

# The conventional arms race between India and Pakistan: A two-player game with only one side in full force

Christoph Bluth\*/Uih Ran Lee†

## Introduction

An arms race is defined as the competitive, resource constrained, dynamic process of interaction between two contending nations or groups of nations in their acquisition of weapons (Brito and Intriligator 1999). Arms races are probably as old as war itself and goes back at least to the ancient Greeks and Romans when the two states built fleets amidst the Persian and the Punic Wars, and to the Warring States period in ancient China when the Seven Warring States fiercely competed until Qin annexed the other six kingdoms in the 3<sup>rd</sup> century BC to be emerged as the first unified state in Chinese history. The pre-Cold War arms races were typically naval due to the labour-intensive structure of military institutions and the absence of aircraft whereas the post-Cold War rivalries have intensified increasing returns to scale in the production of weapons, which have been reinforced by modern computer systems, electronics and software. The Cold War period was unique in that the large scale acquisition of nuclear weapons stockpile coupled with delivery vehicles that had such a range that any point on the planet could be targeted gave those who could deploy such weapons literally infinite military power. This meant that in the first phase of the Cold War superpower confrontation both sides needed to ensure that they developed their arsenals sufficiently so as not to be outmatched by the other side so that one side would have a very decisive strategic superiority. If both sides had a surfeit of intercontinental range weapons, the focus shifted to the prospect of first-strike capabilities against land based missiles and the introduction of re-entry vehicles with multiple warheads that could overwhelm ballistic missile defences. This was a competition with both quantitative and qualitative elements, driven by the fear that new technical capabilities could fundamentally change the military balance. But the very power of nuclear weapons and the sheer size of the arsenals that were developed encouraged diplomatic efforts to codify strategic parity in arms control agreements. An endless arms race was considered, paradoxically, both dangerous and pointless. It was dangerous because the deterrence based on mutual assured destruction was

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\* Department of Peace Studies and International Development, University of Bradford

† Department of Economics, University of Sussex

necessary to prevent war on a scale that would practically destroy the planet, but as the additional acquisition of weapons brought diminishing returns in terms of potential military outcomes it was also pointless.

The traditional model for arms races has been originated by Richardson who proposed the action-reaction model. His original model is a pair of differential equations which simultaneously determine the weapons acquisitions of two states. The model states that the increase in military preparedness of one country, is predicted by its opponent's military capacity. It also incorporates a hysteresis effect in military preparedness (Smith, Dunne and Nikolaidou 2000).

Although the traditional model and its variants have been widely applied to real world data, empirical results employing Richardson's two variable system do not tend to offer statistically significant results (Sandler and Hartley, 1995). This is because the theory is not specific about measurement of the variables, the functional forms and the lag length. Furthermore, the data are often of poor quality leading to the specification and identification problems.

When we consider the situation in South Asia, it could be characterised as being akin to the early phase of Cold War arms race. Both India and Pakistan have ambitions for developing military capabilities that are still in their incipient stages. Most of the attention to the military situation in South Asia has been directed at the strategic nuclear relationship between India and Pakistan. However, a succession of crises involving the use of armed forces since both countries declared their nuclear status means that the conventional military balance between the two adversaries remains important. Moreover, *prima facie* there appears to be a very considerable imbalance between the two sides. The paradox of the situation is that the country that is at a distinct military disadvantage is the revisionist power that initiates crises involving the use of armed forces. In this context it is an obvious hypothesis that Pakistan might seek to change the military balance in its favour, while India would like to maintain its superiority and this expresses itself in a conventional arms race.

In terms of the analysis of the data, we can look at the numbers of weapons systems as well as military expenditure. The difficulty in the application of rigorous mathematical models is that the methods of data collection are inconsistent over a longer time period. For the purposes of this study, it is useful to look at the overall picture in terms of a qualitative interpretation of the data. The picture that emerges is somewhat ambiguous. At the conventional level, India clearly surpasses Pakistan in terms of military spending and equipment. But Pakistan consistently spends more in terms military spending as a proportion

of GDP and over the entire time period that has been examined (beginning four decades prior to the nuclear tests in 1998) this is a very substantial difference. Moreover, since the temporary decline in spending as a result of the global financial crisis of 2008 Pakistan's military spending as a proportion of GDP has risen quite substantially. The same picture emerges from looking at equipment where Pakistan has made substantial efforts to close the gap in the number of armoured fighting vehicles (AFVs) such as main battle tanks and artillery pieces, whereas India has not invested in artillery and its capabilities have declined. In relation to aircraft, Pakistan has clearly been constrained by the availability of high performance fighters, but its joint venture with China has now opened up a reliable source of advanced fighter aircraft and Pakistan is poised to significantly close the gap vis-à-vis India. The spending pattern is significant because Pakistan is such a desperately poor country, and yet devotes very substantial resources to its military, indicating that the development of its military is given very high priority.

### **The conventional balance in South Asia**

Pakistan's attitude to the conventional military balance is contradictory. On the one hand the first use policy and the emphasis on tactical nuclear weapons to counter a large-scale Indian conventional attack, characterizes an Indian conventional threat that is so extensive that it could threaten the survival of the country. As a consequence nuclear weapons need to be employed to deter a conventional attack. On the other hand Pakistani military planning is based on the assumption that they can risk the use of conventional forces to pursue their revisionist political objectives and that they can create local conventional superiority capable of defeating Indian forces (Durrani 2004). In order to engage with this discourse it is necessary to review the evolving military balance in South Asia. If Pakistani policy on nuclear deterrence seems to defy military realities, this applies *a fortiori* to conventional forces. According to the official discourse, conventional forces are central to their deterrence policy and in the words of former President Pervez Musharraf "It is just that the conventional balance in South Asia is extremely important to maintain peace in the region." However, Pakistani analysts are not unaware that the conventional military balance is not necessarily in Pakistan's favour (Mustafa 2009; Khan 2005). Indeed it has been suggested that there is a revolution in military affairs in India that manifests itself in large scale weapons acquisitions from Israel, Russia and other sources to transform India's reconnaissance, command and control, and precision strike capabilities. This means that the conventional military disparity between India and Pakistan is increasing and Pakistani analysts interpret this as a diminution of Pakistan's conventional

deterrent and therefore strategic stability in South Asia. It is the purpose of the following sections to look more closely at the material facts by looking at the balance between Indian and Pakistan air power and ground forces.

