Does Defence Expenditure affect India's External Debt: Evidence from Nonlinear ARDL Model

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Abstract: The study focuses on the asymmetric impact of defence expenditure on India's external debt using the nonlinear auto-regressive distributed lag framework. The NARDL model examined the presence of co-integration in the study period. The estimated NARDL model confirmed the long-run positive and significant impact of defence expenditure on external debt, the import of arms and ammunition is also a positive association with external debt. Furthermore, the study also found that, in the short-run, there is an asymmetric relationship between economic growth and external debt. A positive change in economic growth decreases the external debt, while negative changes in economic growth increase the external debt of the country. Moreover, a positive change in defence expenditure positively affects the external debt; while a fall in defence expenditure has an insignificant impact on the external debt.

Key Words: Defence Expenditure, External Debt, Economic Growth, Arms and Ammunition, Non-Linear Auto Regressive Distributed Lag Model

I. INTRODUCTION

According to the Reserve Bank of India, ₹3.16 trillion was the defence expenditure of India for the year 2019. It was also reported that defence expenditure rose very sharply from 2017 onwards. Recently, the rise in defence expenditure in India is mainly for two reasons; firstly, the geopolitical instability between neighbouring countries such as China and Pakistan and secondly, the salary bill and pensions for more than 2 million veterans [52].

The importance of defence expenditure and external debt was first highlighted in different research papers [17]. He proposed that in the early 1980s, most developing countries had a massive debt burden, owing primarily to defence spending. Defence expenditure can affect the external debt of many developing countries. Some of the explanations are cited. If defence expenditure is financed through public debt, then there is a huge risk of debt trap and, it may negatively affect the economic affluence of the country in long-run [19]. Secondly, many countries are suffering from extremism and also share their borders with neighbouring countries, and hence, to protect the civilians and integrity of the nation, the country imports arms and ammunition from foreign countries [50].The import of arms requires a huge amount of budgetary allocation, and with an insufficient budget allocation, the country is compelled to take debt from a foreign nation, and hence the volume of external debt increases. Thirdly, in recent times, most developing countries have increased their defence expenditure by many folds, and hence, to maintain their status with their neighbouring nations, the government depends on foreign loans from different foreign institutions and strengthens defence expenditure [20].

In the literature, abundant studies have also suggested that, in the long run, the economic prosperity of a country is positively influenced by an increase in defence expenditure [37]. This implies that with a raise in defence expenditure, the country may protect the harmony and peace of the people on the one hand, and on the other, it will also increase the standard of living of security forces by providing safety needs, which may increase the level of productivity among the armed forces in the economy. Thus, it affects economic growth positively. However, there are also studies concerning defence expenditure affect growth negatively, supported [40]. For instance, enhance in defence expenditure by cutting down developmental expenditure may have a negative effect on human capital. This negative impact on human capital will put pressure on the level of production. Therefore, the country may have to rely on imported goods, which in turn creates stress on the reserves of the country and curtails the speed of economic growth. The below conceptual figure illustrates the mechanism of defence expenditure, economic growth, and external debt.

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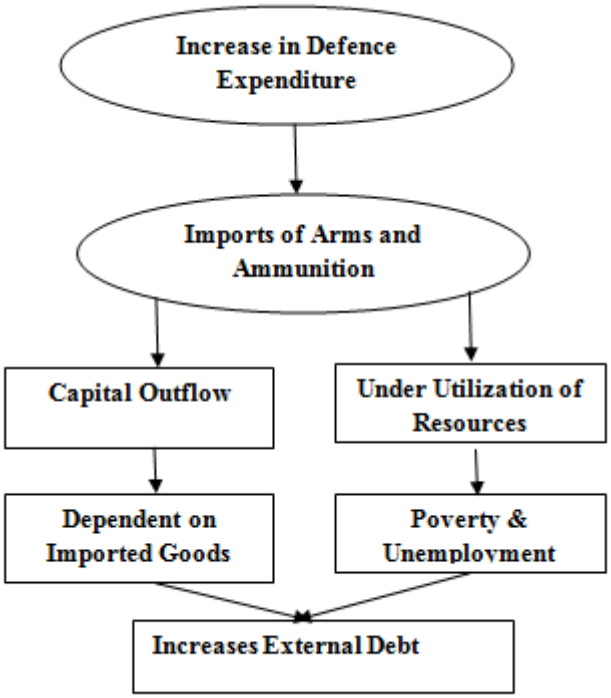
Figure.1: Conceptual Framework

