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India's Military Procurement Programs & Economic Capacity: Compatibility & Pragmatism

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ABSTRACT

In a world of Realpolitik, each state in the world always looks for increasing its power; some for the purpose of their survival and some seek to fulfill their hegemonic ambitions. Having a huge population, territory, economy, and military, the states like India usually desire to establish their hegemony; therefore, it is not surprising that India wants to achieve a Great Power status in world politics. Although India has great numbers in each area of strategic significance it lacks qualitative capacity in terms of military strength where the advanced weapon systems are the backbone of a country's military power. In order to fill this gap, the Indian government has announced very ambitious military modernization programs and is concluding various military procurement programs around the world bearing huge costs while the big arms-exporting countries are getting involved in such ambitious military modernization programs of India. Over the past few years, it has been observed that the Indian economy has not been able to fulfill the costs of military modernization programs and the gap between the estimated costs of military procurements and the budget allocation is continuously increasing. Therefore, this study hypothesized that Indian military procurement programs and Indian economic capacity are not compatible with each other, which shall have perilous effects for the countries involved in such projects. This study provides an analysis of Indian economic growth and its comparison with the costs of India's military procurements and finds that the stated hypothesis is correct to the extent of compatibility difference between the Indian economic capacity and military procurement cost.

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1. Introduction

With the second-largest population in the world, while having a significant size of the territory and economic strength, it is natural for India to desire for having a great power status in world politics. However, it is not possible without establishing military strength and regional influence which India lacks drastically in comparison with other great powers in the world. Therefore, India has launched a huge military modernization program where it is concluding various military procurement deals around the world. Most of the military procurements of India have been signed between Russia, the USA, and Israel while India has also contracted with other countries in this regard. The current military procurements of India with their projected cost are too ambitious as their fulfillment seems to be a difficult task. India has signed Brahmos missiles and fifth-generation fighter aircrafts deals with Russia which shall incur a projected cost of near about $7-billion and $4-billion, respectively (The Economic Times, 2019). Agreement for various types of missile systems with the latest technology has been signed between India and Israel with an estimated cost of $500-Million and $2-Billion, respectively ((Medium-Range Surface-to-Air Missile (MRSAM), 2020); (Gady, Report: India Scraps Israel Anti-Tank Guided Missiles Deal (Again), 2019)). A number of military contracts, namely, M777 ultra-light howitzers, attack, and heavy-lift helicopters and choppers have been signed between India and the United States (The Economic Times, 2018). These contracts contain the projected cost of $750-Million, $3.1-Billion and $20-Billion, respectively ((The Economic Times, 2018); (Ray, 2020)). Additionally, India has signed two agreements with South Korea which include guns and 12 mine counter-measure vessels (MCMVs) (Raghuvanshi, India cancels minesweepers deal with South Korea, 2018). These agreements have an estimated cost of $720-Million and $5.1-Billion, respectively (Gady, India to Receive First Batch of K-9 Vajra Self-Propelled Howitzers This Month, 2018). A new Indian military project entitles "Project-75 I" is being approved with an estimated cost of $4.61-Billion (Times Now News, 2017). The vendors of this project are Sweden, Germany, and Russia. (The Economic Times, 2018; The Economic Times, 2018).

India's military procurement programs are primarily associated with economic growth. Nevertheless, the sustainability of defensive power is not an easy task when a country facing economic crises. India is considered the world’s largest importer of arms with a 12% share in the global arms trade SIPRI, Trends in International Arms Transfers, 2016, 2012). India has signed 169 defense deals for the period of 15 years (2012-2027) having a cost of Rs. 249755 crores (The Economic Times, 2018). Additionally, India is planning to sign further defense deals in the coming years. However, the defense budget of Rs 2,62,389

crore has been allocated for the year 2018 which is estimated to be around 1.58% of the total GDP of India (The Economic Times, 2019). Keeping in view the allocation of the defense budget and volume of the military procurement costs, it is assumed that the projected economic growth of India is not compatible with the cost of its military procurement programs, which shall be perilous for the states involved in military modernization projects of India. Therefore, this study tries to explore that either the Indian economic capacity is compatible with its military procurement programs or not.

Research Methodology

The econometric data from 1960 to 2017 of India has been obtained from SIPRI and world bank. The time step of study data consists on yearly basis. The statistical values of the complete dataset are presented in Table 1 (World Bank, 2020; Stockholm International Peace Research Institute (SIPRI), 2019).

TABLE 1: STATISTICAL INFORMATION ABOUT TIME-SERIES DATA USED IN THIS STUDY

Parameters	GDP	CE	CPI	FDIIN	FDIOT	IP	ME	TE	TI
Mean	5.370	10.296	7.517	0.788	0.294	25.574	3.051	10.550	12.408
Median	5.947	10.505	6.911	0.603	0.047	24.550	3.060	6.955	8.568
Maximum	10.260	12.456	28.602	3.657	1.622	42.480	4.231	25.431	31.259
Minimum	-5.238	6.728	-7.634	-0.030	-0.004	14.570	2.004	3.342	3.750
Std. Dev.	3.088	1.307	5.032	0.902	0.460	7.816	0.500	7.013	8.139
Skewness	-1.058	-0.608	0.905	1.159	1.779	0.557	0.277	0.840	1.018
Kurtosis	4.505	2.952	7.637	3.773	5.010	2.302	2.606	2.258	2.665
Jarque-Bera	16.008	3.575	59.886	10.699	26.447	4.177	1.118	8.299	10.298
Probability	0.000	0.167	0.000	0.005	0.000	0.124	0.572	0.016	0.006
Sum	306.091	597.142	436.008	33.887	11.153	1483.320	176.953	611.915	719.687
Sum Sq. Dev.	533.364	97.355	1443.180	34.151	7.842	3481.936	14.231	2803.413	3775.880

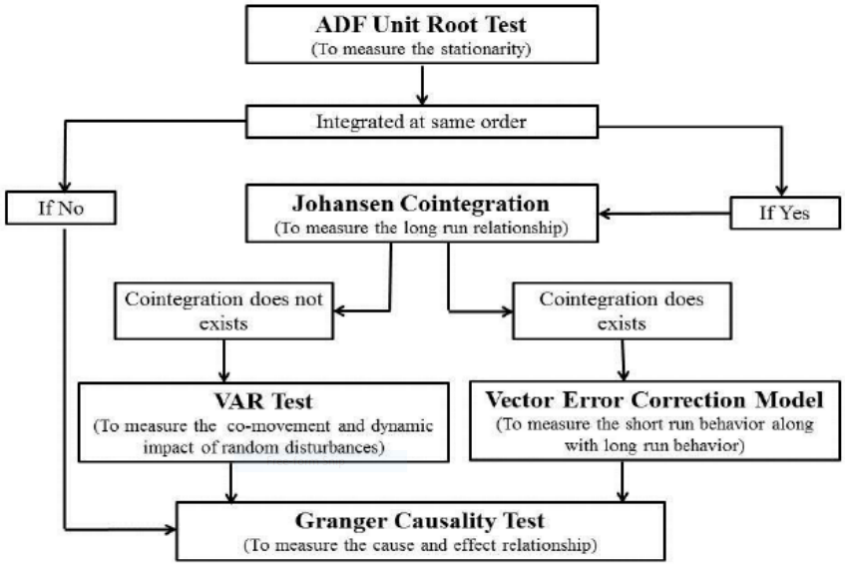
Source: **(World Bank, 2020) (Stockholm International Peace Research Institute (SIPRI), 2019)**

Granger Causality Test

The Granger causality test has been widely used for determining the causal relationship between two variables. The result will indicate either the relation is unidirectional, bidirectional or non-directional (Granger, 1988). First, the ADF unit root test has applied to determine whether the time series data is stationary or not. Afterward, in order to find out the causal relationship between predicted and targeted variable, the granger causality test has been employed. Furthermore, a total number of eight variables have utilized in this process as mentioned above. A schematic diagram of the granger causality test can be seen in Fig. 1 (P.Mohanamani, 2018). Moreover, E-views software has utilized in this study to conduct this test. Null hypothesis (NH) has obtained by the output of the granger causality test which depends upon F-statistic and probability values. These values are responsible in order to determine whether the null hypothesis will be accepted or rejected as: (i) If the p-value is < 0.05, then we reject NH which

indicates the particular variable is stationary, (ii) If the p-value is > 0.05, then we accept NH which indicates variable is not stationary. The limitations of the granger causality test are as followed : (1) Only information about linear features can be given, (2) It is only applicable for stationary data, (3) This test entirely depends upon observed variables (CWJ & AP, 1981).

FIGURE 1: FLOW CHART STRUCTURE OF GRANGER CAUSALITY TEST



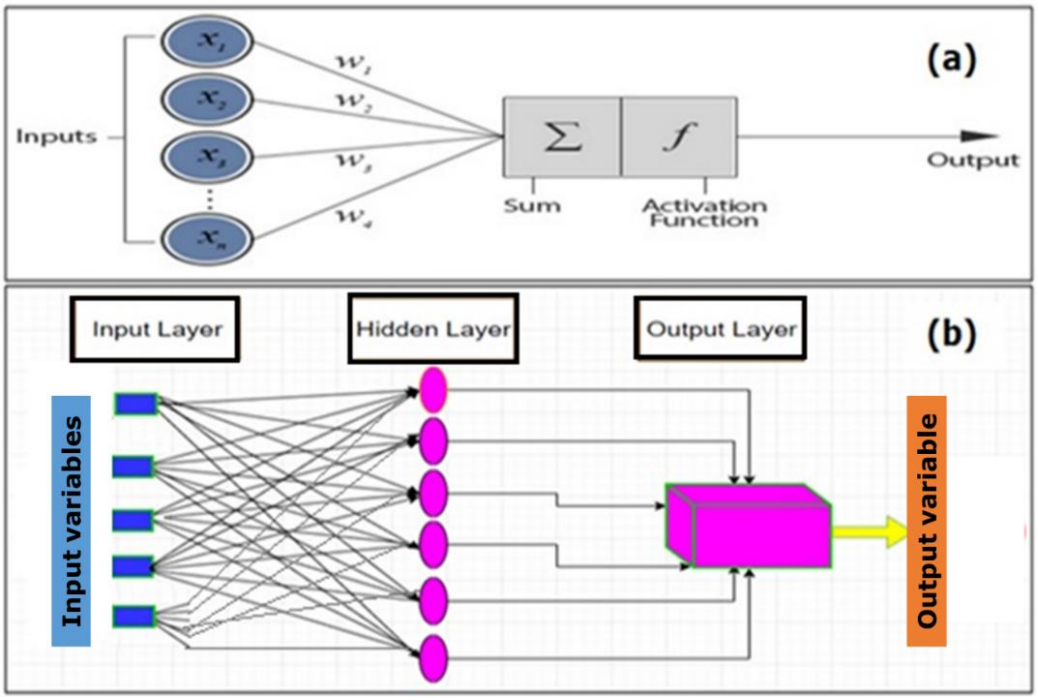
Source: (P.Mohanamani, 2018)

