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Empirical Analysis of the Effect of Foreign Trade in Computer and Communication Services on Economic Growth in India

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Abstract: The Information and Communication Technology industry as well as the Digital Market are significant economic drivers in India, accounting for nearly 13% of GDP. Computer, communication, and further services are essential elements of commercial services, and this research will focus on measuring its role in the country's development. The component of computer and communication lacks a focus in the research area despite its importance in pushing the nation further. This research is an effort to meet this research space. In the research, the export and import of computer communication and other services act as explanatory variables and GDP act as the explained variable. The impact of the control variable own controlled variable will be measured through linear regression analysis. After applying the required tools on the framed data set, the analysis can be interpreted that the independent variables are significantly impacting the dependent variable. Hence, it can be said that foreign trade in computer communication and other services influences the nation's growth prospects in a statistically significant manner. Further, if we look at the calculation of both endogenous variables individually, imports have a statistically substantial influence on the progress, whereas exports impact is not statistically significant.

Keywords: Economic Growth, International Trade, Computer industry, Communication industry

1. Introduction

In the following half of the 1990s, businesses in the commercial services segment accounted for most economic growth, with annual growth rates exceeding 5% for many years in a row [1]. Since 2001, companies have developed at a snail's pace, and in the first half of 2003, their contribution to the economy was even negative for the first time in more than two decades [2]. However, today commercial services play a significant role in catalysing the nation's growth [3]. Computer trade, communication, and other services are essential elements of commercial services, and this research will focus on measuring its role in the country's development [4]. The component of computer and communication lacks a focus in the research area despite its importance in pushing the nation further [5]. This research is an endeavour to fill this research space.

Global telecoms, postal and delivery company service, digital data, news-related assistance operations among residents and foreign residents, building and royalties/license fees and incidental personal and commercial services are all included in the indicator that World Bank used. Individual, amusement and leisure services are incorporated in the categorization. [6].

The Information and Communication Technology industry and the Digital Market are significant financial catalysts in India, accounting for nearly 13% of GDP [7]. India's digital financial system produces around $200 billion yearly via IT and business process management (IT-BPM), information technology-assisted services (ITeS), virtual-commerce, integrated circuit technology production, virtual payments, and digital communication customer services [8]. By 2025, India aspires to have a $1 trillion e-economy and a $5 trillion GDP [9]. Researchers projects that India's IT investment would grow by 6% to $81.9 billion in 2021 [10]. While the coronavirus epidemic has harmed India's e-revolution, businesses are rearranging their IT tactics, controlling functioning

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expenses, automating processes, and deploying innovative technologies to achieve more efficiency [11]. These initiatives are made possible by developing computerised practice mechanisation, big data, artificial intellect, blockchain, cloud computing, the IOT (Internet of things), machine learning, cybersecurity, and augmented/virtual reality [12].

In 2021, IT investment will rise again as Chief Information Officer-CIOs begin framing IT as a "survival required" approach rather than merely a growth driver. With the exception of data centre systems, which are expected to expand at a rate of 8.3 percent, all categories will see an increase in investment [13]. There will be a new dawn in 2021 for the "Digital India" objective as more and more businesses across all sectors begin to invest in IT [14]. Since these digital advances have been so successful, there has been a resurgence in IT investment [15]. For IT investment in 2021, a primary goal is to transform organisations into truly digital businesses [16]. CIOs in India are planning to spend more money on IT in order to speed up the country's digitalization ambitions [17]. Investment in technologies like advanced analytics, access control, encryption software and cloud-based desktops is projected to rise in the next year. RPA, artificial intelligence, machine learning, and digital commerce will all see a rise in investment as a result of this trend.

