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Usage of Military Spending, Debt Servicing and Growth for Dealing with Emergency Plan of Indian External Debt

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***Abstract*—**This study investigates the relationship between external debt and military spending in case of India over the period of 1970–2012. In doing so, we have applied the structural break unit root tests to examine stationarity properties of the variables. The Auto-Regressive Distributed Lag (ARDL) bounds testing approach is used to test whether cointegration exists in presence of structural breaks stemming in the series. Our results indicate the cointegration among external debt, military spending, debt servicing, and economic growth. Moreover, military spending and debt servicing add in external debt. Economic growth helps in lowering external debt. The Vector Error Correction Model (VECM) analysis and Granger causality test reveal that military spending and economic growth cause external debt. The feedback effect also exists between external debt and debt servicing in case of India.

***Keywords*—**External debt, military spending, ARDL approach, structural breaks, India.

***JEL Codes*—**C12, C32, O16.

I. Introduction

THE nexus between external debt and military spending has become a central and topical research area in defense economics of developing countries. India is one of those countries where major portion of budget and external debt is allocated for military spending every year.

References [1] and [2] indicated the huge chunk of income and servicing spending in military sector. They mentioned that India's military was ranked among the top 10 in the world. This implied that India spent a huge amount of her external debt and income on military sector which might use scarce resources and crowd out growth leading spending such as servicing, health and education expenditures and also might stimulate economic growth by spin-off effects. In addition, safety was a public good that increased with country size. Also, and related to the size of government argument above, smaller countries may have to spend proportionately more for defense than larger countries given economies of scale in military spending. This showed that a large country may derive economies of scale from defense spending which protected itself and provided security. This may be one explanatory factor behind the recent growth successes of large developing countries. Yet, India seems to have suffered a lot due to high military spending which have been a substantial part of overall government spending that in turn has depleted resources from government spending on health, education and infrastructure. Though, spending on military sector is treated as unproductive expenditure; it is argued that a number of opportunities of external debt, economic growth process and servicing debt in India have been provided. However, from the policy perspective, it was very need to determine the channels by which military spending affects, external debt, servicing debt and economic growth.

In the history, until 1962 defense spending in India was deliberately limited. After the awakening of the war with China, India's defense spending in current prices has increased substantially over the years and were projected at nearly Rs. 1,200 crore (US$ 195.877 million) in 1970–1971 [3]. In 1994, total defense services expenditures were projected at Rs. 44,110 crore (US$7.2 billion). Proportionately, based on figures provided by the government, 48.4% of expenditures were for the army, 15.7% for the air force, 5.9% for the navy, and 30% for capital outlays for defense services and defense ordnance factories. The defense budget for 1994 was 6.5% higher than the revised estimate for 1993. After the Kargil war in 1999, the defence forces were spending less than the allocation. During 1999–2000, the defence forces spent Rs. 48,504 crore - nearly Rs 3,000 crore more than the allotted sum of Rs. 45, 694 crore. In 2000–2001, they spent Rs. 54,461 crore as against the allocation of Rs. 58,587 crore - less than Rs. 4,000 crore. In 2001–2002, the defence forces are estimated to have spent Rs. 57,000 crore as against the revised allocation of Rs. 65,000 crore - a big gap of Rs 8,000 crore. The increase in defence allocation for 2002–2003 over 2001–2002 was modest. The Finance Minister proposed a defence budget of Rs. 65,000 crore against Rs. 62,000 crore allocated in the fiscal which is coming to an end. A significant development in the current fiscal is that the Defence Ministry will be spending only Rs. 57,000 crore out of the allotted Rs. 62,000 crore, leaving a shortfall of Rs. 5,000 crore. Thus, compared with the actual expenditure during the current fiscal, the budget proposes an increase of Rs. 8,000 crore. The allocation for the Army has been fixed at Rs 35,368.72 crore, marking an increase of 6.69%. It, in fact, gets reduced to 2.59% while making allowance for inflation. The increase covers a number of sectors ranging from other equipment like tanks, artillery and electronic hardware such as weapon-locating radars, welfare and housing and stores. The increase on account of other equipment is a huge Rs. 1,400 crore,

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revealing the government's plan to provide the Army with the modern tools of war. The Air Force gets Rs. 15,589 crore, an increase of 30% over the revised estimates. The allocation is expected to take care of the upgrading of the fighter aircraft (MiG-21 BiS), licence payment for manufacturing of SU-30 fighter aircraft and purchase of Jaguars from Hindustan Aeronautics Limited. In July 2004, in order to catch up with the backlog of expenditure that had not been provided for, the Government increased the allocation for Defence to Rs. 77,000 crore. After a gap, defence expenditure in 2004–2005 has matched the Budget Estimates. It was proposed to increase the allocation for Defence in 2005–2006 to Rs. 83,000 crore, which included an allocation of Rs. 34,375 crore for capital expenditure.

The Defence and military Expenditure is about Rs. 95,922 crore (2004–2005), including the Civil Estimates of around Rs. 16,000 crore comprising about Rs. 11,000 crores towards Defense Pensions. The outlay for defence services in the Budget 2004–2005 is Rs. 77,000 crore. This consists of Rs. 43,517.15 crore for revenue expenditure and Rs. 33.482.85 crore for capital expenditure. The allocation is 17.92% more compared to 2003–2004 Budget. The increased outlay, particularly for capital expenditure, is a reflection of the Government's keenness to ensure speedy modernisation of the Armed Forces. The budget estimates 2004–2005 cater to increased allocation for each of the services and research and development activities. An attempt is made to provide funds to meet the Service commitments both for meeting their maintenance requirements and modernisation. In addition to the above, one new feature in this year's Budget is exempting from income tax the family pension received by widows, children and nominated heirs of members of the Armed Forces and the paramilitary forces killed in the course of operational duties.

The Union Budget for 2005–2006 was presented to the parliament and showed that the allocation for Defence has been increased by about 8% over that of the last year (2004–2005) from Rs. 77,000 crore to Rs. 83,000 crore (about $18.5 billion at current exchange rates). The allocation for defence for the year 2005–2006 is well in tune with the policy of the government to give this core sector its due. The defence expenditure pegged at Rs. 83,000 crore for the year amounts to an increase of Rs. 6,000 crore or 7.79% over the current year (2004–2005). The revised estimate for the new fiscal has been kept at the level of Rs. 77,000 crore, the same as in the budgetary estimate of the current one. The allocation for capital is Rs. 34,375.14 crore which includes Rs. 2,541.86 crore for research and development and Rs. 1,364 crore for married accommodation project. The proposed increase in defence expenditure should take care of the normal growth in pay and allowances, inflation and other specific requirements. The bulk of the capital outlay goes to meet the requirements for the ongoing acquisition projects. The allocation for capital will be providing over Rs. 7,000 crore for new projects for modernisation of the forces.