### *Air Power*

Air power is a key element of military power in contemporary warfare and can be used as the sole element of power projection or to support a conventional ground offensive to occupy territory. Unless India were to launch a surprise attack on Pakistan with the purpose of dividing Pakistani territory and destroying the Pakistani state, India would have to engage the Pakistani air force in any likely scenario for a military campaign rather than destroying most of it on the ground. The Indian air force would have to achieve air superiority or contend with the Pakistani air force while seeking to provide close combat support.

Taking a broad view of the comparative capabilities, Pakistan's air force is clearly outmatched by that of India. In 2017 India had a total of 845 combat aircraft, compared to Pakistan's 425. At an aggregate level this means that India has an advantage of 1.98:1. In order to understand the meaning of this imbalance it is appropriate to look at the level of high performance fighters (fourth generations or even more advanced). According to the state of affairs in 2017, the Indian Air Force has at its disposal 327 advanced performance fighters in its fleet: 250 Su-30 Mki 'Flankers', 62 MiG-29 'Fulcrums' and 50 Mirage-2000. In contrast, the Pakistan Air Force has 76 F-16 of various types as well as 50 JF-17 which are a fourth generation aircraft jointly produced by Pakistan and China. The Indian Air Force's superiority in modern aircraft in 2017 stood as 2.6:1 (Military Balance 2018).

### *Ground Forces*

Perhaps the starkest indication of the advantage enjoyed by India's armed forces with respect to Pakistan is the size of the ground forces which over decades has stood roughly at 2:1. In the 2018 Military Balance India is stated to have an army of 1,200,000 troops, compared to Pakistan's 560,000. But in order to assess the military balance, it is important to consider the quantity and quality of equipment, the quality of the training of the armed forces, and other issues such as force readiness, the deployment of forces and the ability to concentrate military power in the likely conflict areas.

In the past India fielded a very large number of main battle tanks, enjoying a margin of superiority vis-à-vis Pakistan of almost 2:1. Remarkably, this gap has closed in recent years to the point where India has a quantitative advantage of only about 1.1:1. However, these numbers

alone are not decisive, as most of the tanks in the inventory are older second generation types. The more modern high-performance main battle tanks deployed by India are the T-90 (122 vehicles) and the Arjun (around 1,100 vehicles), whereas Pakistan has fielded 320 T-80UDs and 300 Al-Khalids. In this category India has a clear advantage (1.92:1) as of 2017. In relation to artillery units, Pakistan has made a significant effort to increase the number of artillery pieces in its arsenal, from 2,600 in the year of the nuclear tests (1998) to 4,472 in 2017. In 1998 India fielded 5785 artillery pieces, and its holdings increased to a peak of 12,675 in 2006 (compared to Pakistan's 4,291 in the same year). Contrary to Pakistan, India has reduced the number of artillery pieces to 9,684 in 2017. In this category of equipment India has an advantage of 2.17:1. It is also important to point out that at the lower level of fighting levels India and Pakistan have made very different choices. Pakistan has 1,605 armoured personnel carriers whereas India has only 336 such vehicles available. On the other hand India fields 2,500 infantry fighting vehicles (IFV) and Pakistan none. Although IFV are not equivalent to main battle tanks, they are properly armoured and can be deployed in battle. This gives India another edge over Pakistan in relation to ground force equipment.

#### *Revisiting the conventional arms races*

A thorough assessment and comparison of the conventional military capabilities confirms that India does enjoy a very significant margin of superiority over Pakistan. However, there are other factors that need to be considered to assess the likely outcome of a conflict. In particular, if we consider the possibility of a limited conflict between India and Pakistan, the ability by each side to deploy forces in a specific theatre of operations is critical to the achievement of a quick victory. In relation to an armed conflict with Pakistan, the Indian army is particularly maldeployed. The armoured forces are mostly based in central India, a considerable distance away from a likely military engagement with Pakistan. A quarter of the Indian army is deployed in the East, closer to China, Burma and Bangladesh. In the states bordering Pakistan only 18 out of 35 Indian army divisions are stationed. Moreover, as Walter C. Ladwig has pointed out, these include 15 infantry divisions with limited offensive power. Pakistan on the other hand has 18 out of 22 army divisions including all armoured units deployed in the provinces that border India. According to Ladwig, this would mean that the balance of forces between India and Pakistan in a likely theatre of conflict would be roughly equal at the start of any military confrontation (Ladwig 2007/08). India would also suffer from a short of mobile artillery, whereas Pakistan has its self-propelled artillery concentrated in the forces facing India. This means that in order to bring its aggregate superiority to bear in any substantial conflict, it would

take quite a long time to deploy effectively. In other words, India, in a long war, would have a decisive advantage, but this is not necessarily the case for a limited shorter conflict.

The Indian doctrine for conventional conflict adopted in the early 1980s was the Sundarji doctrine, explicitly articulated as a “defensive doctrine” that would inform a military response to aggression that would fall short of a counteroffensive into enemy territory. The Sundarji doctrine was implemented with the deployment of seven defensive corps close to the border area with Pakistan. Contrary to the way in which this doctrine was articulated, in the event of a major attack from Pakistan the counterattack was designed to strike deeply into enemy territory in order to destroy Pakistan’s Army Reserve North and Army Reserve South but in peacetime the armoured forces required were located in Central India (Sawhney and Sood 2003). The operational plans required the Indian Air Force to establish air superiority and provide close air support.