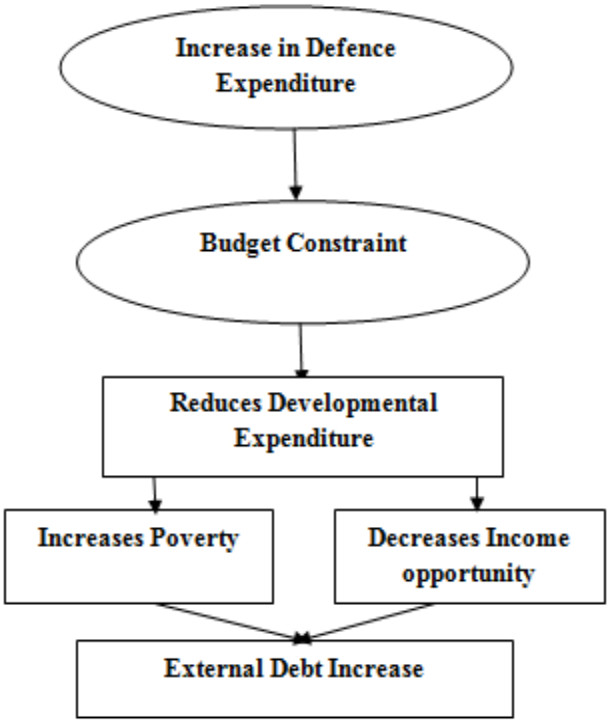


Source: Source: Linkage from different research papers

The growth of any country depends not only on the cost of social and economic infrastructure but also on how the country protects its borders and secures the livelihoods of its citizens. In this regard, expenditure on the armed forces, along with arms and ammunition, played an important role. However, there may be a trade-off between defence and non-defence expenditure. For instance, if there is an excessive expenditure on defence, it may put some pressure on the other expenditures of the government, and to meet the needs of the social program, the government may take financial help from external agencies like the IMF. This may increase the external debt burden of the country.

Moreover, turning to the developmental expenditure variable, there are numerous justifications that may be made to shield the guns or butter argument theoretically. From Butter's viewpoint, if there is an increase in defence expenditure at the cost of developmental expenditure, then it will have an adverse effect on human capital, which ultimately leads to low capital formation and, hence, in the long-run, the economy may suffer from low economic growth and high external debt. On the other hand, if there is a decrease in defence expenditure, then it will directly impact the security of the country. Moreover, weak defence expenditure is positively associated with the crime rate, implying that in an area with a limited size of police activity, it will act as a key ingredient in destabilizing economic prosperity.

Figure.2: Conceptual Framework



Source: Source: Linkage from different research papers

Although there have been a lot of studies done in the literature to look at the effects of defence spending on economic growth, less attention has been paid to the link between external debt and defence spending [9]. Defence spending and external debt were established in a symmetric framework in various research studies [19]. However, these linear models might not allow for dynamics inference and achieve reliable predictions. Moreover, after the in-depth review of the previously carried out studies on defence and external debt modeling, we found only one study which was conducted in an asymmetric framework using asymmetric Autoregressive Distributed Lag (ARDL) [6] who traced out the asymmetric influence of defence expenditure on economic growth. Moreover, existing literature has already observed a dichotomy between defence expenditure and external debt. Therefore, it is expected that external debt may respond differently to positive and negative shocks to defence and developmental expenditure. The current study employed the NARDL model to extract the asymmetric effect of defence and developmental expenditure on India's external debt. One of the implications of the current study is that it will contribute to the literature on external debt in India by using an asymmetric setting to investigate the relationship between defence expenditure and external debt from 1981 to 2019.

II. METHODOLOGICAL FRAMEWORK AND DATA COLLECTION

It has already been mentioned in the literature that a lot of work has been done on defense expenditure and external debt, however, the studies reviewed that there was a symmetric relationship between defense spending and external debt. Moreover, most of the researchers focused on the co-integration model, which explains the short-term and long-term relationships between dependent and independent variables and avoid asymmetric relationship for dependent variable. To fill this critical gap, this study uses an asymmetric ARDL approach and uses annual time series data from 1981 to 2019 to asymmetric defense and development spending against India's external debt.

