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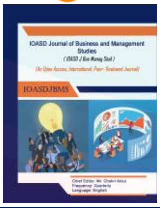

Determinants of India's Defense Expenditure

Dr. Sapana Sharma[1*] & Sanju Karol[2]

[1]Assistant Professor, Dept. of Commerce, GNIOT, Greater Noida, Uttar Pradesh- 201310, India.
[2]Professor of Economics, ICDEOL, Himachal Pradesh University, Shimla-171005, India.

Corresponding Author: Dr. Sapana Sharma
Assistant Professor, Dept. of Commerce, GNIOT, Greater Noida, Uttar Pradesh- 201310, India.

ABSTRACT

Aims: This study aims to empirically examine the determinants of India's defense expenditure, with a focus on assessing the relative influence of economic, demographic, and geopolitical factors over the period 1960–2020. ***Study Design:*** Time-series econometric analysis based on the Autoregressive Distributed Lag (ARDL) cointegration framework. ***Place and Duration of Study:*** Secondary data covering India from 1960 to 2020 were analyzed using ARDL models estimated by the authors between 2023 and 2024. ***Methodology:*** Two ARDL models were constructed. Model 1 (1960–2020) examined the effects of GDP, Pakistan's defense burden, population, trade balance, internal conflicts, and war on India's defense spending. Model 2 (1974–2020) additionally included central government expenditure and a regional security web variable. Cointegration was tested using the ARDL bounds approach, while short-run and long-run dynamics were analyzed through error correction models (ECM). ***Results:*** The F-statistics in both models exceeded the 5% critical bounds, confirming long-run cointegration. In both short and long run, GDP, population growth, and wars significantly increased defense expenditure, while Pakistan's defense burden had no significant effect, rejecting the conventional arms race hypothesis. Central government expenditure was a strong positive determinant in Model 2, while the security web had an unexpected negative effect. Error correction terms were negative and highly significant, indicating rapid adjustment toward long-run equilibrium. ***Conclusion:*** India's defense expenditure is shaped more by domestic economic capacity and strategic priorities than by regional rivalries. External wars exert a greater influence than internal conflicts, while fiscal policy strongly conditions defense spending. Policy implications include aligning defense expenditure with economic growth, investing in technology-driven efficiency, refining conflict management strategies, and reassessing multilateral security arrangements.

Keywords: Determinants, Defense expenditure, ARDL model, India, Strategic policy, Conflict.

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1. INTRODUCTION

India is located in a highly insecure region of South Asia. India is a vast country; thus, its defense spans all battlegrounds: land, sea, air, space, and cyberspace. China, Pakistan, Bangladesh, Nepal, Bhutan, and Sri Lanka share a border with India's mainland, with whom she has had tense relations in the past. India's connections with her neighbors are extremely problematic (Gupta, 1997). Numerous economists argue that persistent political tensions and religious disparities have engendered an arms race between India and its neighboring nation, Pakistan. Additionally, the history of four conflicts occurring between these two countries since their respective independence in 1947 underscores the enduring strain in their relationship.

In addition, many people are concerned about the security of their surroundings. India's longstanding issues with China, dating back to the 1962 Sino-Indian border war, underscore the increasing significance of their relationship in shaping the global political landscape, given their status as two of the world's largest and most influential nations. India's security policies and military spending are influenced by its plans to assert regional power and global power status in South Asia (Hou 2009).

According to SIPRI yearbook 2021, India's military expenditure in 2020 stood at US$ 72.9 billion, adjusted for constant prices in 2019, ranking it third among the world's top 15 countries in defense spending.

Notably, India's per capita PPP-adjusted gross national income is a mere US$ 6,284, and it holds the 124th position out of 186 countries (IMF 2020). Despite its relatively low-income status, India allocates a substantial portion of its resources to defense. In 2017-18, 12.25 per cent share of central government expenditure (CGE) was spent on defense whereas; only 3.96 per cent and 1.55 per cent were spent on education and health respectively (Ministry of Finance, 2019). Therefore, the more share of CGE to defense sector shows the priority of Indian's government to security of the country. India remains dedicated to peace and security despite its focus on social and economic development which are viewed as major aspects for the Indian people's sustained economic development and prosperity. These elements contribute to India's defense burden, which has an impact on defense spending and economic growth.