In the Interim Budget 2009–2010, the allocation for Defence was increased to Rs. 141,703 crore, about 35% increase in current prices from the previous year's revised estimates. The total revised expenditure for 2008–09 was Rs. 114,600 crore. The Plan expenditure will be to the tune of Rs. 86,879 crore against Rs. 73,600 crore and will include Rs. 54,824 crore for capital expenditure as against Rs. 41,000 crore in the RE for 2008–2009. By 2012, India's defense budget was growing by between 13 and 19%, depending interpretation of the numbers, against a forecast GDP growth of 7.6%. There are basically two opinions about how to deal with China's military pressure. One emphasizes clinging to a defensive position on the land while taking advantages of India's superiority in navy and on the Indian Ocean to potentially threaten China's energy-importing and trade passages. Proponents for this strategy call for boosting the development of naval and air forces. The other opinion reiterates the importance of land forces, believing India should strengthen military building and infrastructure construction in the China-India border area so that it's capable of a strong counterattack in the event of armed conflict. Supporters of this opinion include the land forces as well as the Ministry of Home Affairs which exerts certain controls over border management.

The existing defense literature provides numerous studies investigating external debt and military spending nexus for individual countries (*inter alia*, [4]-[14]) as well as for multiple countries (*inter alia*, [15]-[24]).

This paper contributes to existing debate by examining the relationship between external debt and military spending in the case of India, with including debt servicing and economic growth as exogenous variables. The goal of this new relationship consists: i) to extend the external debt model developed by [4], [10], [11], [25] and [26], and ii) to apply the Zivot-Andrews structural break unit root test of [27]. The ARDL bounds testing approach developed by [28] is applied to test cointegration between the variables. We examine the direction of causality by applying the VECM Granger approach and robustness of causality analysis is tested by using the variance decomposition analysis and impulse response functions.

The remainder of the paper is organized as follows. Section II provides a brief summary of the literature review. In Section III, we introduce data and methodological framework. Section IV summarizes and discusses the finding results. Section V concludes with policy recommendations.

II. Literature Review

Empirical research on the issue of the impact of military spending on external debt including growth and others specific variables has attracted the attention of economic researchers, especially for developing countries. Historically, a number of studies have dealt with the external debt-military spending-economic growth nexus in the last three decades.

Based on the argument of [15], [4] indicated that debt crisis of the 1980s in South American countries (Argentina, Brazil and Chile) led to severe recession and chronic economic problems. At this level, they considered one potentially important contributor to the growth of external debt, namely military spending. Empirically, they found no evidence that military burden had any impact on the evolution of debt in Argentina and Brazil, but some evidence that military burden tends to increase debt in Chile. At the same time, Chile was the least affected of the three countries by acute financial crises resulting from the debt problems due to high levels of external debt. This suggested that military burden may be important in determining external debt in countries, but it was only of significance when it was not swamped by other macroeconomic and international factors.

Reference [29] examined the relationships between Turkey's defense expenditure and external debt over the period of 1979–2000 using Engle-Granger causality approach. He showed no clear relationship between defense spending and external debt.

Reference [8] reinvestigated the relationship among external debt, defense spending and economic growth. He applied cointegration, impulse response functions and variance decomposition. The empirical evidence by impulse response functions indicated that defense spending exerts positive effect on external debt.

Investigating political business cycles in the external debt-defense expenditures nexus, [9] reexamined the nexus between eternal debt and defense spending over the period of 1960–2002 in the case of Turkey and found that external debt impacts positively to defense spending. They also noted that that defense expenditures are influenced by political ideology as well as by the fiscal policy of governments after elections.

Along the same line, [10] applied cointegration and error-correction approaches to investigate the effect of military spending on external debt in a Fiji's island for the period 1970–2005. Their empirical analysis revealed that in long-run, military expenditures has significant and positive impact on both external debt and domestic debt. They found that income has positive and statistically significant impact on domestic debt but negative impact on external debt.

Examining the role of military spending on external debt in the Middle East for a sample of six Middle Eastern countries (Oman, Syria, Yemen, Bahrain, Iran, and Jordan) over the period of 1988–2002, [18] mentioned that the Middle East represented an interesting study of the effect of military expenditure on external debt because it had one of the highest rates of arms imports in the world and it was one of the most indebted regions in the world. They applied panel cointegration to investigate the relationship between military expenditure, income, and external debt. Their analysis indicated that a 1% increase in military expenditures lead external debt between 1.1% and 1.6% and a 1% increase in income reduces external debt by between 0.6% and 0.8%. In the short run, defense spending increased external debt but income reduced it insignificantly.

Reference [11] examined the impact of defense spending and income on the evolution of Ethiopia's external debt over the period 1970–2005. Using the bounds testing approach to cointegration and Granger causality tests, he found a long run causal relationship among external debt, defense spending and income. Defense spending had a positive and significant impact on the stock of external debt but income declines it. He also found that an increase in defense spending contributed to the accumulation of Ethiopia's external debt, while an increase in economic growth could help Ethiopia to reduce it.

In a recent study, [19] empirically explored the relationship between military expenditure, external debts and economic growth using data of Sub-Saharan Africa (Botswana, Burkina Faso, Burundi, Cameroon, Cote d'Ivoire, Ethiopia, Gambia, Ghana, Kenya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Sudan, Tanzania, Uganda, Zambia and Zimbabwe) over the period 1988–2007. It first applied two panel techniques based on Ordinary Least Squares (OLS) method known as Fully Modified OLS (FMOLS), Dynamic OLS (DOLS), and he second used the Dynamic Fixed Effect (DFE) to estimate the relationship between defense spending and external debt. He observed that military expenditure had a positive and significant impact on external debt in African countries but real GDP inversely affected the total debt stock. The results indicated that in the long run, a 1% rise in national output showed a decline in external debt by 1.52%, all else is same. The author suggested that African countries need to strengthen areas of fiscal responsibility and pursued models that encourage rational spending, particularly reductions in military expenditure.

Reference [12] studied the relationship between real military spending, level of economic activity, and real external debt by using a Johansen multivariate cointegration framework. The analysis was carried out using time series data of Pakistan over the period 1980–2008. The study investigated the long-run effects and short-run dynamics of the effect of rise in real military spending, level of economic activity, and real external debt. The quantitative evidence showed that external debt is more elastic with respect to military expenditure in the long run, whereas, there had been insignificant effect in the short-run. In the long-run, 1% increase in military expenditure increased external debt by almost 3.96%. On the other hand, 1.00% increases in economic growth decreased external debt by 2.13%. In the short run, 1% increase in economic growth reduced external debt by 2.90%. The results presented in this study reinforced the importance to government, academic, and policy makers.