Econometric model

We have specified the following equation to examine the long-run effects of defence expenditure, economic growth, imports of arms and ammunition, and energy consumptions on external debt in India.

$$ED_t = \alpha_0 + \alpha_1(DE_t) + \alpha_2(EG_t) + \alpha_3(IA_t) + \alpha_4(ENG_t) + \mu_t \text{ ---------- (1)}$$

Where ED denotes external debt, DE denotes defence expenditure, EG denotes economic growth, IA denotes imports of arms and ammunition, and ENG denotes energy consumption. The long-run parameters are $\alpha_1, \alpha_2, \alpha_3 and\ \alpha_4$. Shin et al. (2014) have recently developed the asymmetric ARDL model using two directions of disintegrations that tolerate the asymmetric effects of short and long-run. Moreover, compared to traditional co-integration models, the NARDL approach has a few advantages. Firstly, the NARDL model can perform if the volume of sample is small and secondly, the NARDL model doesn't require a stationary test (Romilly, Song, & Liu, 2001, Ibrahim, 2015). Moreover, if the variables are integrated in different orders such as I (0) and I (1), the NARDL model can be easily perform.

Table: 1. Variables description and data sources.

Variables	Description of variables	Data sources
ED	External Debt	RBI
DE	Defence Expenditure	RBI
IA	Imports of arms and ammunition	SIPRI
EG	Economic Growth	WBI
ENG	Energy Consumption	US Energy Information

Note: External Debt, Defence Expenditure, Imports of arms and ammunition, Energy consumption and economic growth series are in logarithmic form. Furthermore, the data are also taken from various reports of the sources.

Table 2.Descriptive statistic

	ED	DE	IA	EG	ENG
Mean	3.01	8.86	1.86	1.74	2.49
Median	3.00	9.42	2.02	1.82	2.50
Maximum	3.50	11.50	2.62	2.26	3.45
Minimum	2.45	5.99	0.82	0.05	1.43
Std. Dev	0.23	1.57	0.44	0.40	0.61
Skewness	-0.007	0.0002	-0.61	-1.88	-0.06
Kurtosis	3.07	1.88	2.21	1.98	1.82
Jarque-Bera	0.010	2.00	3.45	2.45	2.25
Probability	0.19	0.36	0.17	0.28	0.32

This study adopts Pesaran, Shin, and Smith (2001) bound testing approach by considering the following error correction approach:

$$\Delta ED_t = \emptyset + \sum_{k=1}^{p1} \emptyset_k \Delta ED_{t-k} + \sum_{k=1}^{p2} \emptyset_k DE_{t-k} + \sum_{k=1}^{p3} \emptyset_k IA_{t-k} + \sum_{k=1}^{p4} \emptyset_k ENG_{t-k} + \sum_{k=1}^{p5} \emptyset_k EG_{t-k} + \delta_1 ED_{t-1} + \delta_2 DE_{t-1} + \delta_3 IA_{t-1} + \delta_4 ENG_{t-1} + \delta_5 EG_{t-1} + \mu_t \text{ ---------- (2)}$$

Equation (2) is similar to the technique taken by Engle and Granger (1987). However, there is only one tiny change: we substituted Equation (1)'s lag of error term with its proxy, which is a linear combination of the lagged

level variable. The advantage of using Equation (2) over Engle and Granger's (1987) representation is that we can easily detach the short-run and long-run effects by estimating equation (2). In the equation (2), long-run coefficients are shown $\delta_1, \delta_2, \delta_3, \delta_4 and\ \delta_5$ while short-run coefficients are reflected by first difference variables. Furthermore, it is necessary that one must establish long-run causality for the validity of long-run coefficients. Pesaran et al. (2001) suggested the use of bound F test to substantiate the presence of co-integration between external debt and other independent variables.

In Equation (2), it is assumed that all independent variables are affecting the outcome variable symmetrically, but our concern in this study is to explore the asymmetric impact of defence expenditure, economic growth, import of arms and ammunition and energy consumption on the India's external debt. Therefore, to investigate the asymmetric effect of independent variables the desired variables are decomposed into negative and positive components. This asymmetric regression $x_t = \gamma^+ y_t^+ + \gamma^- y_t^- + \mu_t$, where $\gamma^+ and\ \gamma^-$ are associated with long-run coefficients and y_t is a vector of independent variables decomposed as

$$y_t = y_0 + y_t^+ + y_t^-$$

Where, $y_t^+ + y_t^-$ are the regressors which are disintegrated into positive and negative. The following Equation 3, 4, 5 and 6 are the fractional summation of positive and negative changes in defence expenditure and economic growth.