India's increasing defense expenditure places a significant financial burden on the economy, diverting critical resources from essential sectors such as education and health. While India faces legitimate security threats, the drivers of defense spending remain insufficiently understood. Without a clear empirical understanding of these determinants, policymakers risk adopting unsustainable or misaligned defense allocation strategies. This study investigates the determinants of India's defense expenditure using empirical methods. By analyzing military, economic, political, and social factors, the research seeks to identify the primary variables influencing India's defense budget. The findings will inform policymakers by clarifying the trade-offs between security and economic development, thereby enabling more balanced fiscal planning.

The subsequent sections of the paper are structured as follows: Section 2 provides a comprehensive review of models concerning the determinants of India's defense expenditure. In Section 3, we delve into the details of the data used and the empirical methodology applied in this study. The empirical findings and their analysis are presented in Section 4. Finally, Section 5 serves as the conclusion of the paper.

2. DETERMINANTS OF INDIA'S DEFENSE EXPENDITURE

Numerous researchers have investigated defense expenditure demand in emerging nations, employing diverse methodological approaches such as cross-country regression models and time series case studies. These investigations have categorized the defense expenditure determinants in developing nations into four distinct categories.

a) Military activity (Security consideration).
b) Economic factors.
c) The political context.
d) Additional factors like lagged military expenditure and population demographics.

External conflicts, internal strife, security networks, and military actions are all examples of military activities that can be dealt with in a variety of ways (Hou 2009). Hewitt (1991) found that international wars had a considerable and favorable impact on military burden. Security improvements were most likely a factor in reduced military expenditure by warring countries. Similarly, External war was treated as a dummy variable in Batchelor et al. (2002); Dunne and Perlo-Freeman (2003); Collier and Hoeffler (2007) and Selvanthan & Selvanthan (2014), with a value of 1 to indicate a country's participation in worldwide conflict and 0 to signify non-participation. Participation in a war was shown to be positively connected with military spending in these studies, which is not surprising.

In developing countries, civil wars frequently have serious security repercussions. For emerging countries, internal security challenges, according to Ball (1988), exceed external security concerns. A fundamental objective of the armed forces is to safeguard the ruling regime from its populace. Military expenditure allocations serve as a means for both civilian and military administrations to maintain the support of the armed services. Dunne and Mohammed (1995) discovered that civil war dummies had a large and favorable influence on the military burden, Collier, and Hoeffler (2002); Dunne and Perlo-Freeman (2003a), and Collier et al. (2003) all backed up these findings. In peacetime, developing countries typically allot 2.8% of their GDP to defense expenditure, but during civil conflicts, this allocation increases to 5%. This observation aligns with the discoveries made by Collier et al. in 2003.

Severin authors, including Rosh (1988); Dunne & Perlo-Freeman (2003a &b), and Collier & Hoeffler (2007), have presented an expanded perspective on a nation's security challenges, termed the 'security web.' This framework encompasses neighboring nations and regional actors with the capacity to extend their influence beyond their immediate terrestrial and maritime boundaries. Rosh (1988) discovered that security web variables had a crucial influence in determining the military burden of the third world. Dunne and Perlo Freeman (2003a, 2003b) along with Dunne et al. (2008) categorized countries integrated into a nation's security framework into distinct groupings, including designations like Enemies, Potential Enemies, and Others. They also considered a category for Great Power enemies. Their study found that the military burden of enemies and potential enemies had a significant impact on a country's military burden in most cases. However, the findings regarding security web variables were mixed, and the variables related to Great Power adversaries showed little significance. However, prior studies by Sun and Yu (1999) and Tambudzai (2005) identified a robust and favorable correlation between a country's military expenditure and the burden or expenditure of its adversaries in the context of military expenditures.

Numerous economic factors, including urbanization, wealth and income inequality, real income growth, budget size, and the impact of the military-industrial complex, play pivotal roles in shaping national military expenditure, as asserted by Looney (1989). The proportion of military burden, according to Hewitt (1993), is clearly affected by GDP. Sun and Yu (1999) investigated the demand for China's defense expenditure; Batchelor et al. (2002) focused on South Africa, Tambudzai (2007) on Southern African countries, Hou (2009) on India, and Torres (2013) on Portugal. These studies underscored the significant role income plays in shaping military spending. However, some researchers, including Dunne et al. (2003) and Solomon (2005), found that income had limited long-term relevance for Spain, Greece, and Canada.

In contrast, Dunne and colleagues (2008) conducted research on Less Developed Countries and discovered that income had a notable and adverse effect on military spending, a pattern also noted by Hartley and MacDonald (2010) in the United Kingdom and Kabongi (2018).