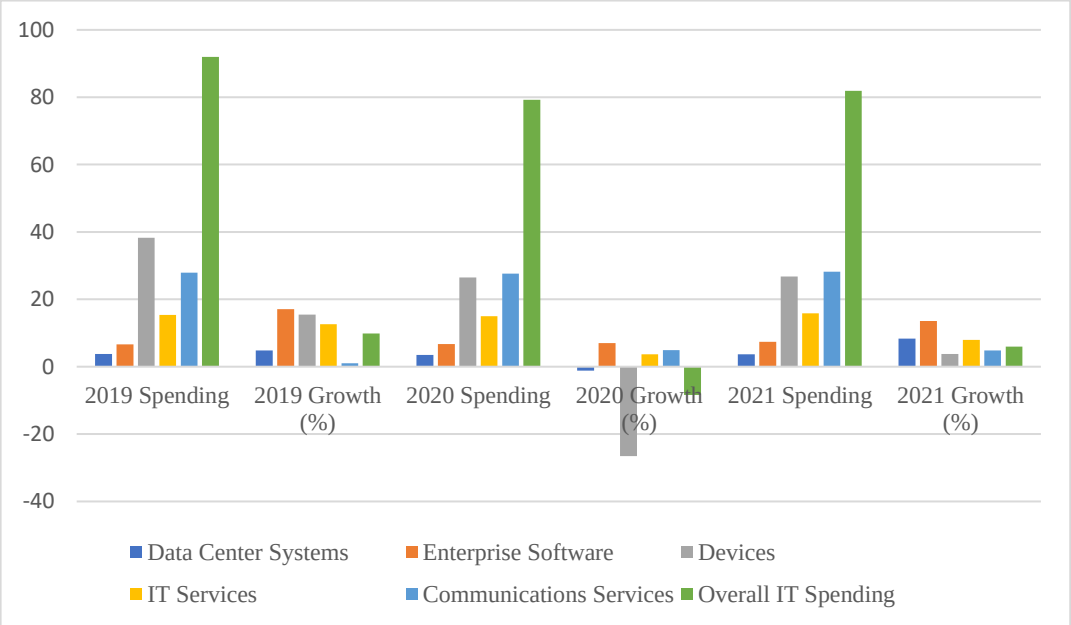

Figure 1. Year-wise Comparison of growth and spending of computer and communication. Source- Compiled by author from various published reports by the government of India

2. Literature Review

Commercial service exports (Y) are a dependent variable of the model; the three explanatory variables are the percentage of high-tech exports in manufactured exports, researchers (per million) in R&D, and the percentage of computer, communications, or other service-related goods and services that are exported commercially (X3). Findings show that both (X2) and (X3) have a positive influence on the variable (X1), whereas (X1) has a negative impact (Y). When (X2) and (3) rise by 10%, the results show that Y also goes up by 11.5%. (respectively 0.271 percent). In contrast, if the variable (X1) rises by 1%, Y reduces by 0.119 percentage points [18].

One of the primary goals of data network supranational structures is to make it possible for people to conduct financial transactions. In order to maintain a high level of quality in the network as a whole, members of the network must share information with each other and build supply chains [19].

Moreover, 60% of India's GDP comes from the services sector, accounting for 40% of the country's total commerce. Other non-service industries have less of an employment burden because of this sector's ability to absorb many workers. From 1996–1997 to Q1:2010–2011, this article uses autoregressive distributed lag and vector error correction model (VECM) methods to investigate the influence of services trade (exports and imports) in India's economic development. A long-term equilibrium link between GDP, service exports, imports, and the real effective exchange rate was found in the research [20].

Using the Environmental Kuznets Curve hypothesis (EKC), a panel of 29 nations (14 developed and 15 developing) from 1977 to 2014, this research examines energy usage as a function of various country factors. Results from individual root-Fisher-PP and Augmented Dickey-Fuller (ADF) tests \. Thus, we used Pedroni Kao's cointegration test from Engle-Granger and Fisher to calculate the results. Short-term causation between GDP per capita growth and manufacturing and coal rent, as well as the causal relationship with manufacturing industries, commercial service export is also found by VEC statistical analysis. Furthermore, there was no correlation between economic development, imports of arms, or coal rent [21].