$DE^+ = \sum_{i=1}^{t} DE^+ = \sum_{i=1}^{t} Max(\Delta DE_{i,}0)$---------- (3)

$DE^- = \sum_{i=1}^{t} DE^- = \sum_{i=1}^{t} Min(\Delta DE_{i,}0)$---------- (4)

$EG^+ = \sum_{i=1}^{t} EG^+ = \sum_{i=1}^{t} Max(\Delta EG_{i,}0)$---------- (5)

$EG^- = \sum_{i=1}^{t} EG^- = \sum_{i=1}^{t} Min(\Delta EG_{i,}0)$---------- (6)

To create an asymmetric ARDL scaffold, replace the negative and positive series generated by Equations 3, 4, 5, and 6 with Equation 2 to get Equation 7. Equation 7 represents the NARDL equation

$\Delta ED_t = \emptyset + \sum_{k=1}^{p1} \emptyset_k \Delta ED_{t-k} + \sum_{k=1}^{p2} \emptyset_k \Delta IA_{t-k} + \sum_{k=1}^{p3} \emptyset_k \Delta DE_{t-k}^+ + \sum_{k=1}^{p4} \emptyset_k \Delta DE_{t-k}^- + \sum_{k=1}^{p5} \emptyset_k \Delta EG_{t-k}^+ + \sum_{k=1}^{p6} \emptyset_k \Delta EG_{t-k}^- + \sum_{k=1}^{p7} \emptyset_k \Delta ENG_{t-k} + \delta_1 ED_{t-1} + \delta_2 IA_{t-1} + \delta_3 DE_{t-1}^+ + \delta_4 DE_{t-1}^- + \delta_5 EG_{t-1}^+ + \delta_6 EG_{t-1}^- + \delta_7 ENG_{t-1} + \mu_t$---------- (7)

Estimation and results

Before assessing the dynamic relationship between defence expenditure, external debt, economic growth, energy consumption and imports of arm and ammunition, we examined the variables for stationarity. The result of ADF unit root tests are employed to discover the stationarity of the variables and avoiding variables are in I (2). Table 3 summarizes the results of unit root tests.

Table: 3. Unit root test (The Augmented Dickey-Fuller Generalized Least Square test results)

Test	ED	DE	IA	ECG	EG
I (0)	-2.61***	-0.92	-.2.01	-1.51	-5.85*
I (1)	-4.71*	-7.28*	-7.65*	-5.96*	----

Note:*, **&*** rejects the null hypothesis of no unit root at 1%, 5% & 10% level of significance

Results of the unit root tests in levels indicate that the computed t-statistics are less than the critical values at any conventional significance level for three variables, thus we do not reject the null hypotheses that variable has a unit root in levels. However, once the first differences of those variables are considered, the null hypothesis of unit root can be rejected. Thus, we have clear evidence that the variables under consideration are stationary but at first difference.

Given these equations, to examine the presence of a long run relationship between defence expenditure and external debt, we use F-test on the joint null hypothesis that the coefficients of the level variables are jointly equal to 0 [45]. Next, Estimate equation (2) using the ARDL co-integration method for long-term estimation. To find the variable level coefficients, we estimated the model considering various criteria such as the R-Square criterion, the Hannan-Quinn criterion, the AIC criterion, and the SBC criterion. The long-term and short-term results for all models were about the same. Therefore, the [41] Monte Carlo experiment documented that AIC was superior to other criteria, especially when the duration was less than 60 observations, and therefore the model was selected based on the AIC criteria. Only the results are shown. However, if the F-statistic of the linear ARDL is below I (0) and I (1), this means that the relationship between the external debt and other independent variables is not definitive. Moreover, for the asymmetric ARDL, bounds test result shows that there is evidence of co-integration among independent variables and external debt because the computed asymmetric ARDL F-statistic value (7.51) exceeds the tabulated value of the upper bound at the 1% level of significance.