Military expenditures are contingent on the size of the state budget, which is determined by central government's expenditure. The percentage of central government expenditure to GDP was utilized by Dommen and Maizels (1988) as one factor of internal economic linkages. In a cross-sectional analysis of 72 Less Developed Countries (LDCs) between 1978 and 1980, the research revealed a notable and favorable correlation between the central government's expenditure-to-GDP ratio and the extent of the military burden. However, when examining the impact of non-defense government spending on the military burden, the calculated coefficient was deemed not statistically significant. This positive relation between military burden and central government expenditure aligns with findings from Hewitt (1993) in the context of developing nations. Top of FormYildirim and Sezgin (2005) employed panel data techniques to examine the relationship between government consumption and military burden across 92 nations from 1987 to 1997. Their research revealed a notable and positive relation between military burden and central government spending, highlighting a consistent correlation between defense expenditures and central government outlays.

Rosh (1988) pioneered the exploration of a potential correlation between a country's level of militarism and its integration into the global economy. He hypothesized that countries with a high degree of global integration would experience greater ease in securing funds for acquiring arms purchases, resulting in increased military spending. His empirical findings supported the hypothesis that trade had a considerable and favorable impact on emerging countries' military burden. In prior research, Dunne and Perlo Freeman (2003) and Dunne et al. (2008) used a comprehensive trade variable encompassing imports and exports to examine its influence on military burden in developing nations from 1981 to 1997. Their findings indicated a significant and positive trade effect, a conclusion supported by Torres (2013). However, during the period from 1967 to 1985, Dunne and Mohammed (1995) did not observe a statistically significant influence of trade on military expenditure in Sub-Saharan Africa.

The impact of population on military budgets is a complex issue that remains unclear. Some studies suggest a negative connection between population size and military expenditure (as a proportion of GDP), this relationship is complex and not fully explored. One potential explanation is that larger populations can serve as a security buffer, (Dunne and Perlo-Freeman 2003a&b; Dunne et al. 2008). Second, larger populations in countries may prioritize civilian consumption needs over security concerns, as indicated by previous studies (Dunne and Freeman 2003b; Collier and Hoeffler 2002 & 2007). The third argument is that nations with smaller populations could face pressure to allot a larger amount of their funds towards advanced weaponry instead of maintaining large conventional armed forces (Dunne and Perlo-Freeman 2003b). However, it is worth noting that there has been a positive impact. In a study focused on developing countries' demand function, Hewitt (1991) determined the influence of population size on military burden. The results showed a significant and positive population coefficient. Hewitt proposed potential reasons for this positive effect, suggesting that a larger population contributes to a country's capacity to maintain a robust military force, consequently bolstering its military prowess. Wang (2013) also argued that a substantial population can make defense spending more economically viable and in demand, further supporting the notion of a favorable impact.

3. DATA AND EMPIRICAL METHODOLOGY

In prior research, various approaches have been employed to analyze military expenditure in less-developed countries (LDCs), considering factors such as military activity, economic conditions, and more. In this paper, building upon insights from Section 2, we formulate a comprehensive model for India's defense expenditure that incorporates key national variables. This results in the following demand equation:

$$DEI = M\,(GDP, THREAT, POP, TB, SW, CGE, INTERNAL, WAR) \quad (1)$$

Where, DEI stands for India's real military spending, GDP for gross domestic product, THREAT for Pakistan's defense burden (DBP) as a rival, POP for total Indian population, TB for trade balance share in GDP, SW for India's security web, INTERNAL and WAR for internal and war dummies.

Defense expenditure is considered a public good, and it is anticipated to exhibit a positive correlation with income. This is because higher income levels generally lead to increased spending on security. In the context of developing nations, the extent of economic limitations, quantified using real GDP (at constant 2015 US$ prices), exerts a noteworthy influence on their military expenditure. An elevation in GDP corresponds to increased capacity for defense-related endeavors and a heightened demand for safeguarding interests, as underscored by the favorable coefficient associated with the GDP variable. (Tambudzai 2007; Sandler and Hartley 1995).

Hypothesis 1: As real GDP rises; military spending will rise as well.

Incorporating the population variable into our analysis allows for the exploration of its potential impact on military spending, considering both size-related and public good influences. While the precise influence of population on defense expenditure remains uncertain, it is incorporated to address demographic factors. Studies have shown varying findings, with some indicating a negative correlation (Dunne and Perlo-Freeman, 2003) and others suggesting the opposite (Wang, 2013).

Hypothesis 2: A country's defense spending will be reduced as its population grows.

The share of trade balance in GDP is used in this study to capture the influence of economic integration on DE. This is an indicator of the economy's openness as well as the increase of foreign currency.