Multilayer Perceptron (MLP)

The neural network can be categorized into static (e.g. MLP) and dynamic (e.g. Elman) network. MLP has commonly used neural network in solving complex classification problems. In this network, the input is given to the network along with target output and the weights have adjusted in such a way that network has generated target output with several attempts. The MLP structure consists of three layers, an input layer, a hidden layer, and an output layer. Each layer contains a number of neurons that have connected in the same pattern with the neurons in the next layer. Each neuron contains a number of predictor variables from the previous layer and the number of outputs to the subsequent layer. Each layer plays a significant role in the overall performance of the structure. The neurons of one layer have connected to the neurons of other layers through a specific connection called weights. These weights are accountable to carry results from one to another layer. The output of each neuron in the input layer becomes an input for the neurons in the hidden layer. Similarly, the output of each neuron from the hidden layer converts into an input for each neuron in the output layer. An architecture neural network of MLP with one hidden layer has presented in Fig. 2 (a). The present study has utilized a scaled conjugate gradient (SCG) method which can be swiftly performed twice as compare to C.G and converging up to 20 times than C.G.D (Sherrod, 2013). Møller (1993) has explained the SCG algorithm in detail. The construction of the MLP structure is described in the next lines. The Input econometric variables, namely, GDP, CE, CPI, EX,

IMP, FDI, IP have fed in an input layer as predictor variables. The calculated military procurement (MP) has used as a target variable in an output layer. The mapping of the input-output relationship with the MLP model can be seen in Fig. 2 (b). The six neurons have been selected in the hidden layer after tuning the neurons. V-fold cross-validation has been currently used to test and validate the input data. The SCG parameters which require to run the developed model are given in Table 2 (Raza, 2020).

FIGURE 2: BLOCK DIAGRAM OF MLP SHOWING ARCHITECTURE NEURAL NETWORK



Source: (Raza, 2020)

TABLE 2: SCG PARAMETERS

Parameter	Value
Number of convergences tries	04
Number of Iterations	10,000
Convergence tolerance	0.006737 ($1.000e^{-005}$)
Minimum improvement delta	0.002478 ($1.000e^{-006}$)
Minimum gradient	0.00091 ($1.000e^{-007}$)
Maximum execution time	0

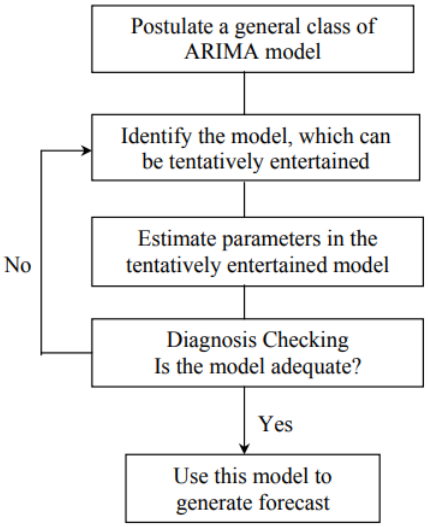
Source: **(Raza, 2020)**

ARIMA Model

This model consists of three iterative stages: (1) model identification (2) parameter identification (3) diagnostic checking. These three iterative steps have been involved in determining the best parsimonious model among the ARIMA models [(Kihoro, 2004)**;** (John H. Cochrane, 1997)**;** (R. Lombardo, 2000)]. After several times iterations, the suitable model has finally selected. Thus, this developed model can be used for future forecasting time series values. A stepwise methodology is shown in Fig.3 (Ratnadip

Adhikari, 2013).

FIGURE 3: STEP-WISE METHODOLOGY OF ARIMA MODEL



Source: **(Ratnadip Adhikari, 2013)**

In the modeling, the essential step has to determine the optimal parametric values of the developed model. For this purpose, auto correlation function (ACF) and partial correlation function (PCF) have been estimated from the given data set by dividing into training and testing sections. The estimated values must well correlate with the actual values. This one can be considered the best method to determine optimal parametric values for the development of model [(John H. Cochrane, 1997)**;** (Faraway, 1998)**;** (J.M. Kihoro, 2006)]. On the other hand, the Akaike information criterion (AIC) and Bayesian information criterion (BIC) have been widely adopted for the determination of suitable parametric values [(Kur Hornik, 1989)**;** (Adhikari, 2013)]. The mathematical form of AIC and BIC are given in equations 1 and 2, respectively.

EQUATION 1: $\boldsymbol{AIC(p\_ = Nln(\frac{\sigma^2_e}{N}) + 2p}$ **EQUATION 2:** $\boldsymbol{BIC(p) = Nln(\frac{\sigma^2_e}{N}) + p + pln(N)}$

Here, σ_e^2, N and P are the sum of square residual values, number of observations and quantity of parameters in the model. By keeping the number of parameters in mind, the optimal model order can be selected which reduces either AIC or BIC. The number of procedures is available in the literature for the identification of optimal model order (Kur Hornik, 1989).

India's Military Procurement Endeavors

Over the past 5 years, global sales of arms have increased. Amongst the top 40 importers of major arms in the world between 2015-2019, India stands at 2nd position holding a 9.2% share in total world's arms imports as a client. India is the 1st largest shareholder as a client with a 25% share in arms exports of Russia who is the second-largest exporter of arms in the world. India also holds a 45% share as a client in Israel's total arms exports **(Pieter D. Wezeman, 2020)**. While the United States stands at the top of the list of countries with whom India has signed agreements for the procurement of weapons and military platforms, the US is followed by Israel and Britain. **(The Economic Times, 2018)** In order to have a better analysis of the relationship between India's military procurement programs and India's economic capacity, it is pertinent to have information about the cost of desired military procurements of India. A cursory list of India's military procurement programs is given below.

TABLE 3: MILITARY PROCUREMENTS OF INDIA (NOT COMPLETED AT GIVEN TIME)

Military procurements	**Cost ($)**
Fire finder Weapon Locating Systems	200 million
USS Trenton (LPD-14)	92.5 million.
Six C-130J-30 "Super" Hercules	1.2 billion
12 P-8I MMPAW aircraft	3.1 billion
22 AH-64D Block III Apache helicopters	1.4 billion
24 L-model Harpoon Block II anti-ship missiles	170 million
99 F414-GE-INS6 power plant	822 million
512 CBU-105 sensor fuzed weapons	257 million
C-17 Globemaster III military transport aircraft	6.5 billion

Source: [**(Luthra, 2007)**; **(Somnath, 2012)**]

TABLE 4: FUTURE MILITARY PROCUREMENTS OF INDIA

Countries	**Future Military Deals**	**Amount ($)**
Russia	Brahmos missile	7 Billion
Russia	Fifth Generation Fighter Aircraft	3 Billion
Israel	MRSAM systems	2 Billion
South Korea	155mm/52-caliber artillery guns	720Million
United States	M777 ultra-light howitzers	750 Million
Israel	Anti-tank guided missiles (ATGM)	500 Million
United States	Attack and heavy-lift helicopters	3.1 Billion
United States	Choppers	3 Billion

Sweden, Germany, Russia	Project-75 I	4.61 Billion
	C-130J-30 "Super" Hercules	1.2 billion
	145 M777 155 mm towed howitzer	542 million
USA	MQ-9 Reaper (Predator B) Drones	2.6 billion
USA	P-81 Maritime Surveillance Aircrafts	1 billion
USA	Gulfstream 550 Aircraft for Intelligence	1 billion
USA	National Advanced Surface-to-Air Missile System II	1 billion

Sources: (The Economic Times, 2019), (Gady, India Approves Procurement of 10 More P-8I Maritime Patrol Aircraft, 2019), (Army Recognition, 2020), (Defense Industry Daily, 2014), (Medium-Range Surface-to-Air Missile (MRSAM), 2020), (Gady, India to Receive First Batch of K-9 Vajra Self-Propelled Howitzers This Month, 2018), (The Economic Times, 2018), (Ray, 2020), (Times Now News, 2017), and (Raghuvanshi, New Weapons Purchases Suffer under India's Latest Defense Budget, 2020)

India's defense budget for the year 2019 was allocated an amount of 49.68 billion US dollars with a rise of 6.87 percent from the former defense budget while an amount of $16.91 billion out of total allocation was fixed for purchase of new weapons. (Raghuvanshi, India's New Defense Budget Falls Way Short for Modernization Plans, 2019) The defense budget for the fiscal year 2020-2021 has arisen to $73.65 billion. Despite having a sufficient rise in comparison with the previous year allocation, Indian analysts are not satisfied and consider the amount insufficient for military modernization as they believe that 90% of allocated funds shall be spent on existing liabilities as only 18.52 billion US Dollars have been allocated for weapon purchases. They believe that the allocated amount against the existing liabilities leaves no room for major purchases from the United States at least for 1 to 2 years. (Raghuvanshi, New Weapons Purchases Suffer under India's Latest Defense Budget, 2020) Amit Cowshish, a former financial adviser for acquisitions at the MoD, said "the military will likely continue to face the challenge of preventing defaults on contractual payments" while quoting a Senior officer from Indian Ministry of Defense, a report by defense news claims that "due to the shortage of funds, at least a dozen pending defense contracts will experience delays". (Raghuvanshi, New Weapons Purchases Suffer under India's Latest Defense Budget, 2020)

TABLE 5: INDIA'S SHORTAGE OF MODERNIZATION FUNDS

Fiscal Year	Committed Liabilities (Rs in Crore)	Modernization Budget (Rs in Crore)	Shortages (Rs in Crore)	Shortages (%)
2016-17	73553	62619	10934	15
2017-18	91382	68965	22417	25
2018-19	110044	73883	36161	33
2019-20	113667	80959	32708	29