Recently, [20] reconsidered the defense spending-internal debt nexus in high income countries using the Arellano-Bond dynamic panel model over the periods 1988–2009 for Organisation for Economic Co-operation and Development (OECD) and 1999–2009 for North Atlantic Treaty Organization (NATO). The empirical evidence revealed that military spending is positively linked with public debt.

Similarly, [21] explored the relationship between defense spending and government debt by applying dynamic Generalized Method of Moments (GMM) panel model using data of European countries (Austria, Belgium, Bulgaria, Czech Rep., Denmark, Germany, Estonia, Ireland, Greece, Spain, France, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, The Netherlands, Poland, Portugal, Romania, Slovakia, Finland, Sweden and the UK). He found that military spending increased government debt over the period of 1996–2009. Despite the diversity of the existing literature, [25] investigated the effect of military spending on external debt in the case of Pakistan over the period 1973–2009. Using the ARDL bounds testing approach to cointegration, their findings indicated the existence of cointegration and showed the presence of a long-run relationship among military spending, external debt, economic growth, and investment. They also found that a rise in military spending and investment increased the stock of external debt but economic growth declined it.

Reference [22] studied the impact of military expenditure and economic growth on external debt for a panel of five selected SAARC countries including Bangladesh, India, Nepal, Pakistan and Sri Lanka, over the period of 1988–2008. Using the test for panel cointegration of [30], it was found that there is a long-run relationship between external debt, economic growth and military expenditure. The study found that external debt is elastic with respect to military expenditure in the long run and inelastic in the short run. In the long run, 1% increase in military expenditure increased external debt between 1.18% and 1.24%, while 1% increases in economic growth reduced external debt between 0.64% and 0.79%, by employed DOLS and FMOLS estimator respectively. In the short run, 1% increase in military expenditure increased external debt by 0.15%, while 1% increase in economic growth reduced external debt by 0.47%.

Reference [14] explored the impact of between military spending, gross fixed capital formation, real GDP, debt service ratio on external debt in Nigeria over the period 1986–2011. The study applied Granger causality, vector autoregressive, variance decomposition and impulse response techniques. The finding results showed long run and a unidirectional causal relationship between military spending and external debt. The response of external debt due to random shock in military spending was positive from the first period up to the fifth period and thereafter became negative all through. The impulse response had a sustained positive short run but negative in the long run horizon. The variance decomposition test revealed that military expenditure own shock on external debt steadily increase external debt. The implication of this study is that any innovations in military policy that does not create spin off effect will trigger external debt burden stock in Nigeria.

Reference [23] empirically explored the effect of military spending, foreign exchange reserves and economic growth on external debt, using a sample of ten Asian countries over the years from 1990 to 2011. The Hausman test suggested that the random-effects model is preferable; however, both random-effects and fixed-effects models were used in this research. The empirical results showed that the effect of military spending on external debt was positive, while the effects of foreign exchange reserves and of economic growth on external debt were negative. For developing countries caught in security dilemma, military expenditure often required an increase in external debt, which might affect economic development negatively.

III. Data and Methodological Framework

Following the general theoretical literature and the empirical framework of [25], the aim of the present paper is to examine the relationship between military spending and external debt by incorporating debt servicing and economic growth variables in external debt function for the Indian case over the period 1970–2012. The general equation is modeled as:

$$ED_t = f\left(MS_t, DS_t, Y_t\right) \quad (1)$$

where ED, MS, DS and Y are real external debt, real military spending, real debt servicing and real GDP, respectively. All variables were indexed as base year 2005. We used total population series to convert all the series into per capita. Annual data were obtained from the *World Bank Development Indicators* (WDI, CD-ROM). We have transformed the series into natural logarithm (ln). In developing economies, simple linear specification provides inefficient and unreliable empirical results due to sharpness in time series [8]. In this case, use of log-linear specification is better option for time series analysis and it directly produces elasticity [31]. Also, log-linear specification provides better and unbiased empirical evidence [29]. In the light of above discussion, the logarithmic linear specification of (1) is modeled as:

$$\ln ED_t = \alpha_0 + \alpha_1 . \ln MS_t + \alpha_2 . \ln DS_t + \alpha_3 . \ln Y_t + \varepsilon_t \quad (2)$$

α_0, α_1, α_2 and α_3 indicate the time-invariant constant and elasticities of real military spending per capita, real debt servicing per capita and real GDP per capita, respectively. ε_t is the error term assumed to be white noise.

Prior to testing for cointegration, we test for stationarity of each series. The study period is characterized by major changes in the global landscape which can potentially cause structural breaks. In fact, traditional unit root tests such as ADF of [32], PP of [33], DF-GLS of [34], and Ng-Perron of [35] are used to test the integrating properties of the variables. However, these tests may provide misleading results when data series exhibit socks. Reference [36] also pointed that empirical evidence on integrating order of the variables by ADF, PP, DF-GLS and Ng-Perron is not reliable and inefficient. Therefore, attempts have been made to develop test of unit root which incorporates the presence of structural breaks in the null hypothesis. There are three recent studies namely [2], [37] and [38] in Indian economy that pointed out structural changes in different sectors and overall GDP. This motivates and also justifies the utilization of unit root test accommodating structural breaks stemming in the variables. To solve this issue, we apply the Zivot-Andrews unit root test to identify structural break which accommodates single unknown structural break in the series. We also choose the ARDL bounds testing approach in presence of structural break. It has several advantages. First, it is flexible as it can be applied regardless the order of integration of the variables.

Simulation results show that this approach is superior and provides consistent results for small sample [39]. Moreover, a dynamic unrestricted ECM (DUECM) can be derived from the ARDL bounds testing through a simple linear transformation. The DUECM integrates the short run dynamics with the long run equilibrium without losing any long run information [25], [26]. For estimation purposes, we propose the following the ARDL models:

$$\begin{aligned}\Delta \ln ED_t &= \beta_1 + \beta_T.T + \beta_D D + \beta_{ED}.\ln ED_{t-1} \\ &+ \beta_{MS}.\ln MS_{t-1} + \beta_{DS}.\ln DS_{t-1} + \beta_Y.\ln Y_{t-1} \\ &+ \sum_{i=1}^{p} \delta_i.\Delta \ln ED_{t-i} + \sum_{j=0}^{q} \delta_j.\Delta \ln MS_{t-j} \\ &+ \sum_{k=0}^{r} \delta_k.\Delta \ln DS_{t-k} + \sum_{l=0}^{s} \delta_k.\Delta \ln Y_{t-l} + \mu_{1,t}\end{aligned} \tag{3}$$