Hypothesis 3: With the increase in foreign reserves of a country there will be rise in defense expenditure.

The inclusion of CGE is expected to have a favorable impact, suggesting an increase in available defense resources.

Hypothesis 4: Defense expenditure (DE) rises with an increase in CGE.

This study incorporates Pakistan's defense expenditure (DBP) to assess the rivalry in defense spending between India and Pakistan. Additionally, it considers the "security web" (SW) component related to militarization, measuring the average military burden of nations, particularly Nepal, Bangladesh, and Sri Lanka, which can impact India's security. China, Bhutan, and Myanmar are omitted from the analysis due to insufficient defense expenditure data. These defense burden variables reflect India's external threats. Furthermore, in the context of security web analysis, it is important to note that the total defense spending of neighboring countries may not provide an accurate measure of their potential threat. For instance, when a significantly weaker nation increases its defense budget, it may not be perceived as a threat by a much more powerful country, leading to the latter's lack of necessity for a response.

Hypothesis 5: If defense spending in adjacent countries is higher, domestic defense expenditures will be higher as well.

External war (war) and internal security threat (internal) are also included as dummy variables. To depict the threats, the war dummy contains India's wars with China in 1962 and with Pakistan in 1965, 1971, and 1999. Internal and cross-border security issues, as detailed in the reviews section, have an impact on India's defense spending amount and trend. The internal variable in this study covers major insurgencies and conflicts within the country but excludes riots to analyze the impact of internal security risks on India's defense spending.

Hypothesis 6: When a country is confronted with a conflict and a threat to its internal security, it will increase its defense expenditure

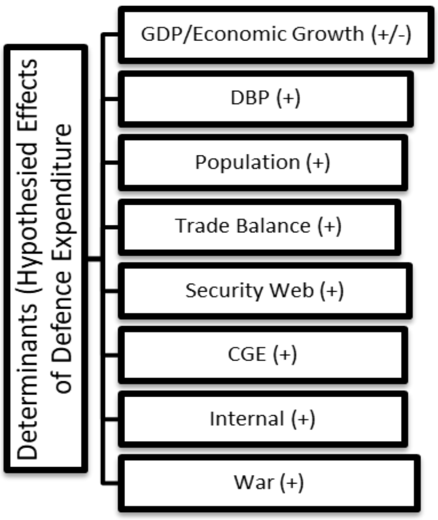

Figure- 1 summarizes the theoretical Expectations from the Determinants of Military Expenditure
Source: Authors' interpretation.

Considering the preceding explanation, India's allocation of funds for defense is shaped by a confluence of economic, security, and pertinent factors. This relationship can be mathematically represented in logarithmic form (referred to as model "l") as stated below.

Model 1:

$$ldei_t = \alpha_0 + \beta_1 lgdp_t + \beta_2 ldbp_t + \beta_3 lpop_t + \beta_4 ltb_t + \beta_5 internal + \beta_6 war + \varepsilon_t \quad (2)$$

Model 2:

$$ldei_t = \alpha_0 + \beta_1 lgdp_t + \beta_2 ldbp_t + \beta_3 lpop_t + \beta_4 ltb_t + \beta_4 lsw_t + \beta_4 lcge_t + \beta_5 internal + \beta_6 war + \varepsilon_t \quad (3)$$

Model 1 is the foundation, and it comprises income, Pakistan's defense burden, population, trade balance, internal, and war dummy variables. The model is then expanded in model 2 by include the portion of central government expenditure in GDP as well as security web factors.

3.1 Data sources and definition of variables

In an ideal world, the current study would have been conducted since India's independence in 1947; however, the determinants of India's defense expenditure is estimated for the period 1960-61 to 2020-21 because the Indian government prioritized defense spending after China attacked India in 1962, resulting in a full-fledged war between the two countries. The research relies on secondary data sources, with a gap in data availability from 1960 to 1973 for certain variables. As a result, the analysis focuses on the period from 1974 to 2020. Data regarding defense spending for India and the defense burden of Pakistan, Sri Lanka, Nepal, and Bangladesh were obtained from various editions of the Stockholm International Peace Research Institute (SIPRI) publications by Oxford University Press. We also obtain data from the World Development Indicators (WDI) published by the World Bank Group, including information on India's GDP, population, central government expenditure, and trade balance. Additionally, we utilize two key dummy variables: "internal," which indicates 0 for periods without conflicts or insurgency and 1 for periods marked by conflicts or insurgency. and "war," which signifies India's external wars with China and Pakistan during the years 1962, 1965, 1971, and 1999 with a value of 1 and 0 for all other years. The variables are defined as follows:

dei – India's defense expenditure in constant 2019 million US$.
gdp – India's GDP in constant 2015 million US$.
pop – India's population in millions.
cge – the % share of central government expenditure of India in its GDP.
tb – India's % share of trade balance in GDP.
dbp – Pakistan defense burden (the share of defense expenditure in GDP) as a rival of India.
sw – the security web of India by analyzing the average defense burden of neighboring countries such as Bangladesh, Nepal, and Sri Lanka.
internal –internal dummy variable is assigned a value of 0 to indicate the absence of conflicts and insurgency, and 1 to signify the presence of conflicts and insurgency.
war – War dummy variable represents India's external wars with China and Pakistan. It is assigned a value of 1 for the years 1962, 1965, 1971, and 1999, and 0 for all other years.

3.2 EMPIRICAL METHODOLOGY

To assess the determinants of India's defense expenditure, a variety of methodologies have been used. These include Arms Race models and Military Alliances Theory Models, which consider the collective influence on military expenditure across countries. some researchers have used simultaneous equation estimate approaches.

Simultaneous equation approaches have faced criticism due to issues such as the unclear differentiation between endogenous and exogenous variables in empirical models. Various methods have been used to analyze the demand for military expenditure. Some studies employed single equation estimation techniques, while others utilized cointegration methods such as the Engle–Granger two-step procedure (as seen in Gadea et al. 2004 for NATO countries) or the Johansen maximum likelihood approach (as demonstrated in Solomon's work for Canada in 2005). These co-cointegration methods rely on the assumption that the involved variables exhibit stationarity. This necessitates conducting unit root testing and using differenced variables when dealing with non-stationary ones. However, utilizing first differences of level variables may eliminate long-term data. Moreover, when dealing with a substantial number of assessed variables, estimating cointegration using vector autoregressive (VAR) modeling becomes challenging due to limitations in degrees of freedom. Consequently, these methods exhibit limitations and are unsuitable for our research.

To avoid the issues associated with different modeling approaches, this study uses the autoregressive distributed lag cointegration approach (ARDL) as described by Pesaran and Shin (1999 This approach offers a key advantage: it can be utilized regardless of the stationary properties of sample variables, enabling inferences on long-term estimations not attainable with other cointegration techniques. Additionally, unlike VAR models, it accommodates many variables in the model.

Given the ARDL (p, q) model (unrestricted ECM model) with a single independent variable for simplicity:

$$\Delta y_t = \alpha_0 + \beta y_{t-1} + \theta x_{t-1} + \sum_{j=1}^{p-1} \gamma_j \Delta y_{t-j} + \sum_{j=0}^{q-1} \varphi_j \Delta x_{t-j} + \mu_t \quad (4)$$

The ARDL approach, according to Pesaran and Shin (1999), entails the following three steps, which could also be applied to multivariate models.

Ascertain the lag order (p and q) for the ARDL model by utilizing model selection criteria such as the Akaike Information Criterion and the Schwarz Bayesian Criteria. Following this, conduct a regression analysis using Equation (4) and apply an F-test to evaluate the existence of a long-term relationship among the variables, specifically assessing the joint non-zero coefficients of yt-1 and xt-1. Subsequently, leverage the Error Correction Model (ECM) representation of the ARDL model to approximate both the long-term relationship and the short-term dynamics of the variables.

According to the explanation in the preceding sections, the ECM representation of the ARDL models for demand models are:

Model 1:

$$\Delta ldei_t = \alpha_0 + b_1 ldei_{t-1} + b_2 lgdp_{t-1} + b_3 ldbp_{t-1} + b_4 lpop_{t-1} + b_5 ltb_{t-1} + b_6 internal + b_7 war + \sum_{j=1}^{p-1} c_{1j} \Delta ldei_{t-j} + \sum_{j=1}^{q1-1} c_{2j} \Delta lgdp_{t-j} + \sum_{j=1}^{q2-1} c_{3j} \Delta ldbp_{t-j} + \sum_{j=1}^{q3-1} c_{4j} \Delta lpop_{t-j} + \sum_{j=1}^{q4-1} c_{5j} \Delta ltb_{t-j} + \sum_{j=1}^{q5-1} c_{6j} \Delta internal_{t-j} + \sum_{j=1}^{q6-1} c_{7j} \Delta war_{t-j} + \varepsilon_t \quad (5)$$

After adding the security web and central government expenditure variables, the demand model is:

Model 2:

$$\Delta ldei_t = \alpha_0 + b_1 ldei_{t-1} + b_2 lgdp_{t-1} + b_3 ldbp_{t-1} + b_4 lpop_{t-1} + b_5 ltb_{t-1} + b_6 lsw_{t-1} + b_7 lcge_{t-1} + b_8 internal + b_9 war + \sum_{j=1}^{p-1} c_{1j} \Delta ldei_{t-j} + \sum_{j=1}^{q1-1} c_{2j} \Delta lgdp_{t-j} + \sum_{j=1}^{q2-1} c_{3j} \Delta ldbp_{t-j} + \sum_{j=1}^{q3-1} c_{4j} \Delta lpop_{t-j} + \sum_{j=1}^{q4-1} c_{5j} \Delta ltb_{t-j} + \sum_{j=1}^{q5-1} c_{6j} \Delta lsw_{t-j} + \sum_{j=1}^{q6-1} c_{7j} \Delta lcge_{t-j} + \sum_{j=1}^{q7-1} c_{8j} \Delta internal_{t-j} + \sum_{j=1}^{q8-1} c_{9j} \Delta war_{t-j} + \varepsilon_t \quad (6)$$

In the context of model, "bi" is defined as the long-term multipliers for i = 1 to n, and "cij" as the short-term dynamic coefficients in the ARDL models. In Model 1, n equals 7, while in Model 2, n equals 9. Our initial step in implementing the ARDL models involves selecting lag durations for the variables, a process guided by information criteria like the Akaike information criterion (AIC). In the second phase of the research, ordinary least squares (OLS) is employed to estimate Equations 5 and 6, aiming to evaluate the presence of a long-term relationship between the variables. To investigate this, an F-test is utilized in Model 2 to compare the null hypothesis, which suggests no long-term relationship (no cointegration), against the alternative hypothesis. The null hypothesis is expressed as H0: b1=b2=b3=b4=b5=b6=b7= b8=b9=0. Once the third stage confirms the existence of a long-term relationship, it becomes possible to estimate both the long-term relationship and short-term dynamics.

4. EMPIRICAL RESULTS

Initially, the ideal lag length for each variable is established through empirical analysis, aiming to maximize the Akaike information criteria (AIC). Given that the data comprises annual series and is constrained to the period 1960-2020, model 1 uses a maximum lag order of 5, while model 2 employs a maximum lag order of 3 in the ARDL models. Our regression Models 1 and 2 are ARDL(3,0,0,0,0,0,0) and ARDL(3,1,0,1,1,0,1,1,0). The F-tests for cointegration are run using these selected ARDL models. This study compares the F-statistics to critical values derived from Narayan's (2005) work due to the limited sample size.

The study examines critical values following Bahmani and Nasir's (2004) framework, which encompass various variable classifications such as I(1), I(0), or fractional integration. If the computed F-statistic surpasses the upper threshold, the null hypothesis of no cointegration is rejected. Conversely, if the F-statistic falls below the lower threshold, the null hypothesis is not rejected. When the F-statistic falls within the range defined by the lower and upper bounds, the outcome remains inconclusive. Table 1 presents our research findings, including the F-test results for the two ARDL models

Table 1: Results of long run significance tests

Dependent variable ldei	
Model 1	F-statistic (6)= 4.717*
Model 2	F-Statistic (7) = 4.360*

Source: Authors' estimations.

Note: *indicates significant level of 5%

In Models 1 and 2, the F-statistics surpass the 5% significance level, resulting in the rejection of the null hypothesis of no cointegration in Equations 5 and 6. Consequently, the F-test results indicate a long-term relationship between the variables in both models. Table 2(a) and Table 2(b) illustrate the findings of short run models for model 1 and model 2, respectively. Within the ARDL framework, a short run analysis with an error correction model (ECM) term is computed. It shows how gdp, dbp, population, trade balance, security web, internal conflicts and insurgencies, and war have an immediate impact on India's defense spending. Table 2(a) indicates a positive influence of the prior year's defense expenditure on India's defense budget. The change in lgdp has a positive impact on defense spending, implying that higher income leads to higher spending on defense. Changes in Pakistan's defense burden (ldbp) have a negative impact on India's defense spending, showing that India is not a follower, contrary to our assumptions. The impact of population increase on defense spending is positive and significant, indicating that a large population allows India to have a large army, which in turn necessitates greater spending. The trade balance coefficient, on the other hand, is positive but small. Furthermore, the number of conflicts and insurgencies (internal dummy) has a positive but small effect on India's defense spending. Additionally, the occurrence of war demonstrates a substantial and favorable effect, aligning with our anticipated findings.