Operation Parakram which was launched in response to the attacks on the Indian Parliament building in New Delhi on 13 December 2001 by five gunmen exposed deficiencies in India’s military response. In particular the size of the strike corps restricted their maneuverability and overall India’s military response could not be implemented in a sufficiently timely manner and therefore failed to achieve its objectives. This resulted in the articulation of the Cold Start doctrine. As was elaborated earlier, the core of this doctrine was that the forces would consist of eight smaller “integrated battle groups” of division size including mechanized infantry and artillery alongside “pivot corps” that would maintain defensive positions. The purpose was to enable India to pursue a limited war with highly maneuverable forces. However, the Cold Start doctrine has not been formally adopted and more importantly India has not implemented the changes necessary to put it into operation.

Pakistan seized upon the Cold Start Doctrine as evidence of India’s hostile and aggressive intent. Instead of taking the limited goals embodied in the doctrine seriously, Pakistani leaders painted it as evidence of aggressive intent and a very dangerous escalation of the threat to Pakistan. The response was two-fold. Pakistan reemphasized the option of first nuclear use and the deployment of dedicated tactical nuclear options to deter India. While Pakistan’s nuclear response to CSD has dominated the narrative, it is the conventional response that was devised first. In the last few years of General Musharraf’s presidency, especially between 2004 and 2007, India and Pakistan were engaged in backchannel negotiations and came tantalizingly close to finding a solution to the Kashmir issue. Then the 2007 Lawyers’ Movement forced Musharraf out of power and a new leadership took charge. With General Kayani as the new chief of army staff, the threat from India came back into focus,

and so did the perceived risk of CSD. Given India's military capability and its declared Cold Start Doctrine, Kayani believed that Pakistan could not afford to let its guard down as the country prepared according to "adversaries' capabilities, not intentions." He went on to give his assessment of the timeline by which India would be able to operationalize CSD — two years for partial implementation and five years for full — betraying the urgency he attached to a counter-response.

But Pakistan also made strenuous efforts to enhance its conventional capabilities to counter an Indian offensive. As Meenakshi Sood from the Center for Land Warfare Studies (the Indian army think tank) reported: "Between 2009 and 2013, the Pakistan Army conducted military exercises codenamed Azm-e-Nau to formalize and operationalize a conventional response to CSD." At its conclusion, Pakistan adopted a "new concept of war fighting (NCWF)" that aims to improve mobilization time of troops and enhance inter-services coordination, especially between the Army and the Pakistan Air Force (PAF). To this end, Pakistan Air Force's aerial exercise High Mark was conducted alongside Azm-e-Nau III in 2010, which saw the participation of over 20,000 troops from all services in areas of southern Punjab, Sialkot, and Sindh along Pakistan's eastern border with India. The 2010 exercises were the largest conducted by the Army since 1989. PAF's exercise High Mark, conducted every five years, synchronizes the Air Force's response with Army maneuvers, covering a vast area from Skardu in the north to the Arabian Sea in the south. As per military sources, with the implementation of the NCFW, the Pakistan Army will be able to mobilize even faster than India. This should worry India as CSD's *raison d'être* lies in the short reaction time it requires to launch an offensive. If Pakistan is indeed able to mount a counter-offensive even before India fires the first shot, literally and figuratively, it blunts the effectiveness of the Indian military doctrine (Sood 2017)." The data show very clearly that Pakistan has invested heavily in a conventional build-up as will be evident from the tables later in this chapter.

The outcome of a limited conflict depends on a number of factors. Walter C. Ladwig's study on Indian Military Modernisation concludes that Pakistan may have a better chance at achieving conventional deterrence against India than it would appear on the basis of the aggregate military balance. As Ladwig explains: "A host of factors, including terrain, the favorable deployment of Pakistani forces, and a lack of strategic surprise in the most likely conflict scenarios will mitigate whatever advantages India may be gaining through military modernization (Ladwig 2007/08)." It is true that the deficiencies in strategic doctrine and the maldeployment of forces means that India still faces serious difficulties in mounting a major offensive against Pakistan in a timely fashion and that this gives a window for Pakistan to

achieve local military superiority and thwart India's intention to mount major operations in specific limited conflicts. However, all the various military crises since 1998 have been initiated by Pakistan. In other words, while Ladwig follows the common Pakistani framing of the issue as one of deterrence against possible Indian aggression, in reality this is about Pakistani efforts to compel India to accede to certain political demands. Pakistan is seeking to deter an Indian nuclear or conventional response to its aggressive actions. It is not surprising that in the Pakistani discourse on this issue there is a complete unwillingness to accept this conceptualisation and it is consistently framed in terms of strategic stability, preservation of peace and deterrence when in reality Pakistan is engaged in a policy of strategic coercion despite the fact that India is a nuclear power and in aggregate its conventional forces are significantly superior to those of Pakistan.

### Testing strategies

To evaluate the dynamics of the conventional arms race between the two adversaries, we employ the vector autoregressive (VAR) approaches and vector error correction models (VECMs). The VAR/VECM approaches yields insights into the dynamic interactions, if any, of Indian and Pakistani military capabilities, measured in military spending or equipment holdings. The baseline unrestricted VAR model is:

$$\mathbf{y}_t = \mathbf{a}_0 + \mathbf{a}_1 t + \sum_{j=1}^k \Phi_j \mathbf{y}_{t-j} + \mathbf{u}_t \quad (1)$$

where the ordering of the variables in  $\mathbf{y}$  is chosen to be a  $2 \times 1$  vector of military capabilities of India and Pakistan:  $(mc^{India}, mc^{Pakistan})$ . The set of coefficient vectors include  $\mathbf{a}_0$  and  $\mathbf{a}_1$ , each of which is a  $2 \times 1$  vector of coefficients, and  $\Phi_j$ , ( $j = 1, 2, \dots, k$ ), which are  $2 \times 2$  matrices of coefficients. Finally,  $\mathbf{u}_t$  is a  $2 \times 1$  vector of disturbances assumed to be a Gaussian white noise process with time invariant positive definite covariance matrix  $\Sigma = E(\mathbf{u}_t \mathbf{u}_t')$ .