Green space in cities has undergone significant transformations as a result of rapid urbanisation. It is imperative that a sustainable development plan for green space be developed via study on the evolution of urban green space. First, the Yangtze River Economic Belt's urban green space is concentrated in terms of geographical distribution, but disparities in urban greening development can be seen throughout the zones. This is especially true of variables like per capita GDP, utility land use, industrial smoke (dust) emissions, and many more. Fourth, this study makes policy and planning recommendations based on the features of urban green space distribution and the driving force behind them, serving as a point of reference for other places dealing with the green space transition [22].

3. Materials and Methods

3.1. Aim

i- To measure the impact of foreign trade in Computer, communications and other related services on economic growth of India.

ii- To compare the influence of foreign trade in Computer, communications and other related services on GDP of Indian economy.

3.2. Hypothesis

i- There is no significant impact of export of Computer, communications, and other services on GDP.

ii- There is no significant impact of import of Computer, communications, and other services on GDP.

3.3. Method

For meeting the research objectives, time-series data from the official website of the World Bank has been collected. In the research, the export and import of computer communication and other services act as explanatory variables and GDP act as the explained variable. The impact of the control variable own controlled variable will be measured through linear regression analysis. To measure the strength of the impact caused by the predictor, ANOVA as a statistical tool is employed on the framed dataset. The following equation represents the basis on which this research will be carried out in the upcoming section of the paper.

$$GDP = \alpha + \beta_1 X_C + \beta_1 M_C$$

Where,

X_C represents exports of computer communication and other services

M_C represents imports of computer communication and other services

GDP represents gross domestic product that will be acting as an index of growth prospects of India.

4. Results

Figure 2 portrays the time series analysis of GDP, export and import of computer, communication and other services covering 1991 to 2020. All three variables show an upward trend, which is exemplary for a developing nation like India. The diagrammatic presentation of all the variables in figure 2 shows the trend projection Overtime. These variables will be used in the further sections of the research to measure the impact of foreign trade in computer communication and other services on the nation's growth. The predictions in GDP based on various factors have always been the focus of various policymakers because GDP is the welfare index. In the present examination, an endeavour to foreknow it based on foreign trade in computers and communication will be made, and the significance of these control variables will be measured. This research is crucial because it will develop discernment in how the computer and communication portion of the Commercial Services can be used to push the GDP. Moreover, it will help the policymaker in policy formulation

based on whether this spot to stimulate the national economic system is relevant to be considered or not.

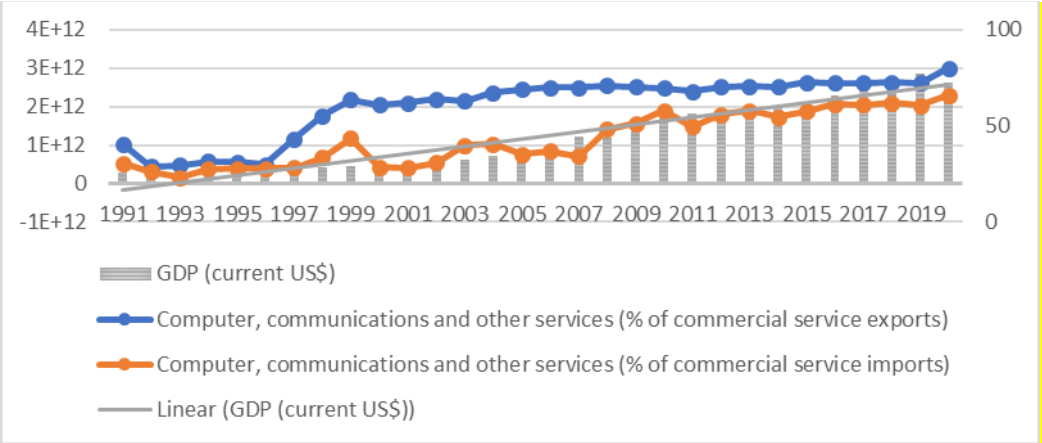

Figure 2. Time Series data of variables used in research (Source- World Bank)