Table 2(a): Error correction representation (short-run estimates) for model 1

Dependent variable ldei 58 observations used for estimation from 1960 to 2020			
Variable	**Coefficients**	**t-statistics**	**Prob.**
D(ldei(-1))	0.484579	4.210161*	0.0001
D(ldei(-2))	-0.157820	-1.175127	0.2457
D(lgdp)	0.226421	1.905896**	0.0627
D(ldbp)	-0.036528	-0.322297	0.7486
D(lpop)	0.473279	1.947702**	0.0573
D(ltb)	0.030654	0.416470	0.6789
D(internal)	0.008856	0.387278	0.7003
D(war)	0.131944	2.673565*	0.0102
CointEq(-1)	-0.486341	-3.997240*	0.0002
R^2 = 0.993	**DW Statistics= 1.75**	**F-Statistics (840.3697) = 0.000**	

Source: Authors' estimations.
Notes: *Indicates significance level at 5% and ** significance level at 10%
ECM is the error correction term.

Table 2(b): Error correction representation (short-run estimates) for model 2

Dependent variable ldei 44 observations used for estimation from 1974 to 2020			
Variable	**Coefficients**	**t-statistics**	
D(ldei(-1))	0.447786	3.277431*	0.0029
D(ldei(-2))	0.426680	2.504345*	0.0186
D(lgdp)	0.126781	0.468482	0.6432
D(ldbp)	0.070735	0.769937	0.4480
D(lpop)	1.576079	1.632180	0.1143
D(ltb)	-0.068837	-0.726423	0.4738
D(lsw)	-0.131635	-2.648399*	0.0133
D(lcge)	0.920496	5.154122*	0.0000
D(internal)	-0.034863	-1.970288**	0.0591
D(war)	0.011955	0.240791	0.8115
CointEq(-1)	-1.045917	-5.620631*	0.0000
R^2 = 0.997	**DW Statistics= 2.242865**	**F-Statistics = 0.000**	

Source: Authors' estimations.
Notes: *Indicates significance level at 5% and ** significance level at 10%
ECM is the error correction term.

Table 2(b), model 2, shows the results obtained after including the lcge and security web (lsw) variables in the regression equation. The influence of lgdp, lpop, and war in model 1 is considerable, whereas they are insignificant in model 2. In addition, while Pakistan's defense burden (ldbp) is positive in model 2, the trade balance and internal dummy are negative. The trade balance variable, as a proxy for openness, would lead to higher defense spending because it would be easier to obtain financing for arms acquisitions in an open economy. In India, the anticipated trade balance coefficient is negative, likely due to its status as a net arms importer, causing a short-term adverse impact on defense spending. Additionally, our analysis reveals a noteworthy and substantial correlation between central government spending and defense expenditure in India, emphasizing the government's dedication to bolstering defense efforts. Surprisingly, the average defense expenditure of security web countries does not influence India's defense spending as expected.

This research investigates the speed of equilibrium reestablishment in a dynamic model, as indicated by the error correction term. The ECM coefficient offers insights into the rate of convergence of variables toward equilibrium. With a negative sign, the term must be statistically significant. For both models 1 and 2, the ECM coefficient is extremely significant, indicating that the long-run coefficients are jointly significant. Furthermore, the ECM coefficient demonstrates statistical significance with a negative sign, signifying the long-term stability of the predictive models 1 and 2. The data shows that models 1 and 2 adjust at a very fast rate in the long run. This rapid adjustment could indicate that defense spending adjusts quickly in the event of a shock. In both scenarios, the model's F-statistic exhibits high significance, and there is no evidence of serial correlation as indicated by the Durbin-Watson statistic.

Tables 3(a) and 3(b) present the estimated long-term coefficients for models 1 and 2. In model 1, all long-term coefficients exhibit the anticipated direction, apart from the defense burden coefficient for Pakistan. This is contrary to results from Sun and Yu (1999); Dunne et al. (2000); Tambudzai (2007); Hou (2009) and Sheikh and Chaudhry (2013) who found the variable positive and significant.

Table 3(a) Long-term coefficient estimates for Model 1

Dependent variable ldei58 observations used for estimation from 1960 to 2020			
Variable	**Coefficient**	**t-statistics**	**Prob.**
Lgdp	0.465559	2.592328*	0.0126
Ldbp	-0.075109	-0.312973	0.7557
Lpop	0.973141	1.847906**	0.0708
Ltb	0.063030	0.428144	0.6705
Internal	0.018210	0.396872	0.6932
War	0.271299	2.087528*	0.0422
C	-2.857640	-2.721561	0.0090

Source: Authors' estimations.