Military capability variables of the two countries may contain a common stochastic trend if there is a long-run causal relationship between the two. The VAR representation (1) omits this cointegration relationship. Rather, a VECM better accommodate this long-run relation between the variables. Assuming  $mc^{India}$  and  $mc^{Pakistan}$  contain unit root (i.e.,

$I(1)$ ), and cointegrated with order 1, we obtain the following VECM by subtracting  $\mathbf{y}_{t-1}$  from both sides of the bivariate VAR representation (1):

$$\Delta \mathbf{y}_t = \mathbf{a}_0 + \mathbf{a}_1 t + \mathbf{\Pi} \mathbf{y}_{t-1} + \sum_{j=1}^{k-1} \mathbf{\Gamma}_j \Delta \mathbf{y}_{t-j} + \mathbf{u}_t \quad (2)$$

where  $\mathbf{a}_1 = \mathbf{\Pi} \boldsymbol{\gamma}$ , and  $\boldsymbol{\gamma}$  being  $2 \times 1$  vector of unknown coefficients. The term  $\mathbf{\Pi} \mathbf{y}_{t-1}$  is known as the error correction term or the long-run part as the coefficient matrix  $\mathbf{\Pi}$  shows the speed of adjustment after being deviated from the long-run equilibrium while the short run movements of the variables are represented by the coefficient matrices  $\mathbf{\Gamma}_j$ .

The coefficients of the VAR/VECM estimations are not of interest unless forecasting purposes. Instead, impulse response functions are one of the common tools to interpret the VAR/VECM estimations as they illustrate the interrelationships among the variables. The impulse response functions can be drawn by the following Wold moving average (MA) representation, which writes the VAR process (1) in terms of the disturbances  $\mathbf{u}_t$  and their lags:

$$\mathbf{y}_t = \sum_{s=0}^{\infty} \mathbf{A}_s \mathbf{u}_{t-s} \quad (3)$$

where  $\mathbf{A}_0 = \mathbf{I}_K$  and  $\mathbf{A}_s$ 's ( $s = 1, 2, \dots$ ) are  $K \times K$  coefficient matrices which can be computed recursively:

$$\mathbf{A}_s = \mathbf{\Phi}_1 \mathbf{A}_{s-1} + \mathbf{\Phi}_2 \mathbf{A}_{s-2} + \dots + \mathbf{\Phi}_p \mathbf{A}_{s-p}, \quad s = 1, 2, \dots,$$

From the Wold MA process (3), it is straightforward that the marginal response of an element of  $\mathbf{y}_t$  with respect to  $\mathbf{u}_t$  innovation is represented by the elements of  $\mathbf{A}_s$ . The corresponding MA process for the VECM representation (2) is given by the following Beveridge-Nelson MA process (see Lütkepohl 2005 appendix C.8):

$$\mathbf{y}_t = \mathbf{\Xi} \sum_{i=1}^t \mathbf{u}_i + \sum_{j=0}^{\infty} \mathbf{\Xi}_j^* \mathbf{u}_{t-j} + \mathbf{y}_0^*, \quad t = 1, 2, \dots, \quad (4)$$

where  $\mathbf{\Xi} = \boldsymbol{\beta}_{\perp} (\boldsymbol{\alpha}'_{\perp} (\mathbf{I}_K - \sum_{i=1}^{p-1} \boldsymbol{\Gamma}_i) \boldsymbol{\beta}_{\perp})^{-1} \boldsymbol{\alpha}'_{\perp}$  and  $\mathbf{\Xi}_j^* = \sum_{j=0}^{\infty} \mathbf{\Xi}_j$ . The  $\boldsymbol{\beta}_{\perp}$  and  $\boldsymbol{\alpha}_{\perp}$  represent the orthogonal complement matrices of  $\boldsymbol{\beta}$  and  $\boldsymbol{\alpha}$  (i.e.,  $\boldsymbol{\beta}'_{\perp} \boldsymbol{\beta} = \mathbf{0}$  and  $\boldsymbol{\alpha}'_{\perp} \boldsymbol{\alpha} = \mathbf{0}$ ). The term  $\mathbf{y}_0^*$  contains all initial values. The coefficient matrix  $\mathbf{\Xi}$  represents the long-run effects of impulse responses whereas the  $\mathbf{\Xi}_j^*$ 's the short-run effects.

The impractical assumption in the impulse responses shown in the MA processes (3) and (4) is that the shocks occur in isolation, which is not true if the elements of the disturbance vector  $\mathbf{u}_t$  are contemporaneously correlated, that is, if the covariance matrix  $\boldsymbol{\Sigma}$  is not diagonal. To isolate the shocks, Sims (1980) proposed the Cholesky decomposition, that is, the decomposition of the covariance matrix  $\boldsymbol{\Sigma}$  into the product of a lower triangular matrix  $\mathbf{P}$  and its transpose (i.e.,  $\boldsymbol{\Sigma} = \mathbf{P}\mathbf{P}'$ ). Rewriting the MA process (3) using the matrix  $\mathbf{P}$  is:

$$\mathbf{y}_t = \sum_{j=1}^{\infty} \mathbf{A}_j \mathbf{P}\mathbf{P}^{-1} \mathbf{u}_{t-j} = \sum_{j=1}^{\infty} \boldsymbol{\Psi}_j \boldsymbol{\varepsilon}_{t-j} \quad (6)$$

where  $\boldsymbol{\Psi}_j = \mathbf{A}_j \mathbf{P}$  and  $\boldsymbol{\varepsilon}_t = \mathbf{P}^{-1} \mathbf{u}_t$ . Thus,  $E[\boldsymbol{\varepsilon}_t \boldsymbol{\varepsilon}_t'] = E[\mathbf{P}^{-1} \mathbf{u}_t (\mathbf{P}^{-1} \mathbf{u}_t)'] = \mathbf{P}^{-1} E(\mathbf{u}_t \mathbf{u}_t') \mathbf{P}'^{-1} = \mathbf{P}^{-1} \boldsymbol{\Sigma} \mathbf{P}'^{-1} = \mathbf{P}^{-1} \mathbf{P}\mathbf{P}' \mathbf{P}'^{-1} = \mathbf{I}_K$ , so the new disturbances, or structural shocks,  $\boldsymbol{\varepsilon}_t$  are contemporaneously uncorrelated (i.e.,  $\text{Var}(\boldsymbol{\varepsilon}_{it}, \boldsymbol{\varepsilon}_{jt}) = 0$ , for  $i \neq j$ ). In other words, a change in one element of  $\boldsymbol{\varepsilon}_t$  has no effect on the other elements because the elements are orthogonal (i.e., uncorrelated). The  $\boldsymbol{\Psi}_j$  are referred as orthogonalised impulse response functions as the elements of the  $\boldsymbol{\Psi}_j$  trace how the orthogonalised shocks work their way through the system over time. By the same token, the orthogonalised impulse responses for the VECM are obtained by substituting  $\mathbf{u}_i$  with  $\mathbf{P}\boldsymbol{\varepsilon}_i$  in the MA process (4). Then the long-run effects of the structural shocks are given by  $\mathbf{\Xi}\mathbf{P}$ .