In corelation matrix of table 1, At 1, Export of Computer and Communication Service had the highest Export of Computer and Communication Service and was 39.29% higher than GDP (current US$), which had the lowest Export of Computer and Communication Service at 0.72. Export of Computer and Communication Service and total Computer and communication (Imports) are positively correlated with each other. Export of Computer and Communication Service accounted for 40.12% of Export of Computer and Communication Service. Export of Computer and Communication Service had 1 Export of Computer and Communication Service, Computer and communication (Imports), and GDP (current US$). Computer and communication (Imports) had 0.77 Export of Computer and Communication Service, 1 Computer and communication (Imports), and GDP (current US$). GDP (current US$) had 0.72 Export of Computer and Communication Service, 0.94 Computer and communication (Imports), and 1 GDP (current US$).

Table 1. Co-relation Matrix

	Computer and communication (Exports)	**Computer and communication (Imports)**	**GDP (current US$)**
Computer and communication (Exports	1		
Computer and communication (Imports)	0.774299566	1	
GDP (current US$)	0.717942592	0.938066178	1

Source: Created by authors

Regression statistics shown in Table 2 shows that model is a good fit. Multiple R with the value of 0.93 is the combined correlation of all the variables, and as far as the precise correlation of individual variables is concerned, it is shown in table one. R square represents the regression coefficient which has the value of 0.88. This value means the prediction of GDP based on foreign trade in communication and computer services has an 88% probability of striking the correct value. However, the value of R square is not preferred because of certain limitations for making predictions. Instead, an adjusted R square with the value of 0.87 will be used as a basis for concluding because it is the more accurate measure that represents a good fit regression equation. Adjusted r square is calculated by inserting certain modifications in the formula of the regression coefficient, which makes it more reliable. Moreover, in time series analysis the regression value of 0.87 is acceptable and is considered a sound numeric of regression coefficient.

Table 2. Regression and related Statistics

Regression Data	Value
r	0.93816
R^2	0.880144
Adjusted R^2	0.871266
Standard Error	3.13E+11
Observations	30

Source: Created by authors

Table 3 consists of certain calculations related to measure the significance of relation between variables. The F- value of the data set is 99.13 which is calculated on the basis of:

Sum of squares (SS),

Degree of freedom (df) and

Mean square (MS).

Moreover, there is significant impact of exports & imports on GDP as p value < .05. The tool employed ANOVA is an evaluation method employed in data that breaks an reflected aggregate inconsistency discovered within a data-set [23] into binary segments: systematic components [24] and random variables [25]. The systematic variables have a arithmetical impact on the supplied data set, whereas the random factors do not [26]. Analysts utilise the ANOVA test to examine the effect that control variables have on the controlled variable in a regression analysis [27].

Table 3. ANOVA and related calculations

	df	**SS**	*MS*	*F*	*Significance F*
Regression	2	1.95E+25	9.73E+24	99.13556	3.65E-13
Residual	27	2.65E+24	9.81E+22		
Total	29	2.21E+25			

Source: Created by authors

The limitation of Table 3 was that it measures the collective impact of independent variables on the dependent variable. However, to analyse the individual effect of the given variables on GDP, Table 4 provides the necessary calculations. The coefficient column represents the constants of the regression equation framed in research methodology. As far as the significance of the impact of independent variables are concerned, it can be statistically measured through t and P values. Furthermore, export is not statistically impacting GDP as a p-value of X> .05. Hence null hypothesis (H1) is accepted.