Source: (Behera, 2020)

FIGURE 4: INDIA'S SHORTAGES OF MODERNIZATION FUND

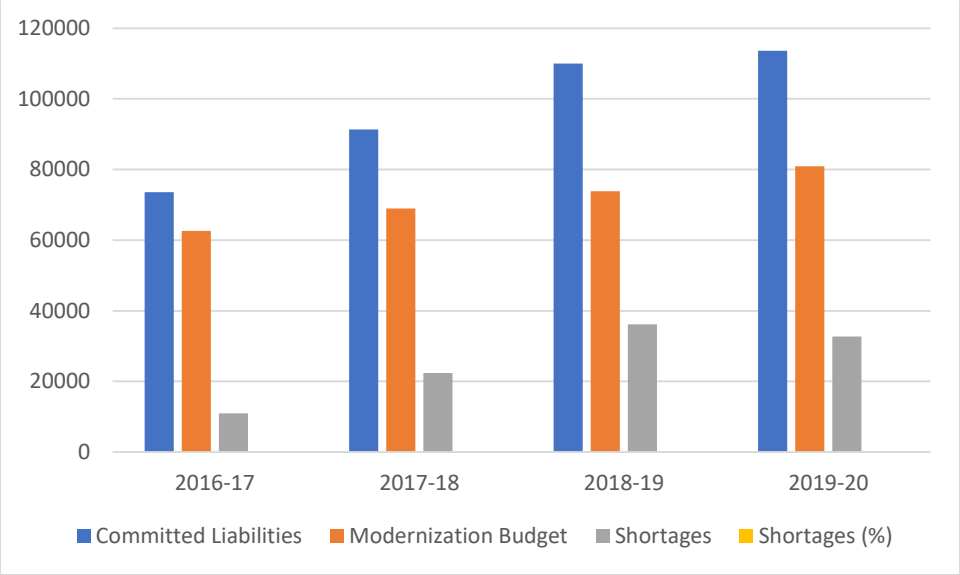
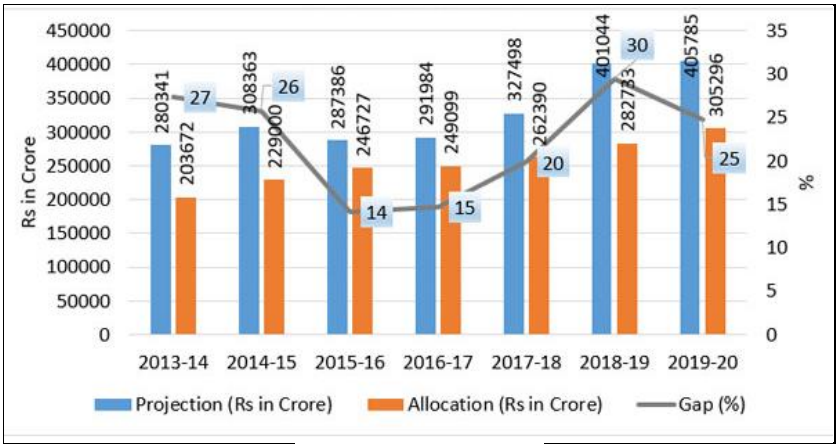


FIGURE 5: INDIA'S MOD'S RESOURCE PROJECTION & ALLOCATIONS



Source: (Behera, 2020)

In light of the military procurement programs amount cited above, it is noteworthy that the desired modernization cost is not compatible with the amount fixed in Inia's defense budget.

India's Economic Development: Pattern and Sustainability

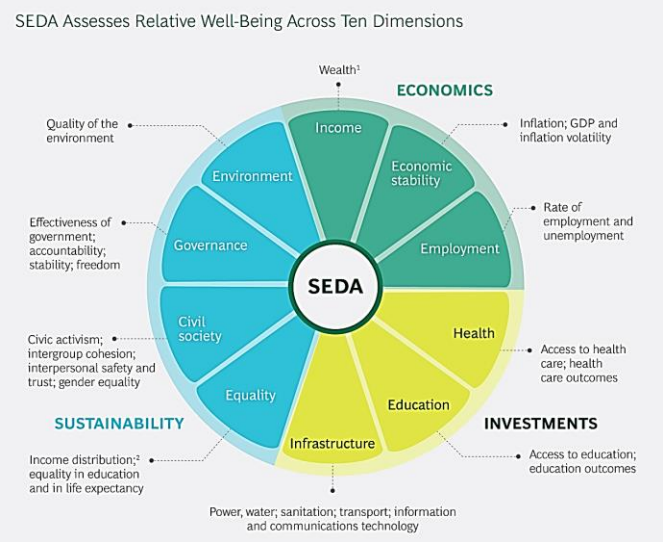
Economic development can be elaborate as the process of improving the living style of a nation and economic up gradation that can be measured through a structural transformation with the help of technological changes, industrial growth, and sustainability (Spacey, 2018)**.** There are a lot of measuring tools to assess the economic development such as infrastructure, education, justice, health care, human rights, safety, consumer protection, political stability, economical sustainability, cultural preservation, financial growth, market equilibrium, transportation equipment's, food quality, energy production, water, economic services, industrialization, sustainability reliance. National income, output, and spending are

the key elements to assess the economic development of any country whether it shows an increasing or decreasing trend of any economy. There is a number of economic indicators that help to extend the sustainability and development pattern (American Association of Individual Investors (AAII), 2020).

There are different types of economies in the world that can be categorized into the different economic systems; i.e. Traditional Economic System, Market Economic System, Command Economic System, and Mixed Economic System (Agarwal, 2017). Each type of economy has its own characteristics. Economic indicators can be classified into three types which consist of Leading, Lagging, and Coincident. The statistics of these indicators show the economic activity on the basis of predict value, performance criteria, and analysis. Leading indicators refer to predict the future of any economy and Lagging indicators confirm the prediction while Coincident indicators show the reality on the basis of data. These indices include Gross Domestic Product (GDP), Gross National Product (GNP), Net National Product (NNP), Net Domestic Product (NDP), National Income at Factor Cost (NIFC), Transfer Payments, Personal Income, Disposable Personal Income, Consumer Expenditure (CE), Consumer Price Index (CPI), Foreign Direct Investment (FDI), Investment Price (IP), Total Export (EX), and Total Imports (IMP) (Sullivan, 2020). It is very essential to know about the determinants of economic development for a particular country. These determinants are divided into economic and non-economic factors. The economic factors include capital formation, natural resources, the marketable surplus of agriculture, conditions in foreign trade and economic systems. In addition, non-economic factors contain human resources, technical information and general education, political stability, social organization, corruption and desire to develop (Chand, 2020).

Sustainable economic development assessment (SEDA) has considered a superior tool to assess performance for a country. The performance has investigated by individuals or groups based on the 152 countries. SEDA focuses on the current and past situation of the country rather than a subjective measure like happiness report. Alternatively, it emphasizes the econometric development tools i.e. GDP, CPI, CE, etc. Ten dimensions are acknowledged in SEDA that majorly summarized into the following three types: (i) Economics (ii) Investment (iii) Sustainability. A complete structure of SEDA with its ten dimensions divisions are presented in Fig. 6.

FIGURE 6: EVALUATION OF A COUNTRY WITH TEN DIMENSIONS OF SEDA



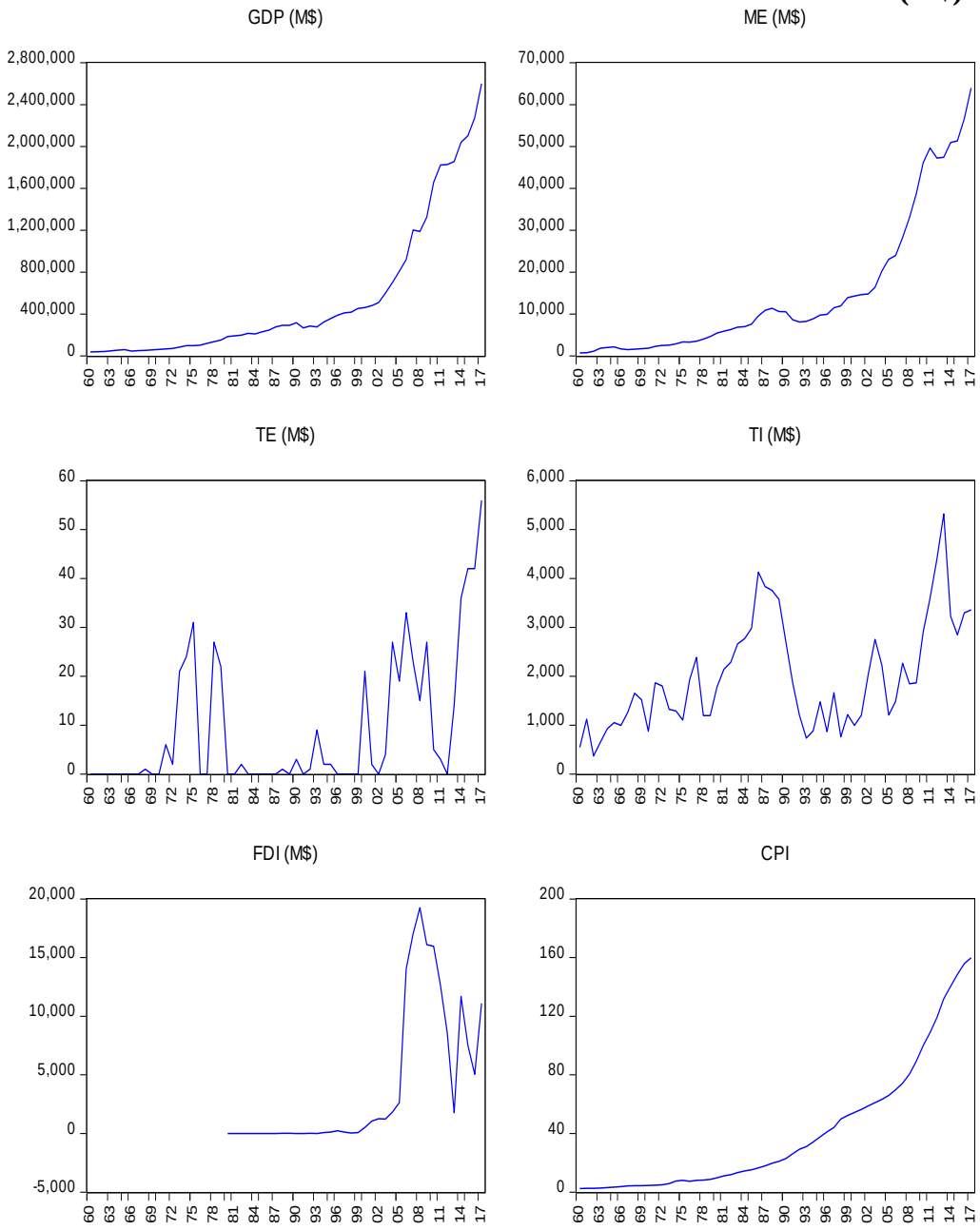
Source: (Boston Consulting Group, 2020)