Orthogonalised impulse response analysis relies on the ordering of the variables. The current ordering scheme of the vector ( $mc^{India}, mc^{Pakistan}$ ) places India before Pakistan. This ordering scheme is arbitrary unless supported by theoretical justification. Therefore, I replicate the VAR/VECM estimations to illustrate generalised impulse response functions (GIRF), which circumvents the recursive ordering problem. The concept of the generalised

impulse response function, advanced in Koop, Pesaran and Potter (1996) originally intended to deal with the problem of impulse response analysis in the case of nonlinear dynamic systems, but it can also be readily applied to multivariate time series models such as VAR.

## **Data**

We compiled a data on yearly sequence of military capabilities for India and Pakistan. Building upon the arms race literature (Anderton 1990; Smith 1980; Yildirim and Ocal 2006; Smith, Dunne and Nicolaidou 2000), we consider military expenditure as a major military capability measure. We collect military expenditure from the World Development Indicators which provides a consistent measure of military expenditure as % of GDP since 1960.

In addition to military expenditure, we consider equipment holdings available for both countries as it is a direct measure of military strength. In particular, we utilise the Military Balance, the annual report drafted by the International Institute for Strategic Studies (IISS) on military capabilities of 171 states and territories (Military Balance 2018). The main advantage of the use of the Military Balance is its comprehensiveness and the symmetric treatment of military capabilities of two contending countries like India and Pakistan, something that is unavailable in the official statistics compiled by either side. Time series of military capabilities reported by the Military Balance often differ across the editions due to the reassessment of equipment holdings and the availability of new information. We take the most recently published information into account in compiling the data when there are multiple pieces of information on the same equipment in a given year.<sup>1</sup> The data on equipment holdings covers from 1989, the year as far back as we could reach, to 2017.

We collect four types of the equipment holdings during the period of interest: armoured fighting vehicles (AFVs), artillery, assault helicopters, air defence missiles. First, AFVs are defined as army's combat vehicles with a combat weight of at least six metric tonnes, and include main battle tanks (MBTs), light tanks, armoured vehicles primarily designed for reconnaissance tasks with no significant transport capability, infantry fighting vehicles (IFVs), armoured personnel carrier (APCs), and armoured utility vehicles (AUVs). Second, artillery in the present paper denotes weapons held by the army, including guns, howitzers, gun/howitzers, multiple-rocket launchers, mortars and gun/mortars with a calibre

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<sup>1</sup> See the Explanatory Notes in Military Balance (2018) for details on compiling methods and the types of equipment and weaponry.

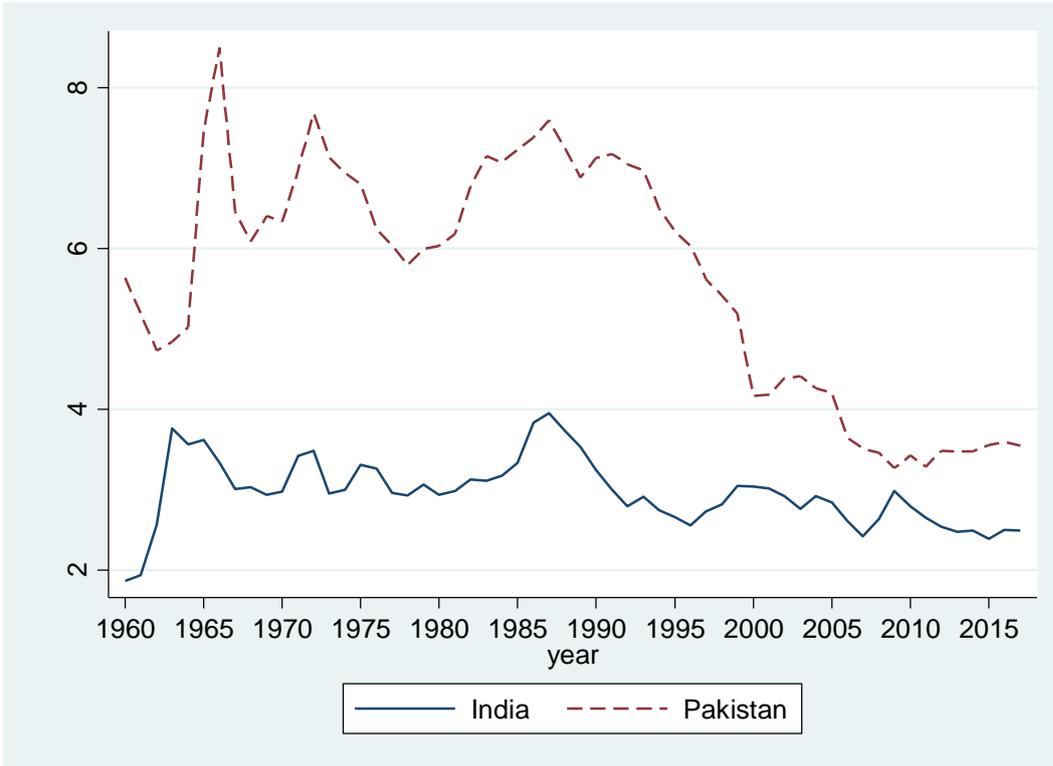
greater than 100mm for artillery pieces and 80mm and above for mortars, capable of engaging ground targets with indirect fire. Third, attack (or assault) helicopters are principal aviation with rotary-wing platforms designed for delivery of air-to-surface weapons, and fitted with an integrated fire-control system. Finally, air defence missile launchers denote surface-to-air-missile (SAM) launchers designed to engage fixed-wing, rotary-wing and unmanned aircraft. Table 1 presents descriptive statistics of military expenditure and equipment holdings of India and Pakistan in the recent decades.