Table: 4.Asymmetric co-integration on the base of bounds test

		1% Critical Values		
	F test	I(0)	I(1)	Decision
Symmetric ARDL	5.40	8.74	9.63	Inconclusive
Asymmetric ARDL	7.51	4.13	5.00	Co-integration

Note: F-statistic values are calculated by bounds testing approach by Pesaran et al. (2001) and Shin et al. (2014)

Table: 5.Asymmetric ARDL estimation results.

Variable	coefficient	Std. Error	t-statistic
Constant	0.85	0.492	1.80***
LENG(-1)	-0.70	0.412	-1.73***
LIA(-2)	0.39	0.113	3.45*
LDE^{+} (-2)	0.28	0.106	2.70*
LDE^{-} (-2)	0.45	0.129	0.34
LEG^{+} (-1)	-0.11	0.030	-3.33*
LEG^{-} (-1)	-0.07	0.037	-2.51*
Adjusted R^2	0.63	-----	-----
F-statistic	8.79	-----	-----
Prob. F(statistic)	0.00	-----	-----

Note:*, **&*** rejects the null hypothesis of no unit root at 1%, 5% & 10% level of significance, Positive and negative sums are reflected with + &–superscripts, respectively.

Before looking at the short-term and long-term positives and negatives change between defence expenditure on external debt in India. We checked the diagnostic statistics like serial correlation, heteroscedasticity, normality, and model specification to know the reliability of the model. The outcomes of these diagnostic tests are reported in Table 6. The χ^2 (p-value) of LM and Breusch–Pagan–Godfrey tests are 0.87 and 0.34, respectively, which indicate that our model is free from the issue of serial correlation and heteroscedasticity. Additionally, The Jarque–Bera test also confirmed normality of residuals. The value (0.52) of Ramsey RESET is also statistically insignificant which naturally describe that our model is correctly specified. The value of variance inflation factor (VIF) is 3.4 which is less than 5, and it shows that there is no multicollinearity issue in our model. Furthermore, we also found that CUSUM and CUSUMQ test as the model is stable.

Table: 6. Diagnostic inspection

Diagnostic tests	Problem	$\chi^2(p$- value)	Decision
LM	Serial correlation	0.87	No serial correlation exist
Jarque–Bera	Normality	0.35	Residuals are normal distributed
Breusch–Pagan–Godfrey	Heteroscedasticity	0.34	No heteroscedasticity exist
Ramsey RESET test	Model specification	0.52	Model is correctly specified
VIF	Multicollinearity	3.4	No Multicollinearity exist
CUSUM	Stability	----------	Model is stable
CUSUMSQ	Stability	----------	Model is stable

First of all, the independent variables jointly capture about 63 percent variation in external debt. While, the F-statistic validated the jointly contribute of all the independent variables in explaining the external debt. The short-run impact of the explanatory variables on the dependent variable is displayed in Table 6. From the table 6, it shows that energy consumption is negatively associated with external debt. An increase in energy consumption significantly decreases the external debt. This due to the reason, energy is engine of economic growth and as consumption of energy increases, it will positively affect the level output. Moreover, increase in the output will lead to increase the export and as a consequence, it decreases the external debt of the country. Turing into, imports of arms and ammunition variable, it is positively associated with external debt. It implies that an increase in the imports of arms and ammunition is increased the external debt of the country by 0.39 percent [39].Turning into other variable, Positive changes in economic growth (EG+) have a negative and significant effect on external debt at 1% level of significance; this implies that, an increase in the economic growth will positively associated with the improvement in the resource allocation and output generation. Further it also helps the country to become self-reliant and decrease the external debt. While, negative changes in economic growth (EG-) have a negative and significant effect on external debt. This implies a decrease in economic growth will create pressure to the government to finance the developmental expenditure. Hence, the country rely on external finance as a result external debt increases [49]. Furthermore, the long-run impact of the explanatory variables on the dependent variable is displayed in Table 7. From the table, it clear that defence expenditure (DE) is a significant determinant of external debt. Positive (DE+) changes in defence expenditure have a positive and significant effect on external debt at 1% level of significance while negative (DE-) changes in defence expenditure have insignificant effect on external debt. This implies that, firstly, an increase in defence expenditure resulting from the import of arms, ammunition and fighter jets will increase the external debt of the country. Secondly, increase in defence expenditure may lead to compensation in the development expenditure, a fall in developmental expenditure leads to fall in socio-economic expenditure such as health, communication and infrastructure expenditure, and this fall in public expenditure will result in an increase in the poverty level, and to fight against the poverty the government may take external monetary support from the different international agencies as a result, external debt of the country rise. These findings are consistent with the view by [17] for developing economies, [28] for industrialized countries.