Trends of Econometric Indicators in India

A number of eight econometric variables has chosen in this study to investigate the performance of India. For this purpose, time-series data of selected econometric variables have been obtained from SIPRI and World bank. The time step of these econometric parameters has given on yearly basis. The study duration consists of 48 years from 1960 to 2017. Moreover, the data has been prepared in a symmetric form and then shows in pictorial form with several forms like linear, scatter and histograms. The individual linear trend and histogram charts of each econometric variable can be seen in Fig. 7 and Fig. 8, respectively. It can be observed in Fig. 7 that the GDP of India from 1960 to 1975 gradually increasing and then showing a rapid increase from 1992 to 2017. The duration of 1976 to 1991 considered the gradual increase in GDP growth. The Fig. 7 also shows that ME of India increasing gradually till 1992 while afterward line looks swiftly increased. The trend of total imports and exports of India has been also mentioned in Fig. 7. The exports of goods in the selected country start from 1967 when the holiday plan has been implemented. Before this plan, there is no contribution of exports in the growth rate of India. Alternatively, the imports of goods from the periods of 1960 to 1978 and 1993 to 2010 show a steady change. On the other hand, the TI of India suddenly falls down and shows a declining trend during the period 1987 to 1993 and 2013 to 2016. India has allowed foreign investment from 1979 and the value of FDI sudden increase from 2004 to 2008. The least part of Fig. 7 depicts the linear trend of CPI for the selected country. The trend of this econometric variable shows the yearly-increasing in CPI and achieved promising growth but not meet that

point which has decided each year. Thus, the overall results of econometric variables depicted the wickedest situation of India.

FIGURE 7: LINEAR TREND OF ECONOMETRIC VARIABLES IN AMOUNT (M$)



The results of each econometric variable have presented in histogram form as shown in Fig. 8. Most studies have been selected some of the economic parameters among them to investigate the economic situation for a particular country. But this study has considered all of the parameters so that economy of India can be precisely evaluated. Additionally, a comparison of each econometric variable with GDP has been made and obtained results are presented in Fig. 9. A number of six segments in Fig.9 can be seen which indicate the relationship between GDP and other econometric variables. It can be observed that ME

and CPI of the selected country look very close for the regression line as compare to other econometric variables. The stronger relationship will be found if points meet the closet to the regression line. Alternatively, TI, TE and FDI graphs show enough divergence. Thus, ME looks more dependent on GDP in comparison to other econometric variables.

The econometric variables have analyzed further in terms of GDP. Linear and scatter plot of combined econometric variables can be observed in Fig. 10. Upon observation, the results depicted that the values of ME have close relation with GDP. In addition, ME has increased when the value of GDP swiftly increases as observed in Fig. 10.

FIGURE 8: INDIVIDUAL HISTOGRAM OF ECONOMETRIC VARIABLES IN AMOUNT (M$)

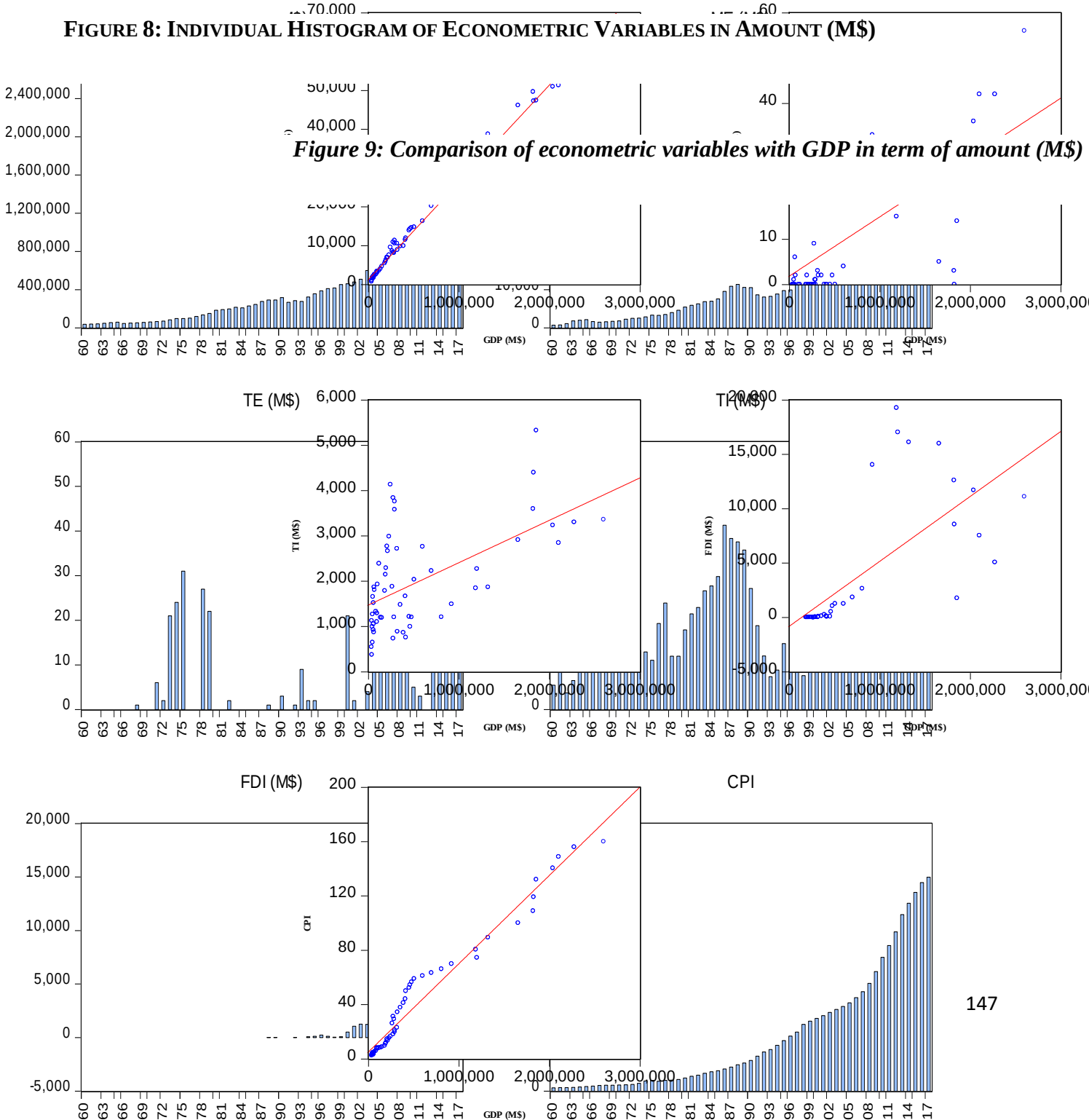
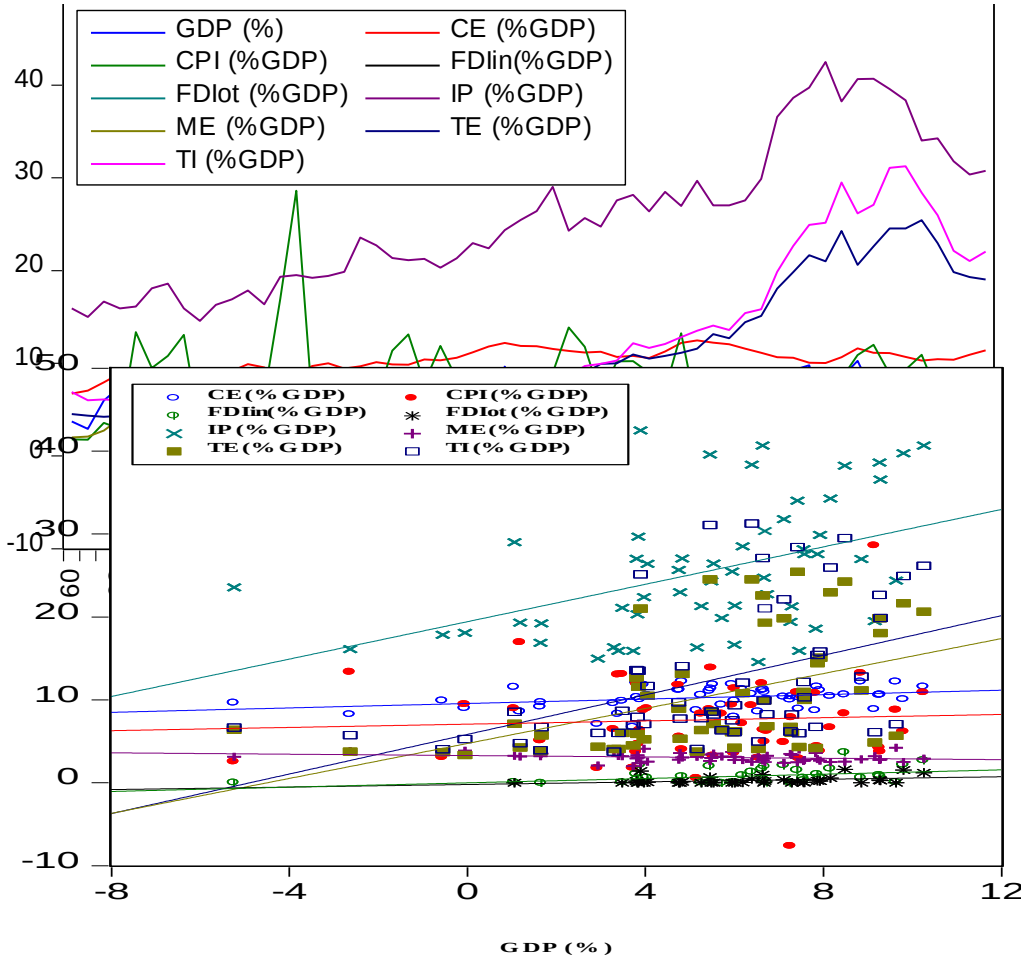