<Table 1: Descriptive statistics of military capability measures>

Measures	Military spending (% of GDP)		Armed fighting vehicles (AFV)		Artillery		Attack helicopters		Air defence missile launchers	
	Ind.	Pak.	Ind.	Pak.	Ind.	Pak.	Ind.	Pak.	Ind.	Pak.
Country										
Mean	2.96	5.63	5,340	3,342	8,066	3,283	91	36	2,036	1,705
SD	0.42	1.48	874	533	3,104	1,218	18	9	1,154	1,119
Min	1.87	3.27	3,457	2,400	3,575	621	65	27	186	350
Max	3.95	8.50	6,876	4,262	12,675	4,607	117	54	3,500	2,990
N	58	58	32	32	32	32	32	32	32	29

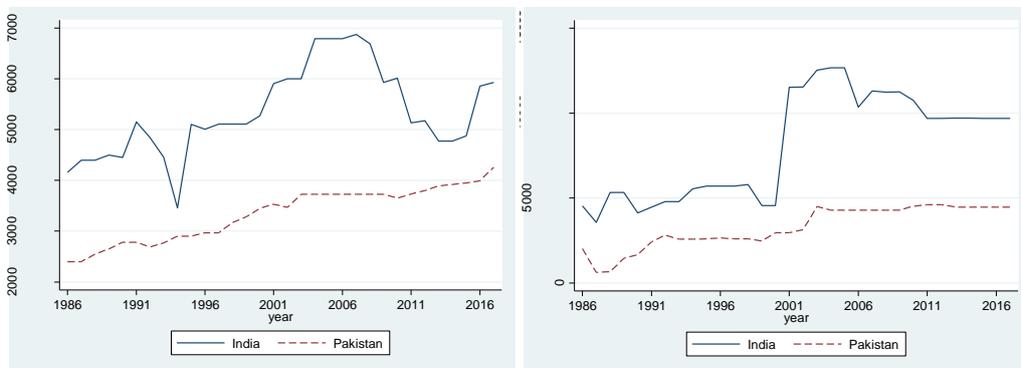
In all measures of equipment holdings, India overwhelms Pakistan in the absolute values as these measures in Pakistan are 40-63% of those of India. However, Pakistan's defence burden surpasses that of India as the annual average of Pakistan's defence expenditure accounts for 5.63% of GDP whereas India 2.96% of its GDP. Figure 1 illustrates the time series of defence expenditure of the two countries during the recent six decades.

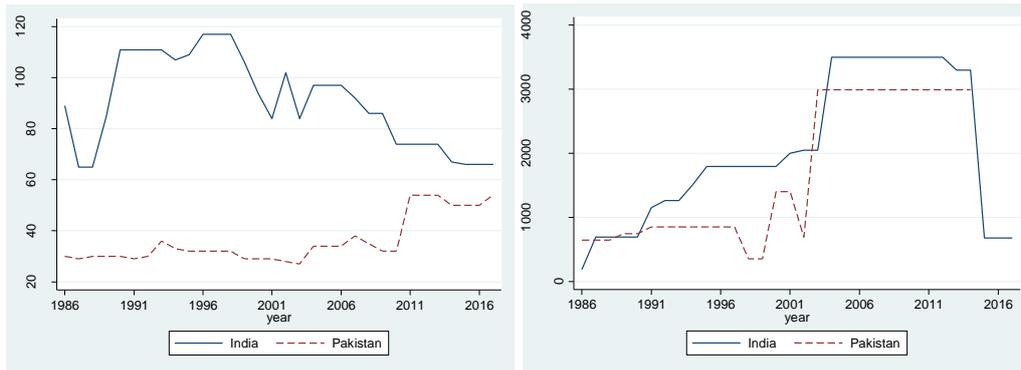
<Figure 1: Indian and Pakistani defence expenditure as % of GDP, 1960-2017>



Military expenditure of the two countries appear to move together until mid-1990s although Pakistan’s military burden is far higher than that of India. Since 1987 military expenditure has rapidly reduced in both countries. It is noticeable that in 2010’s India’s military expenditure tends to have gradually decreased whereas those in Pakistan have progressively increased.

<Figure 2: Equipment holdings in Indian and Pakistani armed forces>





The plots in figure 2 present the four types equipment holdings of interest held by India and Pakistan between 1986 and 2017. Armoured fighting vehicles shown in the upper left plot tend to increase in both countries during the recent three decades although India has reduced its holdings significantly from late 2000s and early 2010s. The upper right plot shows artillery, which appears to have been stationary at 10,000 in India and at 5,000 in Pakistan during the recent past. The lower left plot presents the number of attack helicopters. Pakistan has increased attack helicopters in 2010s whereas India has reduced its holdings to about 60, a half of its late 1990s level. The lower right plot illustrates the air defence missile launchers. Pakistan had held about 3000 air defence missile launchers until 2014 while those of India has reduced to about 700 in 2015.

### Impulse response analysis

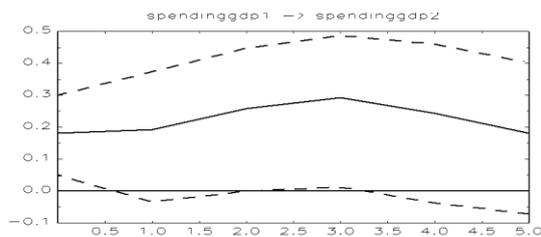
We illustrate our approach by estimating orthogonalised impulse response functions for the bivariate VAR/VECM in the India-Pakistan military capabilities, measured by military expenditure (% of GDP) and four types of equipment holdings. All variables are in logarithms except military expenditure. The results for the orthogonalised impulse responses of military capabilities are presented in Figures 3 and 4, together with 95% Hall bootstrap confidence intervals based on 2000 bootstrap replications.