Table 4. Elements of regression equation

	Coefficients	*Standard Error*	*t Stats*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-1.3E+12	2.28E+11	-5.72747	4.35E-06	3.65E-13	SX
(Exports)	-1.1E+09	5.76E+09	-0.19927	0.843546	Z<	Z<
(Imports)	6E+10	6.62E+09	9.064051	1.12E-09		

Source: Created by authors

On the other hand, the p-value of import of computer communication and other services is less than 0.05, which signifies the statistically significant impact of the variable on the nation's growth prospects. This analysis shows that the Government of India while framing the policies, must focus on favourable measures for promoting the import of computers, communication, and other services. This will make the operations of a nation more effective and act as a catalyst for the nation's growth.

Table 5. Coefficients

Model		*Unstandardized Coefficients*		*Standardized Coefficients*		
		B	*Std. Error*	*Beta*	*t*	*Sig*
1	(Constant)	1306655833289	228137939280.937		5.727	.000
	X	1148380443.095	5763220925.934	0.21	.199	.844
	M	60041877571.182	6624169453.967	0.954	9.064	.000

a. Dependent Variable: GDP

Source: Created by authors

Calculations of Table 5 has been made to find the more prominent influencer of GDP amongst the two independent variables. This distinction will be made based on the standardised coefficient that is beta. The more the beta value, the more impactful the independent variable is the independent variable. From the analysis of table 5, it can be interpreted that imports of computer communication and other services are more powerfully impacting GDP than exports. This is because the standardised beta value of import is 0.954, which is more than the standardised beta of export, which is 0.021—standardised Beta coefficient of M>X. Hence M plays a more significant role than exports in pushing the GDP.

In table 6, At 1,812.76, Sum had the highest Computer and communication (Exports) and was 1,58,897.55 % higher than Skewness, which had the lowest Computer and communication (Exports) at -1.14. Computer and communication (Exports) and total Computer and communication (Imports) are positively correlated with each other. Sum accounted for 71.90% of Computer and communication (Exports). Across all 15 PARTICULARS, Computer and communication (Exports) ranged from -1.14 to 1,812.76, Computer and communication (Imports) ranged from -1.57 to 1,286.87, and GDP (current US$) ranged from -1.13 to 7.62266E+23.

Table 6. Descriptive Statistics

Particulars	*Computer and communication (Exports)*	*Computer and communication (Imports)*	*GDP (current US$)*
Mean	60.42542258	42.89557352	1.19948E+12
Standard Error	2.912018715	2.533541346	1.59402E+11
Median	68.42402346	40.15989006	8.80321E+11
Standard Deviation	15.94978338	13.87677746	8.73079E+11
Sample Variance	254.3955899	192.5649526	7.62266E+23
Kurtosis	-0.218035237	-1.574641799	-1.129039934
Skewness	-1.141555831	0.193883592	0.587263356
Range	51.24471046	43.07174169	2.6004E+12
Minimum	28.86881698	23.07356007	2.70105E+11
Maximum	80.11352743	66.14530175	2.8705E+12
Sum	1812.762677	1286.867206	3.59845E+13
Count	30	30	30
Largest(1)	80.11352743	66.14530175	2.8705E+12
Smallest(1)	28.86881698	23.07356007	2.70105E+11
Confidence Level(95.0%)	5.955746994	5.181673861	3.26013E+11