Figure 9: Comparison of econometric variables with GDP in term of amount (M$)

FIGURE 10: LINEAR AND SCATTER PLOT OF ECONOMETRIC VARIABLES IN TERM OF PERCENTAGE (%)



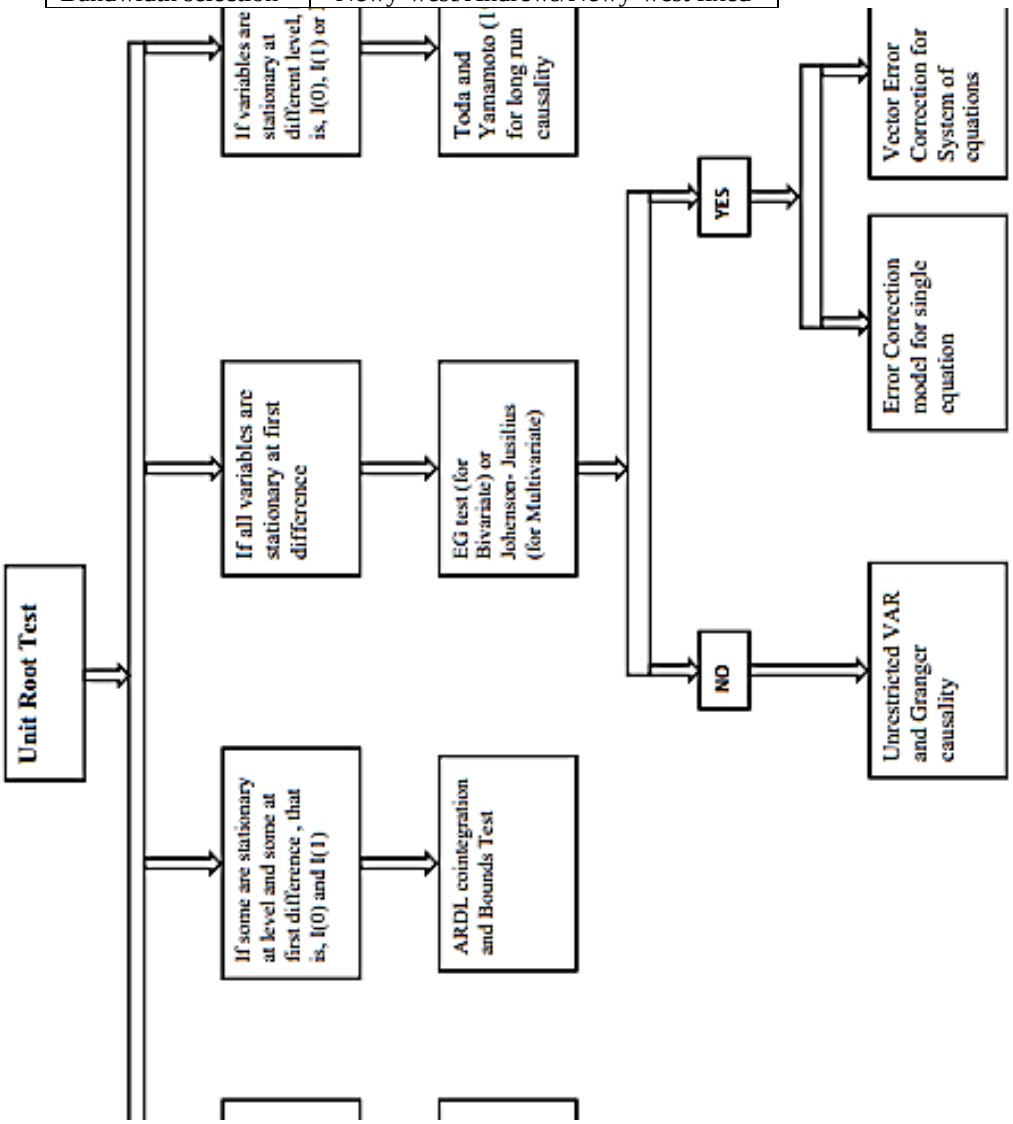
Military Procurement and Economic Sustainability: Compatibility Analysis & Pragmatism

Before performing the analysis, the data set has been prepared and analyzed. The erroneous and suspected observations in the data set cause an adverse effect on the results. Therefore, it must be compulsory to ensure that correct and complete observations have been collected. The unit root test has been applied using E-views software to determine the stationary and non-stationary nature of the data set before applying the Granger causality test and forecasted models. A step-wise procedure of unit root test for the current study is elaborated as followed: (1) Selection of unit root type test among six aforementioned tests (2) Select the unit root test at level, 1st difference and 2nd difference (3) Choose the exogenous variables. The current study utilized the ADF unit root test to check either time series is stationary or non-stationary. In addition, the unit root test has applied at the level stage. The essential parameters for the unit root test are given in Table 6. The general procedure of the unit root test can be seen in Fig. 11. The results of the unit root test have been depicted in Fig. 12 and 13.

TABLE 6: PARAMETERS USED TO DEVELOP THE ARIMA MODEL

Parameters	Applied functions

Test stage	Level
Test equation	Individual intercept
Lag length	Schwarz info criteria
Kernel method	Barlett/Parzen/Quadratic spectral
Bandwidth selection	Newy-west/Andrews/Newy-west fixed



Discerption of the unit root test

[**Source: (Min B.Shrestha, 2018)**]

FIGURE 12: RESULTS OF UNIT ROOT TEST FOR TIME SERIES DATA

Group unit root test: Summary
Series: GDP____, CE___GDP_, CPI___GDP_, FDIIN__GDP_, FDIOT___GDP_, IP___GDP_, ME___GDP_, TE___GDP_, TI___GDP_
Date: 03/16/19 Time: 12:54
Sample: 1960 2017
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 2
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-0.82041	0.2060	9	473
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.49111	0.0002	9	473
ADF - Fisher Chi-square	66.5641	0.0000	9	473
PP - Fisher Chi-square	63.9829	0.0000	9	477

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Group unit root test: Summary
Series: GDP____, CE___GDP_, CPI___GDP_, FDIIN__GDP_, FDIOT___GDP_, IP___GDP_, ME___GDP_, TE___GDP_, TI___GDP_
Date: 03/16/19 Time: 12:56
Sample: 1960 2017
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 2
Newey-West automatic bandwidth selection and Quadratic Spectral kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.06539	0.1433	9	473
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.49111	0.0002	9	473
ADF - Fisher Chi-square	66.5641	0.0000	9	473
PP - Fisher Chi-square	64.3669	0.0000	9	477

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Group unit root test: Summary
Series: GDP____, CE___GDP_, CPI___GDP_, FDIIN__GDP_, FDIOT___GDP_, IP___GDP_, ME___GDP_, TE___GDP_, TI___GDP_
Date: 03/16/19 Time: 12:59
Sample: 1960 2017
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 2
Newey-West fixed bandwidth and Quadratic Spectral kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-0.55402	0.2898	9	473
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.49111	0.0002	9	473
ADF - Fisher Chi-square	66.5641	0.0000	9	473
PP - Fisher Chi-square	66.0127	0.0000	9	477

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Group unit root test: Summary
Series: GDP____, CE___GDP_, CPI___GDP_, FDIIN__GDP_, FDIOT GDP , IP GDP , ME GDP , TE GDP , TI GDP
Date: 03/16/19 Time: 12:56
Sample: 1960 2017
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 2
Newey-West automatic bandwidth selection and Parzen kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.12768	0.1297	9	473
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.49111	0.0002	9	473
ADF - Fisher Chi-square	66.5641	0.0000	9	473
PP - Fisher Chi-square	65.3105	0.0000	9	477

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Group unit root test: Summary
Series: GDP____, CE___GDP_, CPI___GDP_, FDIIN__GDP_, FDIOT___GDP_, IP___GDP_, ME___GDP_, TE___GDP_, TI___GDP_
Date: 03/16/19 Time: 12:58
Sample: 1960 2017
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 2
Andrews automatic bandwidth selection and Quadratic Spectral kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-0.46946	0.3194	9	473
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.49111	0.0002	9	473
ADF - Fisher Chi-square	66.5641	0.0000	9	473
PP - Fisher Chi-square	66.3436	0.0000	9	477

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Group unit root test: Summary
Series: GDP____, CE___GDP_, CPI___GDP_, FDIIN__GDP_, FDIOT___GDP_, IP___GDP_, ME___GDP_, TE___GDP_, TI___GDP_
Date: 03/16/19 Time: 13:00
Sample: 1960 2017
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 2
Andrews automatic bandwidth selection and Parzen kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-0.63402	0.2630	9	473
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.49111	0.0002	9	473
ADF - Fisher Chi-square	66.5641	0.0000	9	473
PP - Fisher Chi-square	65.4452	0.0000	9	477

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

FIGURE 13 RESULTS OF UNIT ROOT TEST AT DIFFERENT KERNEL FUNCTIONS

Group unit root test: Summary
Series: GDP____, CE___GDP_, CPI___GDP_, FDIIN__GDP_, FDIOT___GDP_, IP___GDP_, ME___GDP_, TE___GDP_, TI___GDP_
Date: 03/16/19 Time: 13:02
Sample: 1960 2017
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 2
Newey-West fixed bandwidth and Parzen kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-0.51642	0.3028	9	473
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.49111	0.0002	9	473
ADF - Fisher Chi-square	66.5641	0.0000	9	473
PP - Fisher Chi-square	65.5099	0.0000	9	477

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Group unit root test: Summary
Series: GDP____, CE___GDP_, CPI___GDP_, FDIIN__GDP_, FDIOT___GDP_, IP___GDP_, ME___GDP_, TE___GDP_, TI___GDP_
Date: 03/16/19 Time: 13:05
Sample: 1960 2017
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 2
Andrews automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-0.68077	0.2480	9	473
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.49111	0.0002	9	473
ADF - Fisher Chi-square	66.5641	0.0000	9	473
PP - Fisher Chi-square	65.8825	0.0000	9	477

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Group unit root test: Summary
Series: GDP____, CE___GDP_, CPI___GDP_, FDIIN__GDP_, FDIOT___GDP_, IP___GDP_, ME___GDP_, TE___GDP_, TI___GDP_
Date: 03/16/19 Time: 13:06
Sample: 1960 2017
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 2
Newey-West fixed bandwidth and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-0.54789	0.2919	9	473
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.49111	0.0002	9	473
ADF - Fisher Chi-square	66.5641	0.0000	9	473
PP - Fisher Chi-square	65.3180	0.0000	9	477

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Results of the Granger Causality Test

An essential step in order to apply the Granger causality test has to determine optimal lag value. This lag has responsible to demonstrate relationship (either positive or negative) between given variables. The pairwise granger causality has employed in the current study using the selected data set. The method of determining lag value in the ARIMA model always be a hit and trial process. This process occurs recursively until the optimal lag has generated. In this study, the results from 2 to 11 lag values have been evaluated to find optimal lag value. Additionally, this test has shown error upon increasing the lag value from 11. An error of "positive or non-negative argument to function expected" has appeared. The indices analyzed for best lag selection have F statistics value (F value) and probability value (P-value). The results of F and P values for all the selected 11 lags are presented in Table 8. The first column of Table 8 represented the "granger cause" relationship between variables. For example, CE-GDP means that CE

does not granger cause GDP, either this hypothesis is accepted or rejected based on F and P values. Likewise, a total of 16 relationships have developed in this study which is presented in Table 8. The results at lag value "2" can be seen good among all the other selected lag values. A complete result of lag value 2 by employing the Granger causality test has mentioned in Fig. 14.