$$\begin{aligned}\Delta \ln MS_t &= \beta_2 + \beta_T.T + \beta_D D + \beta_{ED}.\ln ED_{t-1} \\ &+ \beta_{MS}.\ln MS_{t-1} + \beta_{DS}.\ln DS_{t-1} + \beta_Y.\ln Y_{t-1} \\ &+ \sum_{i=1}^{p} \delta_i.\Delta \ln MS_{t-i} + \sum_{j=0}^{q} \delta_j.\Delta \ln ED_{t-j} \\ &+ \sum_{k=0}^{r} \delta_k.\Delta \ln DS_{t-k} + \sum_{l=0}^{s} \delta_k.\Delta \ln Y_{t-l} + \mu_{2,t}\end{aligned} \tag{4}$$

$$\begin{aligned}\Delta \ln DS_t &= \beta_3 + \beta_T.T + \beta_D D + \beta_{ED}.\ln ED_{t-1} \\ &+ \beta_{MS}.\ln MS_{t-1} + \beta_{DS}.\ln DS_{t-1} + \beta_Y.\ln Y_{t-1} \\ &+ \sum_{i=1}^{p} \delta_i.\Delta \ln DS_{t-i} + \sum_{j=0}^{q} \delta_j.\Delta \ln ED_{t-j} \\ &+ \sum_{k=0}^{r} \delta_k.\Delta \ln MS_{t-k} + \sum_{l=0}^{s} \delta_k.\Delta \ln Y_{t-l} + \mu_{3,t}\end{aligned} \tag{5}$$

$$\begin{aligned}\Delta \ln Y_t &= \beta_4 + \beta_T.T + \beta_D D + \beta_{ED}.\ln ED_{t-1} \\ &+ \beta_{MS}.\ln MS_{t-1} + \beta_{DS}.\ln DS_{t-1} + \beta_Y.\ln Y_{t-1} \\ &+ \sum_{i=1}^{p} \delta_i.\Delta \ln Y_{t-i} + \sum_{j=0}^{q} \delta_j.\Delta \ln ED_{t-j} \\ &+ \sum_{k=0}^{r} \delta_k.\Delta \ln MS_{t-k} + \sum_{l=0}^{s} \delta_k.\Delta \ln DS_{t-l} + \mu_{4,t}\end{aligned} \tag{6}$$

where Δ is the first difference operator, T is the time trend and D indicates the structural break point based on the Zivot-Andrews test. Testing cointegration involves comparing the computed F-statistic with the critical bounds generated by [28] for upper critical bound (UCB) and lower critical bound (LCB). The null hypothesis $H_0 : \beta_{ED} = \beta_{MS} = \beta_{DS} = \beta_Y = 0$ of no cointegration is tested against the alternative hypothesis $H_1 : \beta_{ED} \neq \beta_{MS} \neq \beta_{DS} \neq \beta_Y \neq 0$ of cointegration. The series are cointegrated if the computed F-statistic exceeds the UCB; and not cointegrated if the computed F-statistic lies below the LCB. If computed F-statistic falls between the UCB and LCB, the test will be uncertain.

The robustness of the ARDL bounds testing approach to cointegration is tested by the maximum likelihood cointegration approach of [40]. A brief reminder of this approach is illustrated below:

$$X_t = A + \sum_{z=1}^{b} \Gamma_z.X_{t-z} + \eta_t \tag{7}$$

where $X_t = (\ln ED_t,\ \ln MS_t,\ \ln DS_t,\ \ln Y_t)$ represents a vector of endogenous I (1) variables, *A* is a vector of constant terms, Γ represents coefficient matrix, *b* denotes the lag length, and η_t is the error matrix. All variables in (7) are considered to be potentially endogenous. The cointegrating rank can be found via the trace and the maximal eigen value tests. The lag length of the unrestricted Vector Auto-Regressive (VAR) structure in (7) is based on the lag selection of Akaike Information Criterion (AIC).

A VECM is estimated to perform Granger-causality test. This method is followed by the two steps of [41] and used to investigate the long- and short-run dynamic causal relationships. The first step consists to estimate the long-run parameters in (2) in order to obtain the residuals corresponding to the deviation from equilibrium, while the second step leads to estimate the parameters related to the short-run adjustment.

The resulting equations are used in conjunction with Granger causality testing:

$$(1-L)\begin{bmatrix}\ln ED_t \\ \ln MS_t \\ \ln DS_t \\ \ln Y_t\end{bmatrix} = \begin{bmatrix}\phi_{1t} \\ \phi_{2t} \\ \phi_{3t} \\ \phi_{4t}\end{bmatrix} + \sum_{c=1}^{d}(1-L)\begin{bmatrix}\theta_{1,1,c} & \theta_{1,2,c} & \theta_{1,3,c} & \theta_{1,4,c} \\ \theta_{2,1,c} & \theta_{2,2,c} & \theta_{2,3,c} & \theta_{2,4,c} \\ \theta_{3,1,c} & \theta_{3,2,c} & \theta_{3,3,c} & \theta_{3,4,c} \\ \theta_{4,1,c} & \theta_{4,2,c} & \theta_{4,3,c} & \theta_{4,4,c}\end{bmatrix} . \begin{bmatrix}\ln ED_{t-1} \\ \ln MS_{t-1} \\ \ln DS_{t-1} \\ \ln Y_{t-1}\end{bmatrix} + \begin{bmatrix}\lambda_1 \\ \lambda_2 \\ \lambda_3 \\ \lambda_4\end{bmatrix} .ECT_{t-1} + \begin{bmatrix}\xi_{1,t} \\ \xi_{2,t} \\ \xi_{3,t} \\ \xi_{4,t}\end{bmatrix} \tag{8}$$

where, ϕ_j (j=1,2,3,4) represents the time-invariant constant; *c* (*c*=1,…,*d*) is the optimal lag length determined by the minimization of AIC criterion; (1−*L*) is the lag operator; ECT_{t-1} is the lagged residual obtained from the long run ARDL relationships; λ_j (j=1,2,3,4) is the adjustment coefficient; and $\xi_{j,t}$ (j=1,2,3,4) is the disturbance term assumed to be uncorrelated with zero means.

IV. Empirical Results and Discussion

Primarily, we start with the descriptive statistics and correlations matrix (Table I). The Jarque-Bera test indicates that all series are normally distributed with zero mean and finite variance. The correlation matrix reveals that real military spending per capita, real debt servicing per capita are positively correlated with real external debt per capita. Real debt servicing per capita and real GDP per capita are positively correlated with real military spending per capita. The correlation between real GDP per capita and real external debt per capita is negative and similar inference is drawn between real GDP per capita and real debt servicing per capita.