Figure 3 shows Pakistan's responses to a one-standard deviation positive shock (impulse) in India's military capabilities, measured by military expenditure, armoured fighting vehicles, artillery, attack helicopters and air defence missile launchers respectively. The upper left panel shows that a one-standard deviation positive shock in India's military expenditure (0.2 percentage point increase) has a persistent, and marginally significant effect

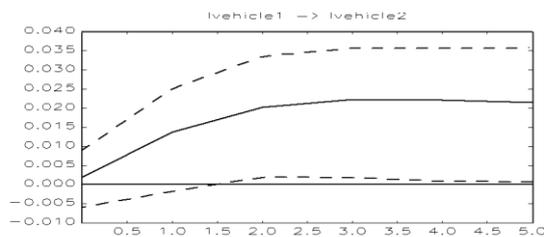
on Pakistan's military expenditure over the five-year horizon. It is interesting that Pakistan's response is immediate, and is roughly a 0.2 percentage point increase, similar to the size of the shock in India's military expenditure. The panel on armoured fighting vehicles also shows that a one-standard deviation shock in India's vehicles (a 0.08 percentage increase) raises those of Pakistan. The effect is persistent and marginally significant over the five-year horizon. On the other hand, Pakistan's responses to a shock in India's artillery, attack helicopters or air defence missile launchers are not statistically significant either in the short-run or in the long-run, represented by the interval estimates (dotted lines) embracing the zero line.

<Figure 3: Responses of Pakistan to the increase in Indian military capabilities>

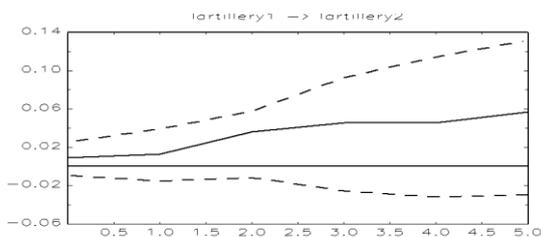
**Military expenditure**



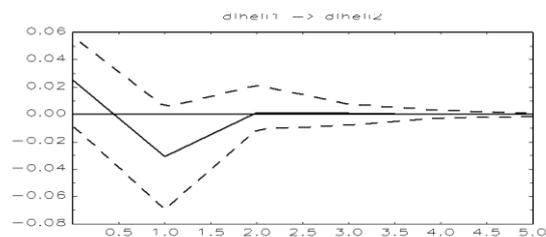
**Armoured fighting vehicles**



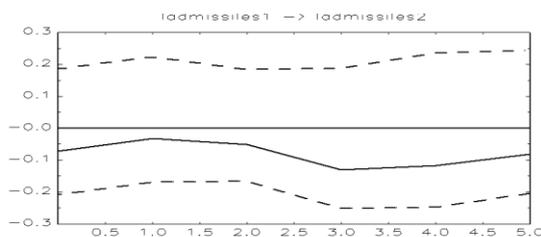
**Artillery**



**Attack helicopters**



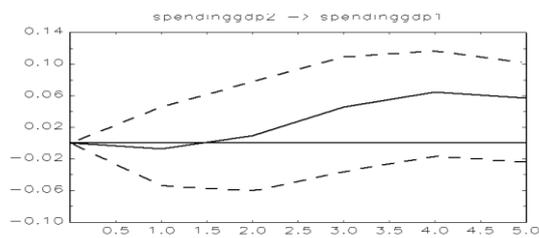
**Air defence missile launchers**



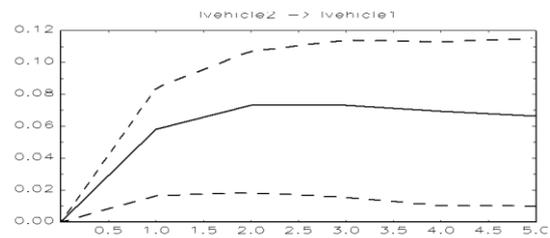
Looking at India's responses to the increase in Pakistan's military capabilities, the panel on military expenditure in Figure 4 shows that a one-standard deviation positive shock in Pakistan's military expenditure (a 0.4 percentage point increase) raises that of India from one year after the shock, but this effect is not statistically significant at the 5% level. However, the panel on the armoured fighting vehicles suggests that an increase in Pakistan's vehicles significantly and persistently raises those of India. The panel on the armoured fighting vehicles, together with its counterpart in figure 3, suggests that India and Pakistan are responsive to the increase in each other's military capabilities measured by armoured fighting vehicles although India's reaction is much larger. The artillery panel in Figure 4 shows that an increase in Pakistan's artillery instantaneously raises India's artillery. After this over-shooting, the effects tend to die out in a year after the shock occurred. More importantly, the effect is marginally significant during the first year of the shock only. The panels on attack helicopters and air defence missile launchers indicate that India's responses to the increase in Pakistan's attack helicopters and air defence missile launchers are positive but largely insignificant, if not marginally significant, over the five-year horizon.