FIGURE 14: RESULTS OF GRANGER CAUSALITY TEST AT MINIMUM LAG

Pairwise Granger Causality Tests
Date: 03/16/19 Time: 12:45
Sample: 1960 2017
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
CE___GDP_ does not Granger Cause GDP____	55	1.38713	0.2592
GDP____ does not Granger Cause CE___GDP_		3.34858	0.0432
CPI___GDP_ does not Granger Cause GDP____	55	2.81818	0.0692
GDP____ does not Granger Cause CPI___GDP_		3.32003	0.0443
FDIIN__GDP_ does not Granger Cause GDP____	40	3.00474	0.0625
GDP____ does not Granger Cause FDIIN__GDP_		2.62212	0.0869
FDIOT___GDP_ does not Granger Cause GDP____	35	1.50825	0.2376
GDP____ does not Granger Cause FDIOT___GDP_		2.07451	0.1433
IP___GDP_ does not Granger Cause GDP____	55	8.22749	0.0008
GDP____ does not Granger Cause IP___GDP_		2.67104	0.0790
ME___GDP_ does not Granger Cause GDP____	55	4.06340	0.0232
GDP____ does not Granger Cause ME___GDP_		3.98422	0.0248
TE___GDP_ does not Granger Cause GDP____	55	6.59266	0.0029
GDP____ does not Granger Cause TE___GDP_		2.44680	0.0969
TI___GDP_ does not Granger Cause GDP____	55	6.18716	0.0040
GDP____ does not Granger Cause TI___GDP_		0.89674	0.4144

It can be observed in Fig. 14 that the null hypothesis of all econometric variables has generated by applying the Granger causality test. This null hypothesis will either be accepted or rejected on the basis of probability (P) value. For example, 1st row in Fig. 14 stated as CE does not granger cause GDP, either this statement is accepted or rejected based on the P-value. It can be seen in Fig.14 that P-value against this null hypothesis is 0.2592 (25.92%). If the P-value is greater than five percent (>5%), the null hypothesis can be accepted. In addition, the alternative hypothesis will be accepted if less than five percent (<5%) has generated as in the case of IP, ME and TE. The P values of these aforesaid variables can be observed in Fig. 14. To the best knowledge of authors, results obtained at minimum lag value have always considered best. The results of all lag values observed in Table 7 also endorse the preceding proclamation which indicates the best results at a minimum lag.

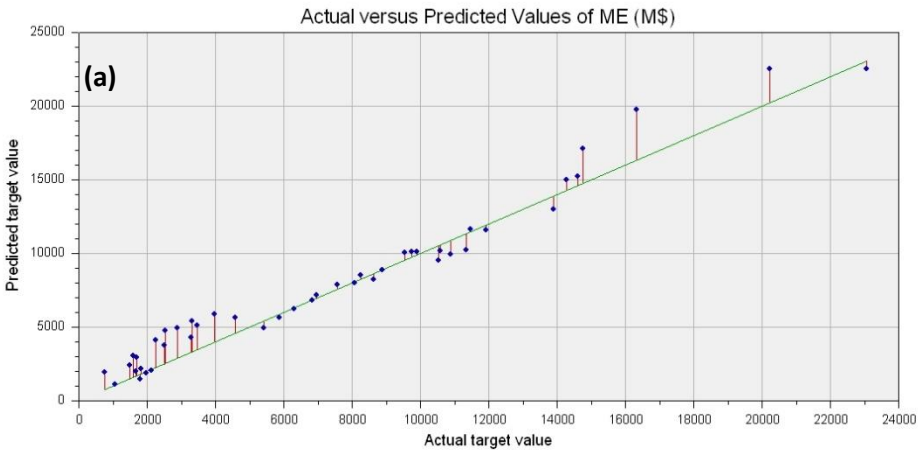
Results of MLP Model

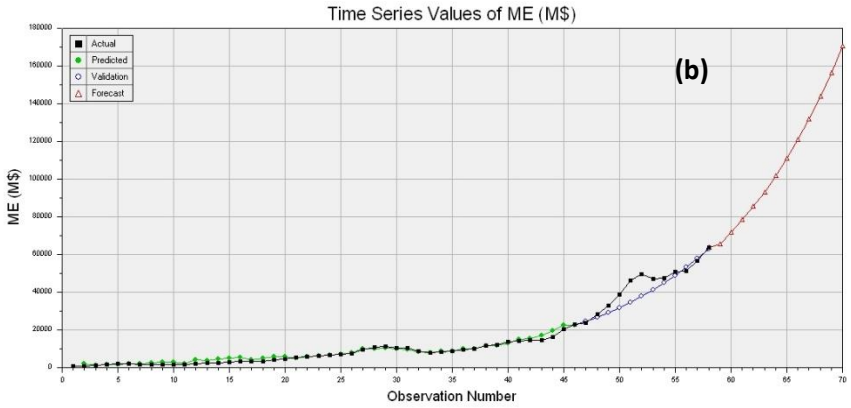
The MLP model has been applied to selected time series data. The results obtained through the MLP model can be seen in Figures 15. Fig. 15 (a) represented the actual and predicted values for the given data set. It can be observed in Fig. 15 (a) that predicted values from the MLP model have trailing well with the actual values. The predicted, validated and forecasted results obtained by employing the MLP model can also be seen in Fig. 15 (b). However, the predicted values from the MLP model are coinciding well with

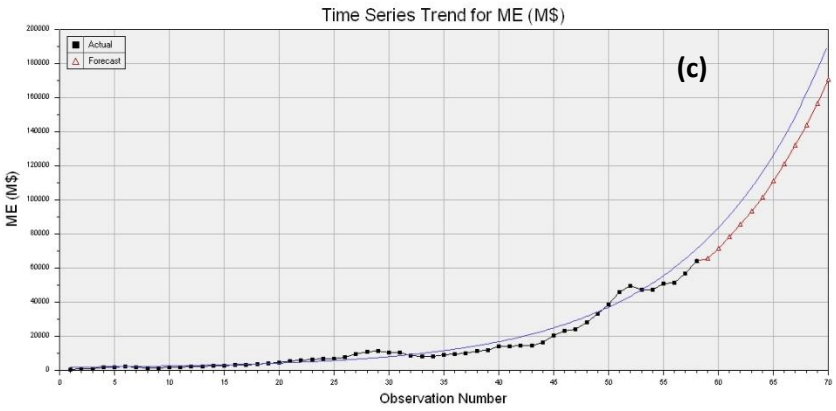
actual values while the MLP model has also the capability to validated these results. After validation, the MLP model has shown forecasted Indian military expenditures which can be seen in Fig 15 (c). Fig. 15 (c) clearly indicates the trend line of Indian military expenditures. It can be perceived from Fig. 15 (c) that Indian military expenditures increased smoothly in the start section (0-25) and follow the trend line. But after 25 observations, there have been abrupt changes observed up to 45 which do not sprawl well with the trend line. Additionally, forecasted military expenditures from 57 to 70 show too much deviation from the trend line. The deviation from the trend line indicates that the Indian military will have less amount to be spent and unable to fulfill their military procurements. The divergence in both lines can be observed in Fig.15 (c).