TABLE I
Descriptive Statistics and Correlation Matrix

	ln *ED*	ln *MS*	ln *DS*	ln *Y*
Mean	5.8193	2.7813	5.8554	9.8248
Median	6.1138	2.8879	6.0725	9.7374
Maximum	7.0652	4.7875	7.2571	10.7212
Minimum	4.5199	0.6592	4.5748	9.3243
Std. Dev.	0.8183	1.2292	0.8193	0.4225
Skewness	-0.2539	-0.0789	-0.1655	0.6086
Kurtosis	1.6343	1.7433	1.5917	2.1916
Jarque-Bera	3.7151	2.8069	3.6623	3.7371
Probability	0.1560	0.2457	0.1602	0.1543
ln *ED*	1.0000			
ln *MS*	0.0713	1.0000		
ln *DS*	0.0373	0.1027	1.0000	
ln *Y*	-0.0017	0.0224	-0.1471	1.0000

Secondly, we mentioned that the traditional unit root tests, such as ADF, PP, DF-GLS, Ng-Perron, etc. cannot detect structural break arising in the series. In doing so, we have used the Zivot-Andrews unit root test containing information about single unknown structural break stemming in the series. The results of Zivot-Andrews are detailed in Table II which shows that non-stationary process is found in all series at level with intercept and trend but variables are found to be stationary at first difference. This confirms that real external debt per capita, real military spending per capita, real debt servicing per capita and real GDP per capita are integrated of order 1, i.e. I(1). The structural break points detected in 1989 and 1991 can be verified by the work of [42] who studied and also suggested the severe foreign exchange crisis related to Indian external debt at these dates. He mentioned that the outstanding level of external debt was US$ 83,800 million over the period 1989–1991. At this level, external debt was about 40% of GDP and the debt service payment was about 30% of exports of goods and services. Several destabilizing forces acting on the Indian foreign exchange markets were a downgrade of India's sovereign credit ratings to non-investment grade, reversal of capital flows, exacerbated the foreign exchange crisis and withdrawal of the foreign currency deposits held by non-resident Indians. In addition, through the speech of the Finance Minister of India, concerning the budget 1992–1993 in the severity of the Indian situation as also integrated in the investigation of [42], Dr Manmohan Singh said:

"*When the new government assumed office (June 1991) we inherited an economy on the verge of collapse. Inflation was accelerating rapidly. The balance of payments was in serious trouble. The foreign exchange reserves were barely enough for two weeks of imports. Foreign commercial banks had stopped lending to India. Non-resident Indians were withdrawing their deposits. Shortages of foreign exchange had forced a massive import squeeze, which had halted the rapid industrial growth of earlier years and had produced negative growth rates from May 1991 onwards*".

With this background, [42] came to prove that the first cause of these breaks is that India is historically managed with a very low volume of external capital inflows; secondly, the third world debt crisis of early 80s also had a little impact and India got into a massive foreign exchange crisis in 1990–1991. This led Indian economy to save from the contagious currency crisis of 1997.

TABLE II
Zivot–Andrews Structural Break Trended Unit Root Test

	At level			*At first difference*		
	T-statistics	*Time break*	*Decision*	*T-statistics*	*Time break*	*Decision*
ln*ED*	-3.692 (2)	1997	Unit root exists	-6.440 (0)*	1993	Stationary
ln*MS*	-2.958 (0)	1991	Unit root exists	-6.306 (2)*	1978	Stationary
ln*DS*	-4.716 (1)	1989	Unit root exists	-5.102 (1)**	1985	Stationary
ln*Y*	-4.094 (1)	1997	Unit root exists	-5.894 (0)*	2006	Stationary

Lag length of variables is shown in small parentheses.
* and ** denote significance at the 1 and 5% levels, respectively.

Armed with information about stationarity, we apply the ARDL bounds testing approach to cointegration in the presence of structural break. The ARDL bounds test is sensitive to lag length. To find the lag order, we use the AIC as reported in column-2 (Table III). The dynamic link between the series can be captured if appropriate lag length is used [43]. The results of the ARDL bounds tests are reported in Table III.

As noted, we use LCB and UCB from [44]. The first step in applying bounds testing approach to cointegration is the selection of the optimal lag length. The second step deals with the calculation of F-statistic in order to confirm whether cointegration between the variables exists. The empirical evidence indicates that calculated F-statistics $F_{ED}=\left(ED_t / MS_t, DS_t, Y_t\right)$=7.126; $F_{MS}=\left(MS_t / ED_t, DS_t, Y_t\right)$= 5.424; and $F_{DS}=\left(DS_t / ED_t, MS_t, Y_t\right)$= 7.831 are more than the UCB at the 5, 10 and 5% level of significance respectively. This indicates that there are three cointegrating vectors which confirm the existence of long-run relationship between real external debt per capita, real military spending per capita, real debt servicing per capita and real GDP per capita for the period 1970–2012 in India. The diagnostic tests also show high values of R^2 for the ARDL models show and an extremely good adjustment for (2) ($R^2 \rightarrow 1$). In addition, the Durbin-Watson (DW) statistic is approximately equal to two (absence of errors autocorrelation).

TABLE III
THE ARDL BOUNDS TESTING TO COINTEGRATION

Estimated models	*Optimal lag length*	*Structural break*	*F-statistics*	*R²*	*Adjusted-R²*	*F-statistics*	*DW*
$ED_t = f\left(MS_t, DS_t, Y_t\right)$	2, 2, 1, 2, 1	1997	7.126**	0.8024	0.5678	3.4209*	1.7015
$MS_t = f\left(ED_t, DS_t, Y_t\right)$	2, 1, 2, 1, 1	1991	5.424***	0.8537	0.6989	5.5142*	2.1367
$DS_t = f\left(ED_t, MS_t, Y_t\right)$	2, 2, 1, 2, 1	1989	7.831**	0.8521	0.6764	4.8518*	1.9564
$Y_t = f\left(ED_t, MS_t, DS_t\right)$	2, 1, 2, 1, 2	1997	1.146	0.6696	0.2773	1.7069	2.1534

	Critical values (T=40)#	
Significant level	Lower bounds $I(0)$	Upper bounds $I(1)$
1% level	7.527	8.803
5% level	5.387	6.437
10% level	4.447	5.420

The optimal lag length is determined by AIC. DW indicates Durbin-Watson statistic.
*, ** and *** denote significance at the 1, 5 and 10% levels, respectively.
Critical values are collected from [44].

The robustness of cointegration is also investigated by applying Johansen-Juselius multivariate cointegration. We find two cointegration vectors at the 1 and 5% levels respectively (Table IV). This confirms that the ARDL bounds testing analysis results are consistent and robust.

TABLE IV
JOHANSEN-JUSELIUS COINTEGRATION TEST

Hypothesis	Trace Statistic	Maximum Eigen Value
$R = 0$	77.6112*	38.0387*
$R \leq 1$	39.5725**	23.8665**
$R \leq 2$	15.7060	10.2020
$R \leq 3$	5.5039	5.5039

* and ** denote significance at the 1 and 5% levels, respectively.