Table: 7. Long-run coefficients.

Variable	Coefficient	Standard Error	t-statistic
Constant	4.70	2.83	1.66***
$LDE^{+}(-1)$	1.57	0.57	2.74*
$LDE^{-}(-1)$	0.24	1.02	0.24

Note:*, **&*** rejects the null hypothesis of no unit root at 1%, 5% & 10% level of significance

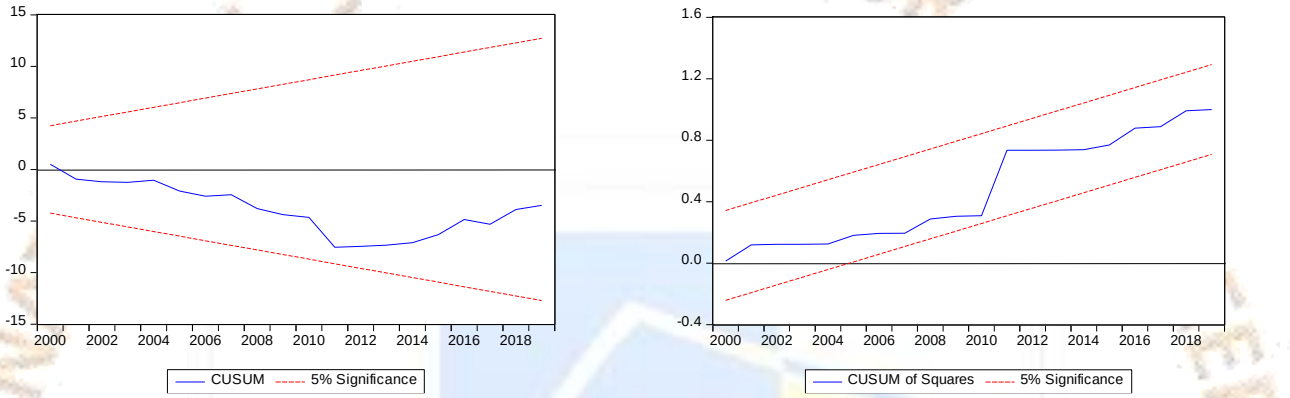
The stability of the parameters of NARDL model is examined using CUSUM and CUSUMSQ stability approach introduced [18]. If the blue line exceeds the upper or lower bound, it means that the parameters of the model are not stable. Since the blue lines in both plots are within the lower and upper bounds, we can conclude that the estimated model parameters are stable (see Figure 3). Table 7 shows the results of long-term asymmetric relations.

Table.7: Long run asymmetry test

	F-statistic	P-Value	Conclusion
Defence Expenditure	5.28	0.0015	The asymmetric relationship exists between defence expenditure and external debt

Note: To confirm the asymmetric relationship Wald test is being utilized

Figure.3: The stability analysis CUSUM and CUSUMQ Test



CUSUM and CUSUMQ test for structural change: plots of (a) cumulative sum and (b) cumulative sum of squares of recursive residuals. Note: The straight lines refer to critical bounds at the 5% level of significance.

SUMMARY & CONCLUSION

This study contributes to the literature using the asymmetric ARDL model to examine the asymmetric impact of defence expenditure on external debt in India using annual data from 1981-2019. The advantage of using asymmetric ARDL is it is potential to generate both short and long run asymmetries in a given model. From the result, it is observed that in the short run, energy consumption is negatively associated with external debt, while an import of arms and ammunition positively affects the external debt of the country. The empirical evidence revealed that a significant and positive asymmetric relationship exists between defence expenditure and external debt in the long run. An increase in defence expenditure (DE+) is positively associated with external debt, while a decrease in defence expenditure (DE-) is insignificant affect on the external debt of the country. The results of the study also confirmed the existence of an asymmetric relationship between defence expenditure and economic growth. Moreover, an increase in economic growth (EG+) tends to decrease the external debt while a fall in economic growth (EG-) has increased the external debt of the country. Finally, more study is needed, to understand the complex association between defence expenditure and external debt. This kind of research will help to identify the complex association between defence and debt in India. Therefore, policies should be designed in such a way as to encourage domestic defence industries. This will create employment opportunities on one side while on the other will work as an antidote for external debt.

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