Parameters	Obs	lag 2		lag 3		lag 4		lag 5		lag 6		lag 7		lag 8		lag 9		lag 10		lag 11	
		F index	P Value	F index	P Value	F index	P Value	F index	P Value	F index	P Value	F index	P Value	F index	P Value	F index	P Value	F index	P Value	F index	P Value
CE-GDP	55	1.387	0.259	4.052	0.012	5.233	0.002	3.199	0.016	2.524	0.037	2.433	0.038	2.226	0.052	2.498	0.030	2.240	0.048	2.115	0.071
GDP-CE	55	3.349	0.043	2.470	0.073	2.103	0.097	1.823	0.130	1.056	0.406	0.885	0.529	0.724	0.669	0.818	0.604	0.798	0.632	0.706	0.721
CPI-GDP	55	2.818	0.069	1.979	0.130	1.899	0.127	2.653	0.036	1.854	0.1145.	0.997	0.450	0.987	0.464	1.041	0.432	1.459	0.211	1.428	0.226
GDP-CPI	55	3.320	0.044	2.248	0.095	1.378	0.257	2.211	0.072	1.785	0.128	1.818	0.115	1.423	0.225	1.230	0.311	1.719	0.129	2.629	0.024
FDIIN-GDP	40	3.005	0.063	1.118	0.356	-1.253	0..3109	0.692	0.634	0.439	0.845	0.446	0.8615.	0.248	0.975	0.405	0.912	0.475	0.874	0.803	0.642
GDP-FDIIN	40	2.622	0.087	3.117	0.114	2.345	0.078	2.131	0.003	2.915	0.029	2.881	0.030	2.469	0.056	1.767	0.164	1.009	0.490	0.464	0.882
FDIOT-GDP	55	1.508	0.238	1.241	0.314	0.886	0.480	1.116	0.412	1.112	0.39.36	0.851	0.564	0.728	0.666	0.769	0.649	0.594	0.778	1.390	0.439
GDP-FDIOT	55	2.070	0.143	1.946	0.146	-1.800	0.162	1.350	0.282	1.090	0.405	1.109	0.406	0.986	0.491	0.780	0.641	0.713	0.697	0.377	0.900
IP-GDP	55	8.227	0.001	5.312	0.003	7.417	0.000	3.84	0.006	2.348	0.050	1.692	0.140	1.158	0.354	1.668	0.143	1.458	0.211	0.842	0.603
GDP-IP	55	2.671	0.079	2.285	0.091	1.953	0.119	2.22	0.071	2.450	0.042	2.764	0.021	3.553	0.005	3.197	0.008	4.117	0.002	3.813	0.003
ME-GDP	55	4.063	0.023	2.421	0.078	1.738	0.159	0.925	0.475	1.993	0.001	1.604	0.167	1.382	0.242	1.813	0.109	1.834	0.104	1.511	0.194
GDP-ME	55	3.984	0.025	3.078	0.036	2.457	0.059	2.118	0.088	1.319	0.273	1.472	0.210	1.404	0.108	1.426	0.223	1.239	0.314	1.352	0.260
TE-GDP	55	6.593	0.003	3.415	0.024	3.937	0.008	1.963	0.105	1.163	0.346	0.730	0.648	0.619	0.756	0.741	0.668	0.791	0.638	0.630	0.785
GDP-TE	55	2.447	0.097	1.370	0.264	0.927	0.457	0.735	0.602	1.029	0.422	1.291	0.283	1.564	0.175	1.322	0.268	1.166	0.356	0.763	0.671
TI-GDP	55	6.187	0.004	3.316	0.028	3.787	0.010	1.985	0.101	1.293	0.284	0.720	0.656	0.644	0.735	0.591	0.793	0.511	0.873	0.843	0.601
GDP-TI	55	0.897	0.414	0.850	0.474	0.536	0.640	0.480	0.789	0.746	0.616	0.754	0.629	0.796	0.611	0.755	0.657	0.633	0.772	0.746	0.685

FIGURE 15: RESULTS OF MLP MODEL







Results of ARIMA Model

The ARIMA model has been applied to time series data from 1960 to 2000. The Indian military expenditure has obtained in terms of percentage of GDP. The forecasted values using the ARIMA model can be seen in Fig. 16. A total number of 25 ARMA model has been estimated and (2, 0) (0,0) automatically selected based on AIC criteria. The red line shows the actual value of military expenditure while the blue line in Fig.16 indicates forecasted value. The forecasted ME shows a sustainable linear pattern while actual ME has a low value. This may be due to the fact that ME has accounted for only one parameter and no other economic parameter has been applied. Surprisingly, ME values have declined without introducing exogenous parameters.

FIGURE 16: ARIMA MODEL FORECASTING USING GDP PARAMETER

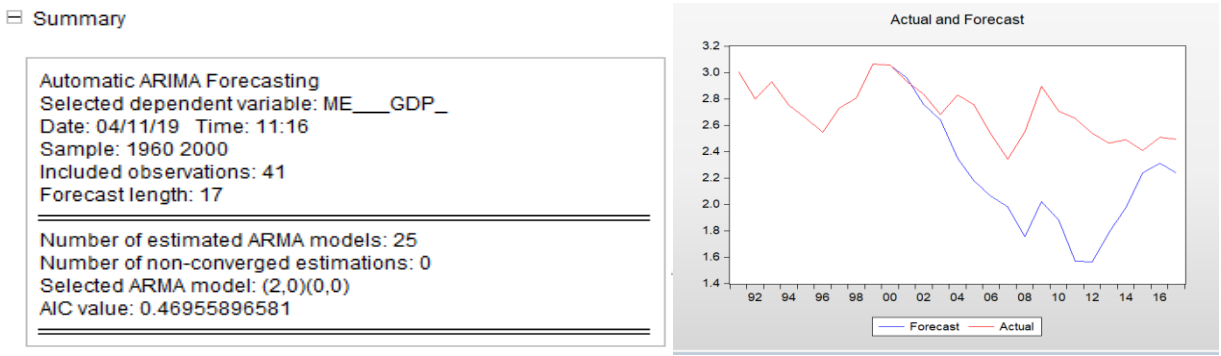


Fig. 17 shows

the forecasting results of the ARIMA model when GDP introduced as an exogenous variable. It can be observed that the forecasted value of ME coincides well with actual value. In the case of GDP as an exogenous variable, the ARMA model (2,0) (0,0) has considered best which identified by automatic functions of the ARIMA model based on AIC value. It can be observed in Fig. 17 that the actual values of ME look superior to forecasted value. The influence of GDP on ME can be observed by investigating the difference in trend lines between Fig. 16 and 17. The forecasted line depicts lower costs need to fulfill the military expenditure of India. However, actual values present a higher amount that has been allocated to fulfill the need. Therefore, it becomes more important to investigate further ME by introducing other econometric variables as exogenous variables.

When inputs of GDP and total imports (TI) introduced in the ARIMA model as exogenous parameters, actual values look closer to forecasted. The actual values look inferior to the forecasted value which can be seen in Fig. 18. A number of 25 ARMA models have been developed when applying to time series data from 1960 to 2000. The 17 values have forecasted by employing the ARIMA model. The ARMA model (2,0) (0,0) has selected the best-fitted model with an AIC value of 0.5062 as perceived from Fig. 18.

FIGURE 17: RESULTS OF ARIMA FORECASTING USING GDP AND TI

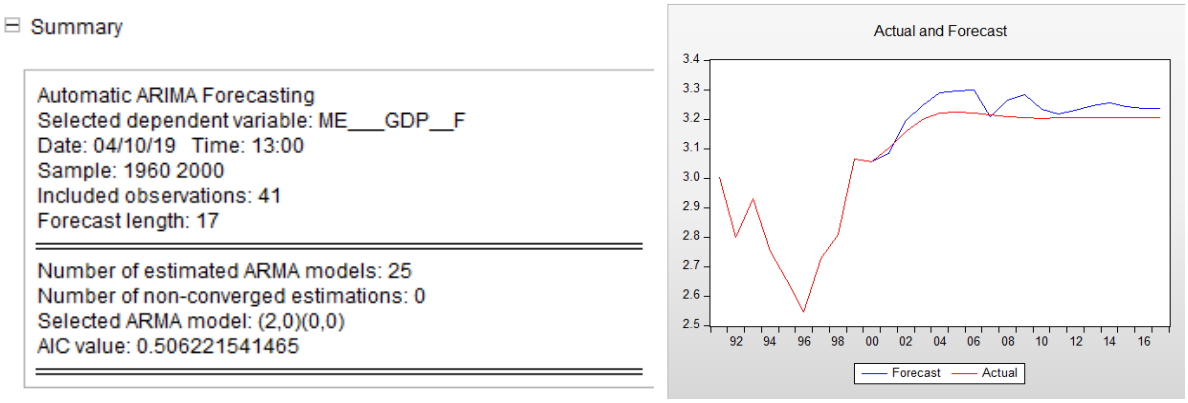
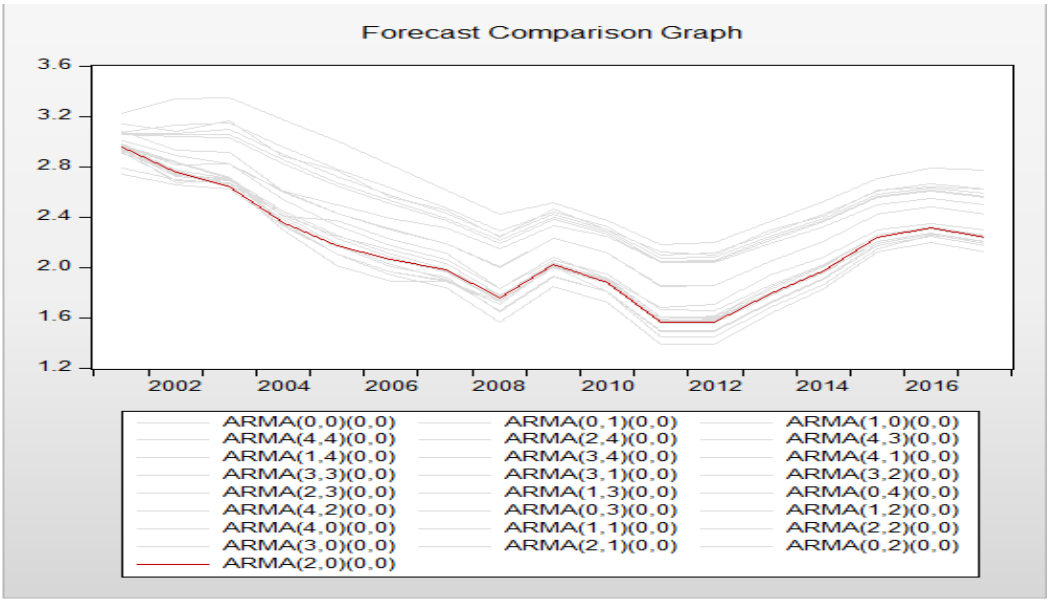


FIGURE 18: DEVELOPMENT OF 25 ARMA MODELS USING GDP AND TI



Here, it should be noted that results would be different If the number of variables has increased. Thus, the ARIMA model has been employed on econometric data along with GDP, TI, $FDI_{in,}$ and FDI_{out} as exogenous variables. The results achieved from the ARIMA model is presented in Fig. 19. It can be observed from Fig. 19 that forecasted values suddenly decline and too much deviation has been found from actual values. A number of 25 ARMA models have been generated with the use of these econometric variables. The ARMA model of (2,3) (0,0) has selected the best-fitted model in this case. The results of the 25 models have obtained and presented in Fig. 20. The best model has highlighted with the red line and has -0.2130 of AIC value.