Table V reports the long- and short-runs elasticities of lagged real external debt per capita, real military spending per capita, real debt servicing per capita and real GDP per capita on the real external debt per capita. The existence of long-run relationship between the variables helps us to find out partial impacts of lagged real external debt per capita, real military spending per capita, real debt servicing per capita and real GDP per capita on the real external debt per capita. It is evident from Table V that real external debt per capita ($\ln ED_t$) is positively affected by lagged real external debt per capita ($\ln ED_{t-1}$), real military spending per capita ($\ln MS_t$), and real debt servicing per capita ($\ln DS_t$) and it is statistically significant at 1% level of significance. The real GDP per capita ($\ln Y_t$) is inversely linked with real external debt per capita at the 10% significance level. It is noted that a 0.2715% increase in lagged external is increased by a 1% increase in external debt related to the previous period. A 1% increase in $\ln MS_t$ and $\ln DS_t$ will increase $\ln ED_t$ by 0.3933% and 0.4659% respectively. A 1% increase in $\ln Y_t$ will decrease $\ln ED_t$ by 0.6054% in long run by keeping other things constant. This implies that an increase in lagged real external debt per capita, real military spending per capita, real debt servicing per capita increases real external debt per capita in India might be through spin-off effect or it may be due to the fact that military expenditure provides peaceful environment for investment and debt servicing to domestic and foreign investors. On contrary, an increase in real GDP per capita decreases real external debt per capita. Moreover, the diagnostic tests of part *I* presented in Table V also reflect that long-run model passes all diagnostic tests against serial correlation, autoregressive conditional heteroscedasticity, non-normality of residual term, white heteroscedasticity and misspecification of model. The high value of R^2 shows that the adjustment of ARDL model is extremely good ($R^2 = 0.9444 \rightarrow 1$). The F-statistic shows that overall model is statistically significant at the 1% level.

To examine the short-run impact of independent variables, lagged Error Correction Term (ECT_{t-1}) is used by applying OLS version. The results of short-run model are reported in part *II* of Table V. The coefficient of ECT_{t-1} indicates the speed of adjustment from short-run towards long-run equilibrium path with negative sign. It is pointed out by [45] that significance of lagged error term further validates the established long-run relationship between the variables. Our empirical exercise indicates that coefficient of ECT_{t-1} is -0.1543 and significant at the 1% level of significance. It means that a 0.1543% of disequilibrium from the current year's shock seems to converge back to long-run equilibrium in the next year. It is evident from Table V that in short-run, real external debt per capita is positively affected by lagged real external debt per capita, real military spending per capita and real debt servicing per capita, and negatively affected by real GDP per capita; hence, these results confirm long-run findings. For short-run model, diagnostic tests also indicate that there is no evidence of serial correlation, and the error term is normally distributed. The autoregressive conditional heteroscedasticity and white heteroscedasticity are not found. Finally, short-run model is well specified as confirmed by Ramsey RESET test. The high value of R^2 for ECM-ARDL model shows that the adjustment of ARDL model is good ($R^2 = 0.7755 \rightarrow 1$). The F-statistic shows that overall model is statistically significant at the 1% level.

TABLE V
LONG-AND-SHORT RUNS RESULTS

Dependent variable = $\ln ED_t$						
	I- Long Run Analysis			*II- Short Run Analysis*		
Variables	Coefficient	T-Statistic	P-value	Coefficient	T-Statistic	P-value
Constant	6.3825**	2.0690	0.0458	0.0545	1.1592	0.2544
$\ln ED_{t-1}$	0.2715*	3.2481	0.0025	0.4425*	3.1146	0.0037
$\ln MS_t$	0.3933*	3.0049	0.0048	0.2035	0.6439	0.5239
$\ln DS_t$	0.4659*	4.8675	0.0000	0.1090	0.7278	0.4717
$\ln Y_t$	-0.6054***	-1.8928	0.0664	-0.1564**	-2.0684	0.0463
ECT_{t-1}				-0.1543*	-11.067	0.0000
Diagnostic tests	Test	F-Statistic	P-value	Test	F-Statistic	P-value
	R^2	0.9444		R^2	0.7755	
	F-statistic	153.14*	0.0000	*F-statistic*	23.491*	0.0000
	χ^2_{NORMAL}	1.0459	0.5955	χ^2_{NORMAL}	0.3089	0.8568
	χ^2_{ARCH}	1.7456	0.2404	χ^2_{ARCH}	0.2052	0.6531
	χ^2_{REMSEY}	1.6738	0.2042	χ^2_{REMSEY}	0.3859	0.5386
	χ^2_{SERIAL}	1.0914	0.2000	χ^2_{SERIAL}	1.4848	0.2417
	χ^2_{WHITE}	1.2480	0.3094	χ^2_{WHITE}	1.4280	0.2094

*, ** and *** denote significance at the 1, 5 and 10% levels, respectively. χ^2_{NORMAL} is for normality test, χ^2_{ARCH} is for autoregressive conditional heteroscedasticity, χ^2_{WHITE} for white heteroscedasticity, χ^2_{REMSEY} is for Remsey RESET test, and χ^2_{SERIAL} is for LM serial correlation test.

TABLE VI
THE VECM GRANGER CAUSALITY ANALYSIS

Dependent Variable	Direction causality								
	Short-run				Long-run	Joint long- and short-run causality			
	$\Delta \ln ED_{t-1}$	$\Delta \ln MS_{t-1}$	$\Delta \ln DS_{t-1}$	$\Delta \ln Y_{t-1}$	ECT_{t-1}	$\Delta \ln ED_{t-1}, ECT_{t-1}$	$\Delta \ln MS_{t-1}, ECT_{t-1}$	$\Delta \ln DS_{t-1}, ECT_{t-1}$	$\Delta \ln Y_{t-1}, ECT_{t-1}$
$\Delta \ln ED_{t-1}$	#	Ø	3.9443** (0.0293)	2.4675* (0.1003)	-0.8422*** [-3.2049]	#	3.6997** (0.0219)	6.2360*** (0.0025)	4.7264*** (0.0079)
$\Delta \ln MS_{t-1}$	Ø	#	Ø	Ø	Ø	Ø	#	Ø	Ø
$\Delta \ln DS_{t-1}$	Ø	Ø	#	Ø	-0.1442***[-4.6963]	8.7011*** (0.0002)	8.9391*** (0.0002)	#	7.4755*** (0.0007)
$\Delta \ln Y_{t-1}$	Ø	Ø	Ø	#	Ø	Ø	Ø	Ø	#

*, ** and *** denote significance at the 1, 5 and 10% levels, respectively. Ø denotes absence of significance. P-values are listed in parentheses and t-statistics are presented in brackets. With respect to Eq. (8), short-run causality is determined by the statistical significance of the partial F-statistics associated with the right hand side variables. Long-run causality is revealed by the statistical significance of the respective error correction terms using a t-test.