Source: Created by authors

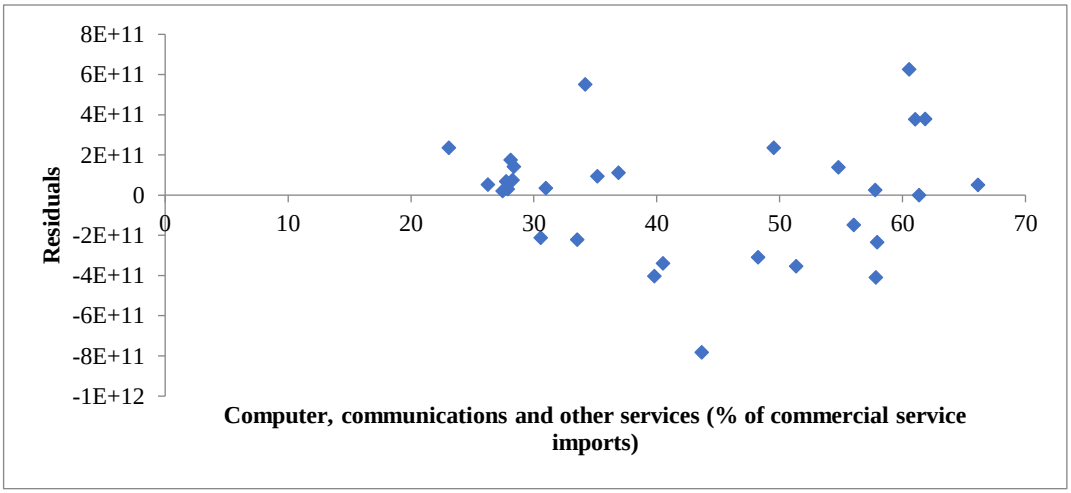

Figure 3. Computer and communication (Imports) Residual Plot (Source: Created by authors)

Figure 3 shows the diagrammatic presentation of relation between import of computer and communications with its residual. Residual is defined as the difference between observed height and expected height using a prediction equation [28]. The residual is positive if the data point is above the graph of the prediction equation. Residuals are negative when data points are below the anticipated equation's graph, and zero when data points are on that graph. There are situations when an equation can't or won't run through all of the data points when it's used to model data. The residual plot shows how near each data point is to the model's prediction equation graph in terms of vertical distance. Even whether the data point is above or below the graph of the prediction equation of the model that is meant to be the best match for the data, it is clearly shown.

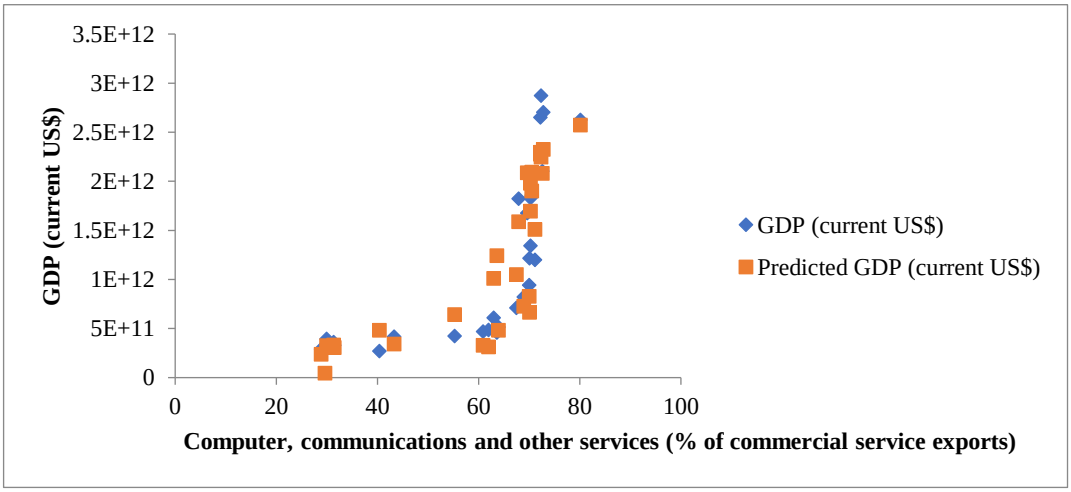

Figure 4. Computer and communication (Exports) Line Fit Plot (Source: Created by authors)

In Figure 4, it can be observed that the values of export of computers and communication can be significantly used to predict the GDP of India. As seen in the figure, the difference between predicted value of regressand and actual criterion lies quite nearer to each other. Hence the relationship between these two variables is strong and significant.