Note: *Indicates significance level at 5% and ** significance level at 10%

Table 3(b): Long-term coefficient estimates for Model 2

Dependent variable ldei 44 observations used for estimation from 1974 to 2020			
Variable	**Coefficient**	**t-statistics**	**Prob.**
Lgdp	0.564663	4.138111*	0.0003
Ldbp	0.067630	0.786552	0.4384
Lpop	0.461287	0.990879	0.3305
Ltb	0.072241	1.127587	0.2694
Lsw	-0.125856	-2.895628*	0.0074
Lcge	1.223064	10.077707*	0.0000
Internal	-0.067015	-2.391671*	0.0240
War	0.011430	0.238341	0.8134
C	-4.130236*	-3.003164	0.0057

Source: Authors' estimations.

Note: *Indicates significance level at 5% and ** significance level at 10%

Now, shifting our focus to the outcomes of model 2, it becomes evident that, except for the trade balance, the estimated coefficient exhibits comparable sign and magnitude as observed in the short-term model 2. As previously stated, the availability of security web data is limited to the period from 1974 to 2020, potentially leading to less reliable results due to the constrained sample size. As a result, the values and signs of several calculated coefficients change dramatically, contrary to our predictions. Furthermore, the unexpected outcome emerged when assessing the impact of shifts in the frequency of conflicts and insurgencies (internal dummy) on the fluctuations in India's defense budget. Specifically, it was observed that these shifts had a notable and adverse influence, contrary to our initial expectations. For a more trustworthy and efficient estimation, more observations are required.

5. CONCLUSIONS

This study investigates the determinants of India's defense expenditure using ARDL modeling approaches across two time periods. The results confirm the existence of long-run relationships among the selected macroeconomic and geopolitical variables. The F-statistics for both models significantly exceed the critical bounds at the 5% level, establishing cointegration and justifying the use of the ARDL framework.

In the short run, the models reveal that GDP, population growth, and wartime events positively influence defense spending, while Pakistan's defense burden does not have a significant impact—challenging the conventional "arms race" hypothesis. Notably, internal conflicts and trade balance show minimal or mixed effects, suggesting that defense spending is not solely reactive to domestic disturbances or economic openness.

Model 2, which includes central government expenditure and security web data, shows some divergence in the results. Central government expenditure is found to be a strong and significant determinant of defense spending, reinforcing the idea that fiscal policy plays a critical role in shaping defense priorities. However, the security web variable exhibits a counterintuitive negative effect, and internal conflict appears to negatively influence defense spending—both contrary to theoretical expectations. These anomalies could be attributed to sample limitations and the complexity of India's geopolitical and fiscal environment.

The error correction terms in both models are negative and highly significant, indicating a robust speed of adjustment toward long-run equilibrium. This finding underscores the dynamic nature of defense budgeting in India, where deviations from equilibrium levels are corrected rapidly, reflecting the government's responsiveness to both internal and external stimuli.

Based on the findings of this study, several policy implications emerge. First, the lack of a significant relationship between Pakistan's defense burden and India's defense spending suggests that India does not operate within a traditional arms race framework. This implies that Indian defense policy is more autonomous and strategically driven, and thus should continue to focus on long-term national interests rather than reactive military posturing. Second, the consistent and positive impact of GDP on defense expenditure highlights the importance of aligning defense budgets with broader economic performance. As the economy grows, increased fiscal space should be utilized to modernize and rationalize defense infrastructure, ensuring that spending is sustainable and effective.

The study also finds that population growth contributes positively to defense spending, likely due to the demands of maintaining a large military force. This suggests a need to invest in defense technologies and training programs that enhance productivity and reduce reliance on labor-intensive strategies. Additionally, the ambiguous and sometimes counterintuitive effects of internal conflict and the security web on defense spending suggest that more nuanced and data-driven internal security policies are required. India's participation in regional or multilateral security arrangements should be periodically reviewed to assess their tangible benefits to national defense priorities.

Moreover, the significant role of central government expenditure in influencing defense budgets underscores the importance of maintaining strong coordination between fiscal and defense planning. Defense allocation decisions must be integrated within the broader fiscal framework to ensure optimal resource utilization. Finally, future research and policy formulation would benefit from expanded and higher-quality datasets, particularly for variables like regional alliances and internal security indicators. Improving data availability will allow for more robust modeling and evidence-based policymaking in the defense sector.

Competing Interest Disclosure:

Both authors declare no conflicts of interest.

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