After determining the presence of cointegration between variables, the next step consists to perform the Granger causality test in order to provide a clearer picture for policymakers to formulate economic policies and external debt strategies by understanding the direction of causality. As the variables are cointegrated, we employ the Granger causality in the VECM framework to determine the direction of causality between the variables. The results of the VECM Granger causality are presented in Table VI. Thus, since the variables are cointegrated, the direction of causality can be divided into short- and long-run causation. The short-run causality is determined by the statistical significance of the partial F-statistics associated with the right hand side variables. The long-run causality is revealed by the statistical significance of the respective ECT using a t-test.

Begin with long-run causality, we find that defense spending and economic growth Granger cause external debt. The feedback effect is found between external debt and debt services. The unidirectional causality is also found running from defense spending and economic growth to external debt services. Turning to short-run causal effect, we find that defense spending Granger causes external debt and external debt is Granger cause of economic growth. In contrast, we find bi-directional Granger causality in the joint short- and long-run between real external debt per capita and real debt servicing per capita. This implies that external debt provides debt servicing for investment and production in military. External debt also decreases economic growth, but is helpful in enhancing the debt servicing.

The stability of short- and long-run estimates is tested by applying Cumulative Sum (CUSUM) and CUSUM of Squares (CUSUMSQ) tests. The related graphs of these tests are presented in Fig. 1. As can be seen from Fig. 1, the plots of CUSUM and CUSUMSQ statistics are well within the critical bounds at the 5% significance level, implying that all coefficients in the error-correction model are stable and reliable. Therefore, the selected model can be used for policy decision making purposes, such that the impact of policy changes considering the explanatory variables of external debt function will not cause major distortion in the level of real external debt per capita.

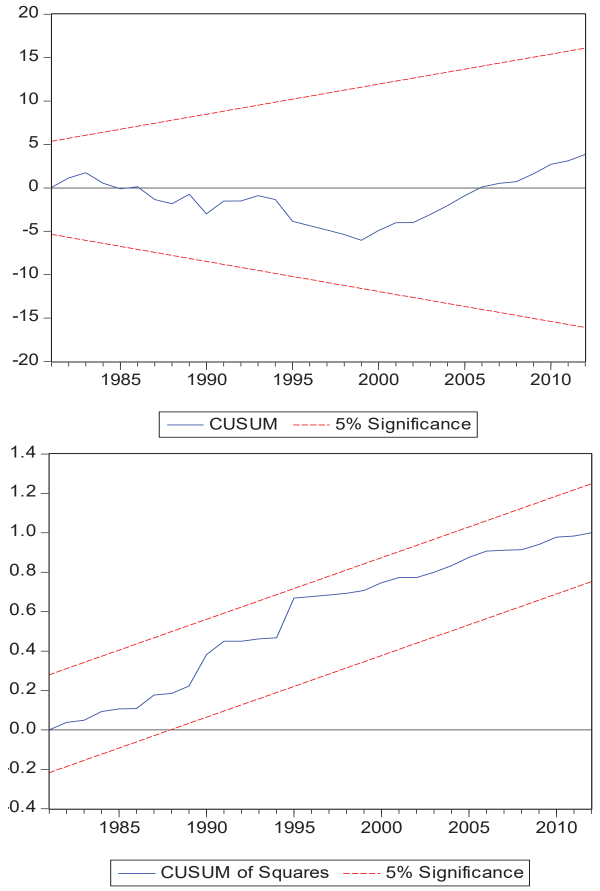

Fig. 1 Plots of CUSUM and CUSUMSQ of recursive residuals

The Granger causality tests suggest that exogenous variables in the system have significant impacts on the future values of each of the variables. However, the results do not, by construction, indicate how long these impacts will remain effective. Variance decomposition and impulse response functions give this information. Hence, we conduct generalized variance decomposition and generalized impulse response functions analysis proposed by [39] and [46]. A distinguishing feature of this generalized approach is that the results from these analyses are invariant to the ordering of the variables entering the VAR system. The generalized impulse response functions trace out responsiveness of dependent variables in the VAR to shocks to each of the variables. For each variable from each equation separately, a unit shock is applied to the error, and the effects upon the VAR system over time are noted [47]. The findings from the impulse responses functions for (2) are provided in Fig. 2.

Fig. 2 revealed that real external debt responds positively due to standard shocks in real defense spending but economic growth lowers real external debt after 8^{th} time horizon. Real debt servicing increases real external debt initially but starts to decline it after 7^{th} time horizon. The response in real defense spending is fluctuating due to shock arises in real external debt but shock stems in real debt servicing increases defense spending till 12^{th} time horizon. Real defense spending responds negatively due standard shock in economic growth. Real debt servicing is negatively linked with economic growth after 6^{th} time horizon. The response in economic growth is negative due shock in real defense spending but economic growth positively responds due to standard shock in real debt servicing.

Variance decomposition gives the proportions of the movement in dependent variables that are due to their "own" shocks, versus shocks to the other variables. The results of variance decomposition over a period of 15 years' time horizon are presented in Table VII. The results indicate that after 5 years, 90.3970% of the variation in the forecast error for real external debt is explained by its own innovations, while at the end of 15 years, this drops to 73.5864%. About 5.6816% of variation in the forecast error for real external debt is explained by innovations of real debt servicing after 5 years, while at the end of 15 years about 4.8136% of the variation in the forecast error for real external debt is explained by innovations of real debt servicing. Also about 3.3540% of variation in the forecast error for real external debt is explained by innovations of real military spending after 5 years, while at the end of 15 years about 19.9139% of the variation in the forecast error for real external debt is explained by innovations of real military spending. Finally, about 0.5673% of variation in the forecast error for real external debt is explained by innovations of economic growth after 5 years, while at the end of 15 years about 1.6859% of the variation in the forecast error for real external debt is explained by innovations of economic growth. Thus, for the debt analysis, the strong link between real external debt and debt servicing affects directly the economic situation of India and affects in second order the military spending. This also confirms the existence of causality relationship between the variables.