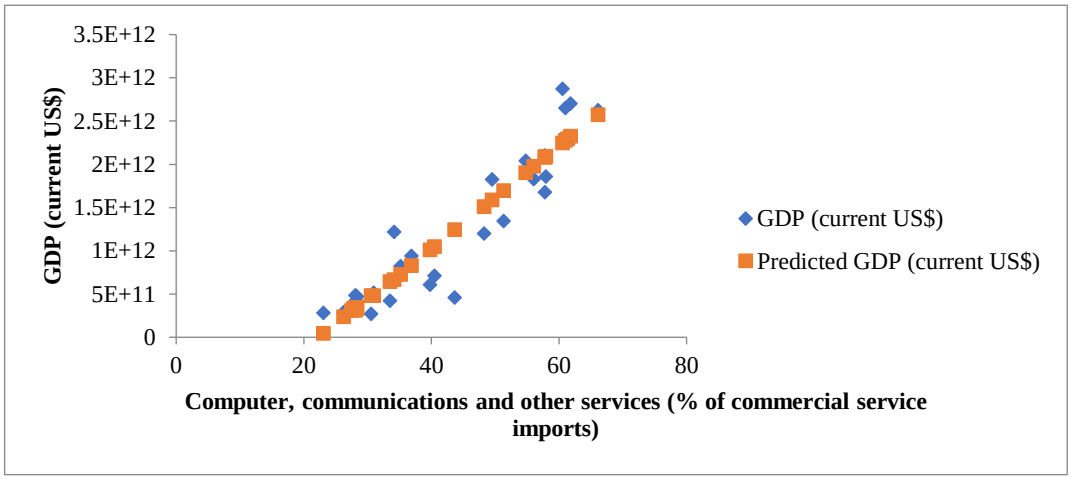

Figure 5. Computer and communication (Imports) Line Fit Plot (Source- Author's Calculations)

India's GDP can be accurately predicted using the import values of computers and communications shown in Figure 5. The discrepancy between expected GDP and actual GDP is seen in the figure. Most of the plots of predicted GDP lies near the actual GDP. This represents the high probability of calculating the GDP based on computers, communication, and other services imports. As a result, a high and substantial correlation exists between these two variables. This analysis shows that the import of communication services plays a notable role in propelling the GDP of India. Hence it can be deciphered that the upper house of India must bring in policies to elevate its utilization.

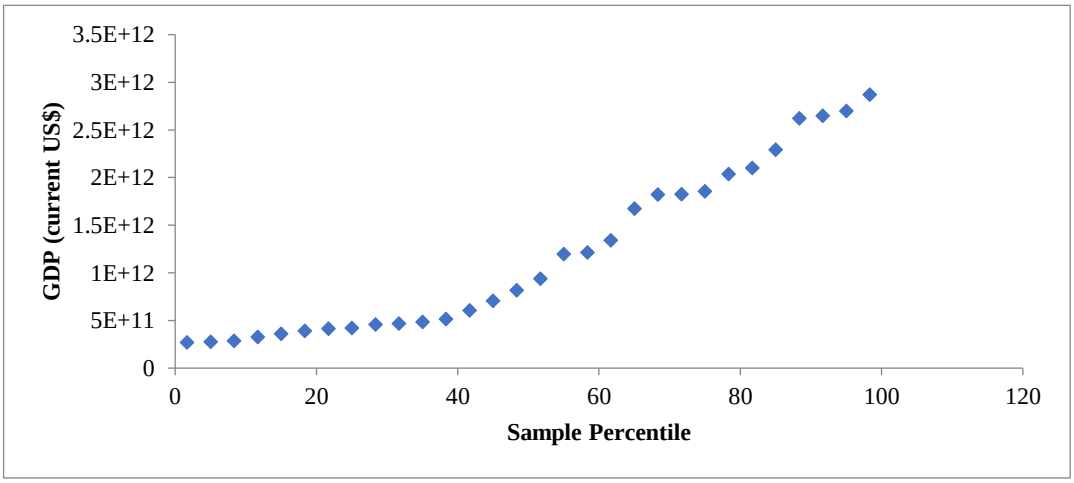

Figure 6- Normal Probability Plot (Source- Author's Calculations)

Figure 6 shows the normal probability plot of dependent variable. To determine whether or whether your data is normally distributed (i.e. follows a bell curve), a graph of your data might be helpful. You can use a histogram to determine whether a set of data is normal or not, but a more specialised graphic called a normal probability plot is also an option. You may use a normal probability plot to plot z-scores (normal scores) against the data you've collected.

