMilexMM=0	8.18	0.0042	lnMilexMM has short-run causality on lnMilexBD
[D_lnMilexMM]LD.lnMilexBD=0	1.07	0.3012	lnMilexBD has no short-run causality on lnMilexMM
Equation 2			
Statement	chi2 (1)	Prob > chi2	Decision
[D_lnMilexBD]LD.lnMilexMM=0	10.96	0.0009	lnMilexMM has short-run causality on lnMilexBD
[D_lnMilexMM]LD.lnMilexBD=0	1.74	0.1872	lnMilexBD has no short-run causality on lnMilexMM

- The L._ce1 variable in table 3 is negative and significant in the first column (equation D_lnMilexBD). It is also negative in the second column (equation D_lnMilexMM) but not significant. The L._ce1 variable coefficient is neither negative nor statistically significant in equation D_lnMilexMM in table 4.
- The lagged difference of lnMilexMM is statistically significant in equation D_lnMilexBD in table 3.
- The L._ce1 is not significant in equation D_lnMilexMM of table 6. In both the lagged differences of lnMilexBD in table 6, the estimates are not significant.
- the first and second lagged difference of lnMilexMM is statistically significant in the short-run equation, D_lnMilexBD (table 6).

Discussion I

- In the case of equation 1, the L._ce1 variable's negative, less than one in absolute terms and statistically significant estimate from equation D_lnMilexBD in table 3 provides that the target model of equation 1 is dynamically stable. There is indeed a long-run relationship running among the variables in the model.
- The long-run estimates from both the tables 1 and 2 indicate that the source of the long-run causal relationship exists between lnMilexBD and lnMilexMM since each of the variables is statistically significant in the cointegrating equations when they are treated as a dependent variable.
- Also, lnMilexBD is not statistically significant as an independent variable. This phenomenon is also observable in table 4 that the adjustment coefficient is neither significant nor negative.
- This result implies a strong short and long-run causality from lnMilexMM to lnMilexBD.
- So, we can conclude that the causality from lnMilexMM to lnMilexBD is not reciprocated.

- we fail to see a long-run relationship in equation 2 running from lnMilexMM to lnMilexBD. Similar to the results in tables 3 and 4, we see a significant short-run impact of lnMilexMM on lnMilexBD, but not of lnMilexBD on lnMilexMM.
- This conclusion is also apparent from the linear tests of the hypothesis in table 7. Here, in this table, the lagged difference of lnMilexBD is statistically significant in both the equation 1 and 2 while lnMilexMM is not, implying a significant uni-directional short-run causality from lnMilexMM to lnMilexBD.
- The independence of Myanmar's military buildup to Bangladesh while Bangladesh's response to Myanmar's buildup implies that Bangladesh perceives Myanmar as a security threat. Even though there has not been a large-scale or full-blown war between the two nations, the historical clashes and continuous refugee displacement have contributed to the outcome. In addition, the internal political volatility of Myanmar, the absence of a democratic process, and the absence of ethnic harmony contributed to the past and ongoing tensions between the two countries.
- The uni-direction causalities open the door to further exploration of the issue of a one-sided arms race.

Discussion III

- If both countries perceive each other as security threats, under the symmetry of threat perception assumption by both countries, it would be reasonable to postulate that there would be a bi-directional causality, at least in the long run. The uni-directional causality thus fails to support the symmetry of threat perception. Causality running from Myanmar's military expenditure to Bangladesh's military expenditure implies an asymmetry of threat perception that Bangladesh perceives Myanmar's military buildup as a security threat.

Discussion IV

Figure 2: Dynamic Forecast of Equation 1

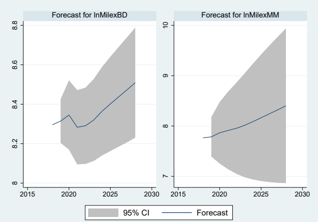
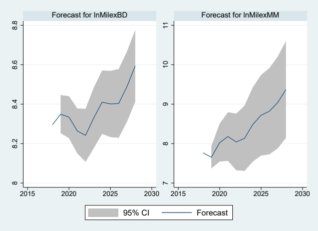


Figure 3: Dynamic Forecast of Equation 2



Conclusion

- Relying on military expenditure, real GDP, age dependency ratio, and political regime data for both the countries, the vector autoregressive specifications in the lights of (Lewis Fry Richardson 1939; Lewis F Richardson 1960; Amir-ud-Din, Waqi Sajjad, and Aziz 2020) provide uni-directional short and long-run causality running from Myanmar's military expenditure to Bangladesh's military expenditure. So, the result suggests an asymmetric long-run causality which we propose is the result of unilateral threat perception by Bangladesh.

Data & Code

Data and code for this paper is available at GitHub repository (https://github.com/azmeer54/Bangladesh-Myanmar-Military-Buildup-A-One-sided-Arms-Race).