<Figure 4: Responses of India to the increase in Pakistan's military capabilities>

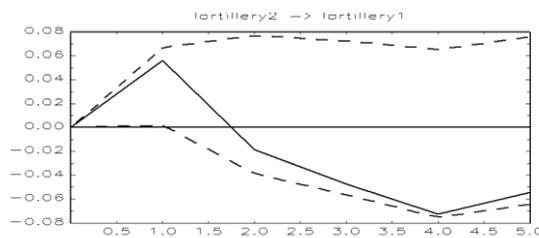
Military expenditure



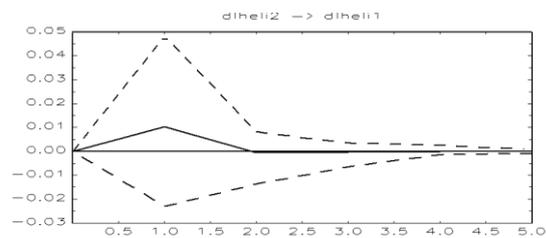
Armoured fighting vehicles



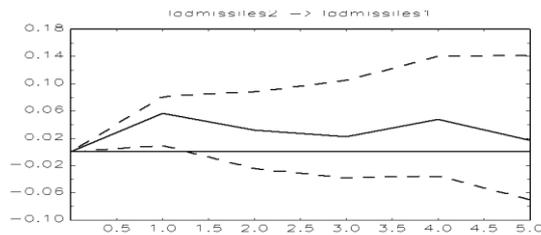
Artillery



Attack helicopters



Air defence missiles



We replicate the VAR/VECM estimations to obtain the generalised impulse response functions (GIRFs) which were developed by Pesaran and Shin (1998) to circumvent orthogonalised impulse response functions' (OIRFs) shortcoming of the dependence on the ordering of the variables. The results obtained from the GIRFs are largely consistent with those from OIRFs (available upon request). It is not surprising that the GIRFs and OIRFs yield consistent results as the residual correlations between the military capability variables of India and Pakistan in general very small for all VAR/VECM estimations.

## Discussion

Both India and Pakistan are highly organised and commanded, and respond predictably to the increase in military capabilities of each other. In particular, the conventional arms race between the two sides in terms of armoured fighting vehicles (AVFs) is found to be bidirectional. When one side strengthens its ground forces through increasing AVFs such as main battle tanks, the other side makes strenuous efforts to hold more AVF stocks. There are however marked asymmetries between the two sides in terms of the persistency of their strategic reactions, and the technology at their disposal. Except AVFs, Pakistan is not engaged in the systematic interactions with India through altering the number of equipment holdings. Instead, Pakistan's strategic reaction is directed towards military spending. That is, Pakistan spontaneously and persistently increases its military spending in response to the increase in that of India. On the other hand, India's strategic reaction is directed towards AVFs, artillery, and air defence missiles, all of which are defensive, rather than offensive, weapons. Furthermore, India's response in terms of artillery and air defence missiles persists only for a short-term period.

An analysis of the balance of conventional forces and the manner in which Indian and Pakistani forces have been developed and deployed requires a completely different framing of the strategic situation. Once again comparison with the Cold War example can yield useful

insights. The Warsaw Pact deployed forces that were numerically superior to those of NATO in peacetime and were designed to achieve a militarily significant superiority within a few days after mobilisation. The Soviet Union forward deployed over 500,000 troops in East Germany as well as over 40,000 main battle tanks in Eastern Europe and the forces were at a such high state of readiness that they could initiate military operations within hours. Operational plans were based on launching offensives that would result in the complete occupation of Western Europe with the exception of the British Isles. NATO on the other hand focussed on countering a Soviet attack with a high density of anti-tank weapons and armoured divisions to halt the advance of Warsaw Pact forces. NATO was committed to maintain a conventional defence for as long as possible but deployed a sizeable force of theatre nuclear forces that could be used if conventional means failed to terminate the conflict.

In terms of the balance of power and its imputed aggressive intent, India is in the position in South Asia that the Soviet Union occupied in Europe. However, India's force posture is completely at odds with this conceptualisation. There is no massive deployment of Indian forces in the states bordering Pakistan, with divisions equipped with artillery pieces, main battle tanks and an air force ready to launch major strikes and provide close air support combat ready and capable of initiating major military operations at short notice. Quite the opposite, the most important elements of India's army are located at very considerable geographical distance from the theatre of operations. Moreover, India's peacetime ammunition stocks are so low that India might struggle to support a major war for more than ten days. A report on a review by the Comptroller and Auditor General (CAG) of India stated: "The Indian military is required to hold ammunition enough to fight a short intense war of 20 days. Earlier, Indian military was required to have store supplies, spares and ammunition - called War Wastage Reserve (WWR) - to fight a 40-day intense war. In 1999 the WWR was scaled down to only 20 days. The CAG says that of the 152 types of ammunition identified as critical stocks of only 31 were available for 40 days whereas as many as 12 types of ammunition was available for 30 to 40 days and stocks of as many of 26 types of ammunition was available for a little over 20 days (Sen 2017)." The level of readiness of India's forces is low and recent experience has demonstrated that India struggles to convincingly respond to low-level conflict provoked by the other side. This leads to a profound conclusion. Just as at the strategic nuclear level India is not defining its force posture in relation to Pakistan, the same is true for its conventional forces. This is a peculiar strategic relationship in which one side develops and configures its forces for conflict with another party, whereas the other party does not reciprocate. Pakistan is

focussed on its strategic relationship with India. India is acting as if such relationship does not exist.

## **Conclusion**

The conventional wisdom that India and Pakistan follow the pattern of a tit-for-tat arms race has been tested, controlling for the overwhelming superiority of India's military capabilities. Multivariate time series analysis offers evidence that both sides are systematically and predictably engaged in conventional arms race. There are however distinctive differences in their strategic reactions to each other's provocation. India's reaction to the increase in Pakistan's military capabilities is instrumented with strengthening defensive weapons including air defence missile systems, artillery pieces and armoured fighting vehicles. Furthermore, India's peacetime ammunition stocks are just enough to meet the requirements for a short intense war. On the contrary, Pakistan has made consistent and significant efforts to narrow the gap in military equipment holdings. More importantly, its reaction is directly and strongly associated with higher levels of military spending as well as defensive weapons.

This polarised strategic reactions between the two sides is likely stem from the extent to which military forces affect politics in the two countries. While India's nonprovocative defence strategy, as articulated by Sundarji doctrine in 1980s, has provided military forces with a clear guideline, Pakistan's military presence in politics has been long-standing, which awards military forces with power to be aggressively engaged in a conventional arms race with its counterpart through adaptably altering military spending and mobilising ground forces. Our findings challenge the dominant view on the conventional arms race between India and Pakistan since this non-zero sum game follows unconventional patterns where only one side is in a full-fledged arms race in a two-players noncooperative game.

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