FIGURE 19: RESULTS OF ARIMA FORECASTING USING GDP, TI, FDIIN, FDIOUT

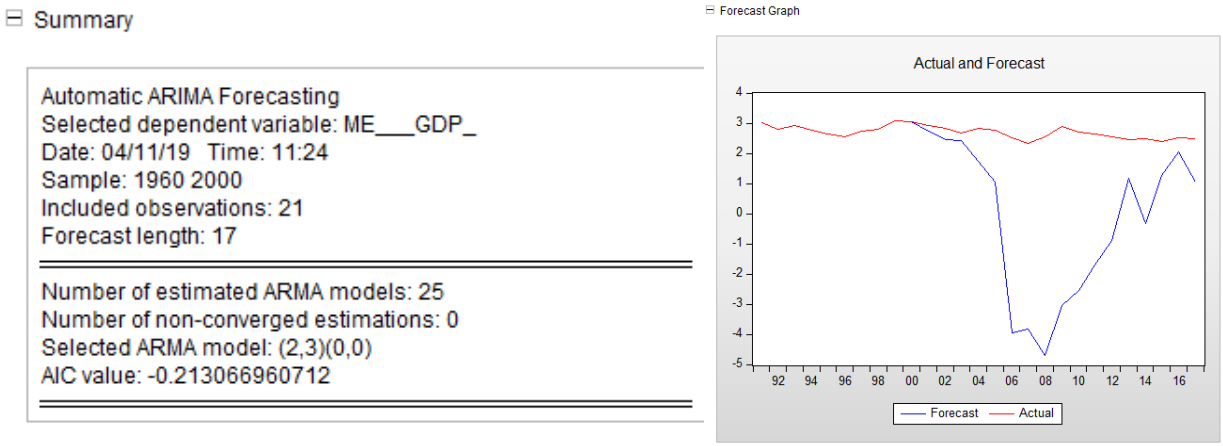
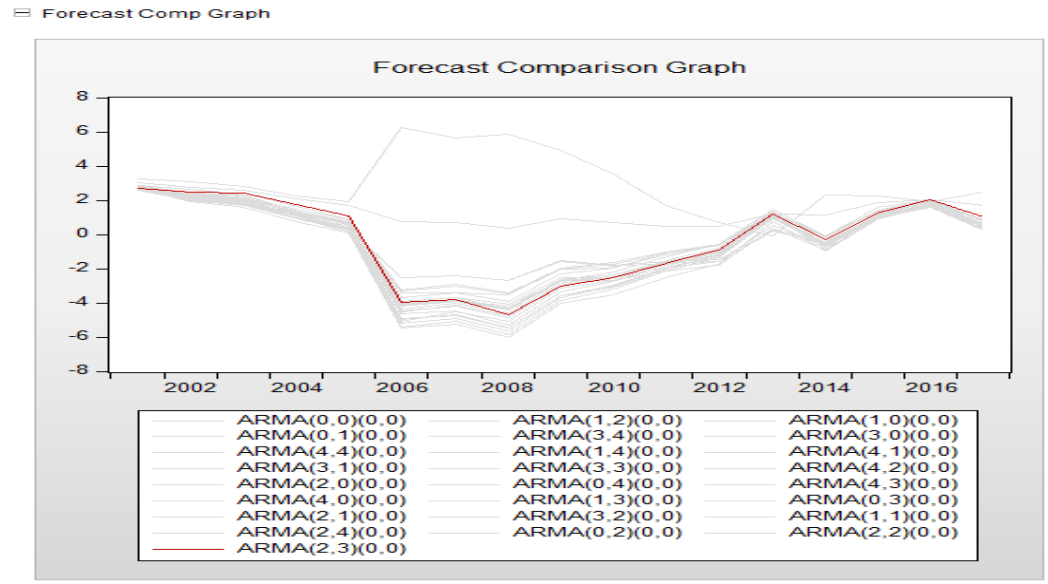


FIGURE 20: DEVELOPMENT OF 25 ARMA MODELS USING GDP, TI, FDIIN, FDIOUT



Likewise, Fig. 21 represents actual and forecasted values by considering econometric variables of GDP, TI CPI, and CE as exogenous variables. The ARMA model with (3,4) (0,0) has considered best among all the developed models with AIC value of -0.430 as observed in Fig. 22.

FIGURE 21: RESULTS OF ARIMA FORECASTING USING GDP, TI, CPI AND CE

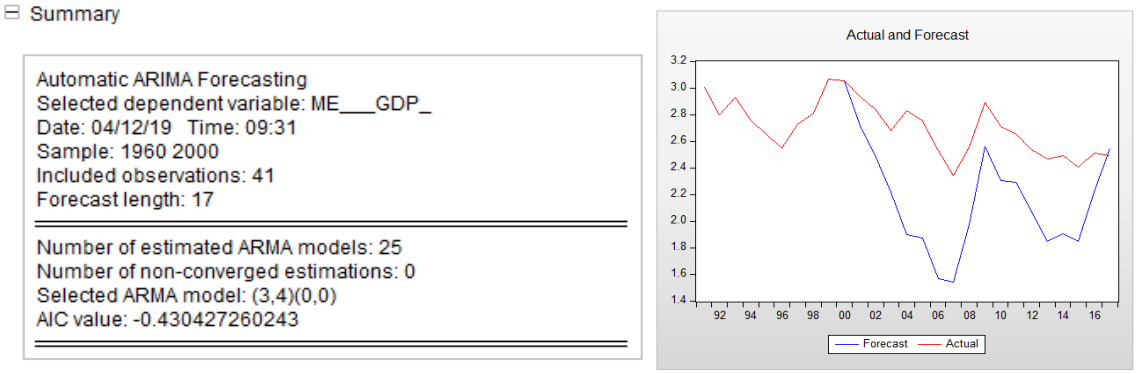
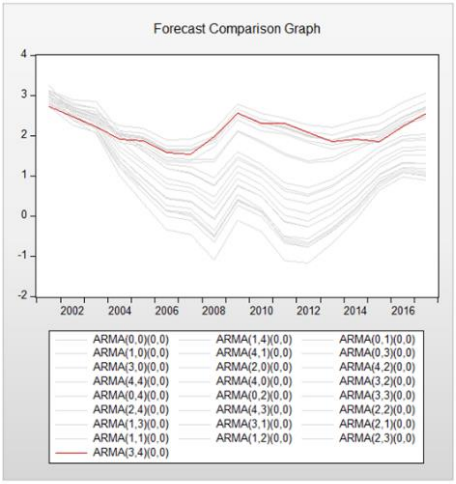


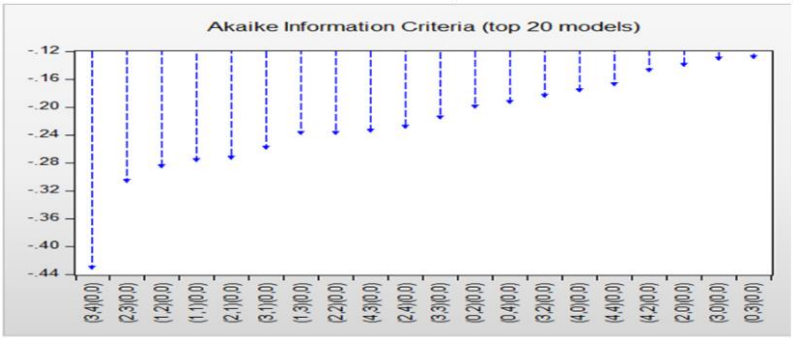
FIGURE 22: DEVELOPMENT OF 25 ARMA MODELS USING GDP, TI, CPI AND CE



ARMA Criteria Table

Model Selection Criteria Table
Dependent Variable: ME___GDP_
Date: 04/12/19 Time: 09:31
Sample: 1960 2000
Included observations: 41

Model	LogL	AIC*	BIC	HQ
(3,4)(0,0)	21.823759	-0.430427	0.112900	-0.232577
(2,3)(0,0)	17.286349	-0.306651	0.153088	-0.139240
(1,2)(0,0)	14.850740	-0.285402	0.090748	-0.148429
(1,1)(0,0)	13.657686	-0.275985	0.058371	-0.154231
(2,1)(0,0)	14.594587	-0.272907	0.103243	-0.135934
(3,1)(0,0)	15.285495	-0.257829	0.160115	-0.105637
(1,3)(0,0)	14.868819	-0.237503	0.180441	-0.085311
(2,2)(0,0)	14.858752	-0.237012	0.180932	-0.084820
(4,3)(0,0)	17.798820	-0.234089	0.309239	-0.036239
(2,4)(0,0)	16.674770	-0.228038	0.273496	-0.045407
(3,3)(0,0)	16.415574	-0.215394	0.286139	-0.032763
(0,2)(0,0)	12.081516	-0.199098	0.135257	-0.077344
(0,4)(0,0)	13.954802	-0.192917	0.225027	-0.040725
(3,2)(0,0)	14.770173	-0.183911	0.275828	-0.016499
(4,0)(0,0)	13.615541	-0.176368	0.241577	-0.024176
(4,4)(0,0)	17.426894	-0.167166	0.417957	0.045904
(4,2)(0,0)	15.006923	-0.146679	0.354854	0.035952
(2,0)(0,0)	10.867725	-0.139889	0.194466	-0.018135
(3,0)(0,0)	11.678404	-0.130654	0.245496	0.006319
(0,3)(0,0)	11.641699	-0.128863	0.247287	0.008110
(4,1)(0,0)	13.621732	-0.127889	0.331849	0.039522
(1,0)(0,0)	7.678946	-0.033119	0.259442	0.073415
(0,1)(0,0)	6.710836	0.014106	0.306667	0.120640
(1,4)(0,0)	-2.857246	0.675963	1.135702	0.843375
(0,0)(0,0)	-9.515161	0.756837	1.007604	0.848152



Conclusion

This study has applied econometric and neural network models simultaneously in order to evaluate India's military procurements programs with several economic indicators. The time-series data from 1960 to 2017 of India has been analyzed. The time step of study data consisted on yearly basis. A number of seven economic indicators (GDP, CPI, TI, TE, IP, CE, FDI) have been assessed in order to check the economic influence of India's military procurements programs. The granger causality test has been applied to determine the relationship of Indian's military procurements programs with each econometric parameter. This study also demonstrates the trend in the fulfillment of Indian military procurements with other countries. The reliability of arms procurement deals by India with other countries has been added as questionable entities. The obtained results of Indian military procurements with the individual and combined effect of economic indicators demonstrate the economic unsustainability of its defense procurement. The results indicate that India's economic capacity is not capable of meeting the cost of its procurement programs. Therefore, it will be perilous for the countries that are getting involved in procurement programs with India.

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