TABLE VII
GENERALIZED FORECAST ERROR VARIANCE DECOMPOSITION

Period	Variance Decomposition of $\ln ED_t$				Variance Decomposition of $\ln MS_t$				Variance Decomposition of $\ln DS_t$				Variance Decomposition of $\ln Y_t$			
	$\ln ED_t$	$\ln MS_t$	$\ln DS_t$	$\ln Y_t$	$\ln ED_t$	$\ln MS_t$	$\ln DS_t$	$\ln Y_t$	$\ln ED_t$	$\ln MS_t$	$\ln DS_t$	$\ln Y_t$	$\ln ED_t$	$\ln MS_t$	$\ln DS_t$	$\ln Y_t$
1	100.0000	0.0000	100.0000	0.0000	4.7794	95.2205	0.0000	0.0000	0.0050	0.6319	99.3629	0.0000	13.8864	0.3560	8.5359	77.2215
5	90.3970	3.3540	5.6816	0.5673	0.8250	93.7919	3.4069	1.5760	1.3121	2.1575	96.0132	0.5170	2.7888	0.6848	6.9195	84.6067
10	79.2480	12.9394	5.3613	1.4511	0.5521	93.6833	3.6966	1.8678	1.6008	11.4529	85.2243	1.7218	0.6415	1.7543	2.9829	94.6210
15	73.5864	19.9139	4.8136	1.6859	0.4190	93.2257	3.7554	2.0997	1.8453	18.0173	78.5228	2.1144	0.3471	1.7617	2.4377	95.4533

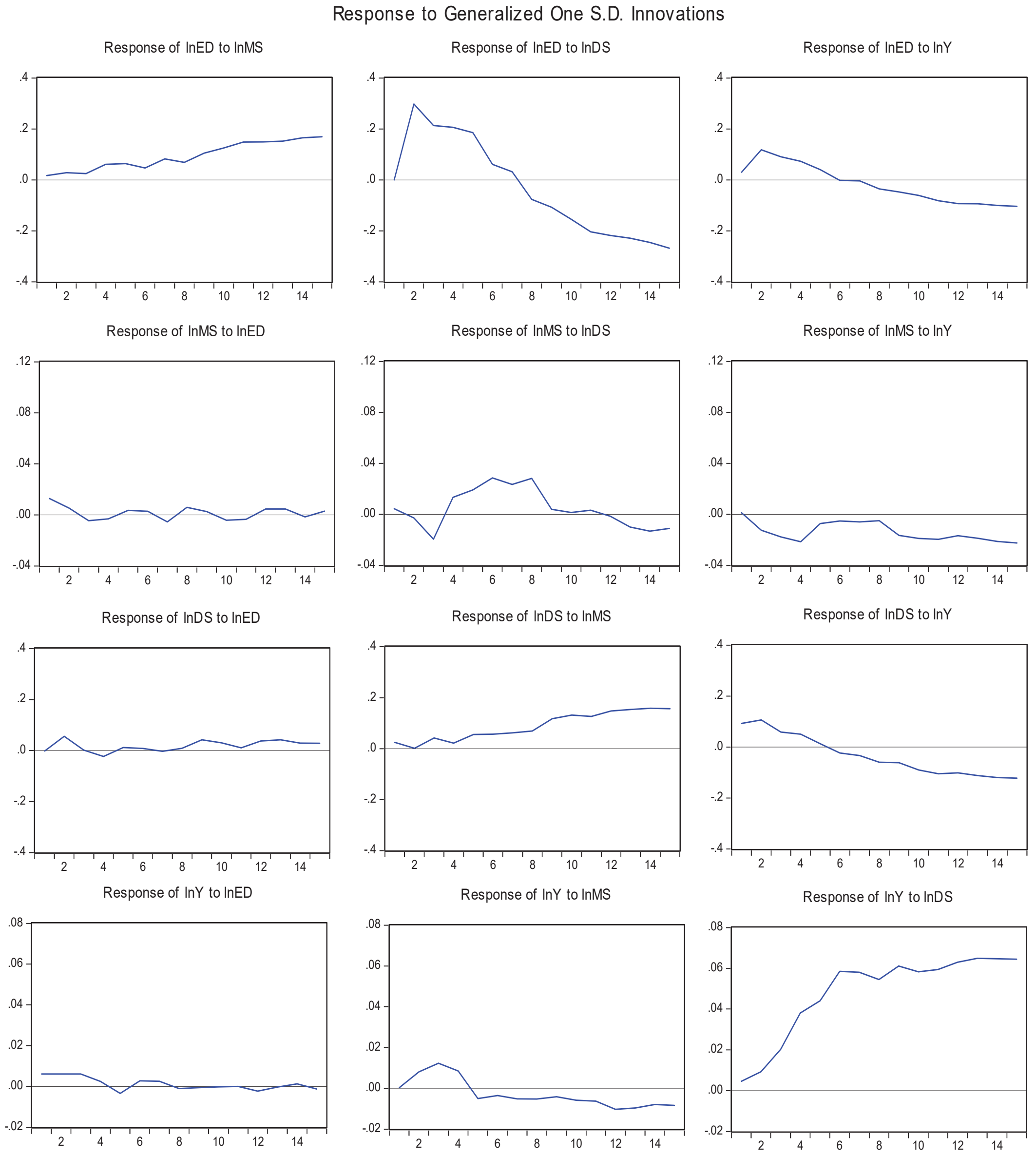

Fig. 2 Impulse response functions

V. Conclusion and Policy Recommendations

The present study reinvestigates the effect of real military spending per capita, real debt servicing per capita and real GDP per capita (economic growth) on real external debt per capita using time series data for India over the period 1970–2012. To test the stationary properties of the data, we used the Zivot-Andrews unit root test containing information about single unknown structural break which incorporates endogenously determined structural break in the series.

The ARDL bounds testing approach to cointegration is also used to model the relationship between variables. Based on the Zivot-Andrews test, the findings showed that non-stationary process is found in all series at level, while variables are found to be stationary at 1st difference, i.e. I(1).

Our results confirmed the presence of cointegration among the variables. We found that real military spending and real debt servicing increases real external debt, while economic growth declines it. The causality analysis revealed that real military spending, real debt servicing and economic growth Granger cause real external debt. The unidirectional causal is running form real external debt, real military spending and economic growth to real military spending in the long-run. In short-run, real debt servicing Granger causes real external debt and same is true from economic growth to real external debt. Impulse response functions and variance decomposition analysis also confirm the findings of the VECM Granger causality analysis. This implies that real external debt provides real debt servicing for investment and production in military. Real external debt also decreases economic growth, but is helpful in enhancing the real debt servicing. Thus, for the debt analysis, the strong link between real external debt and real debt servicing affects directly the economic situation of India which impacts in second order the military spending. This also confirms the existence of causality relationship between the variables. Based upon these results, we expect a higher real external debt in India if more public resources are diverted from the civilian sectors to defense of the economy now; however, these expenditures must be up to a limit as if expenditure on economic activities crosses this limit it will have negative effect. However, expenditure in the real debt servicing has positive impact on the real external debt of India in the long run. This implies that Indian Government must allocate major proportion of her external debt in debt servicing followed by military sector and sooner or later she should reduce the expenses on military sector. Therefore, keeping these points in mind Indian policy-makers should control their external debt.

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