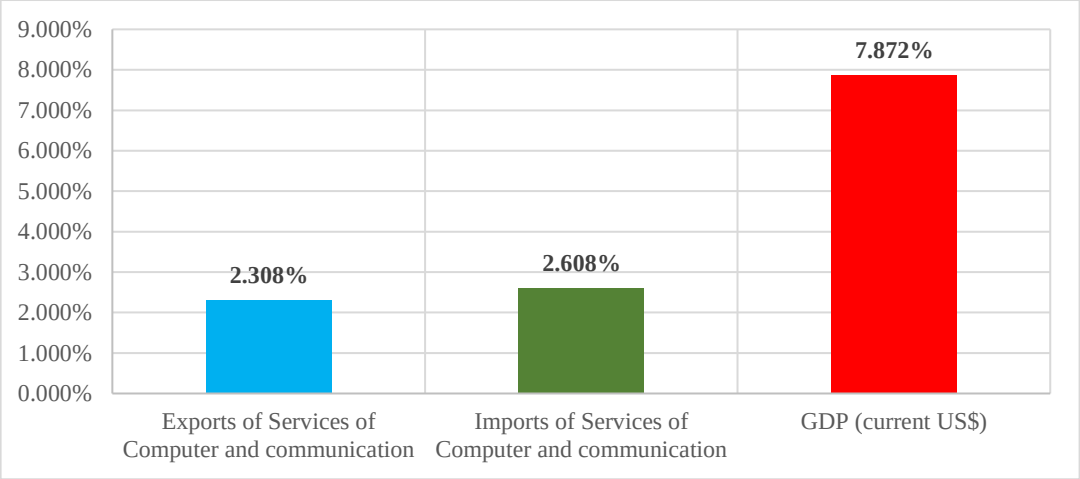

Figure 7- CAGR of the variables used in research (Source- Author's Calculations)

After applying the required tools on the framed data set, the analysis can be interpreted that the independent variables are significantly impacting the dependent variable. Hence, it can be said that foreign trade in computer communication and other services influences the nation's growth prospects in a statistically significant manner. There is a strong and positive relationship between the covariates of the research and the GDP. This is because the value of the adjusted regression coefficient is 0.87.

Moreover, this prediction is statistically significant as the P-value from the ANOVA calculations is less than 0.05. Further, if we look at the calculation of both endogenous variables individually, imports have a statistically significant impact on the growth, whereas exports impact is not statistically significant. This observation is made from the individual P values from table 4. However, beta coefficients off import are more than exports as represented in Table 5, importing of computer, communication, and other services helps in better development of a nation.

CAGR refers to the compound annual growth rate of the variables. This tool reckons the leap over the period on the elements on which the CAGR is applied. Figure 7 shows the export and import of computer, communication and other services has a CAGR of 2.308% and 2.68% respectively, which shows almost equivalent growth in export and import over time. On the other hand, the dependent variable of research, GDP, shows a CAGR of 07.872%, which is a reasonable growth rate for India.

$$CAGR = (EV/BV)^{(1/N)} - 1$$

CAGR refers to compound annual growth rate
EV refers to end value
BV refers to beginning value
N refers to number of years

The value obtained by applying the above formula is then converted into a percentage, which gives us the value by which a particular variable changes annually in a compound manner. The compound annual growth rate (CAGR) is a helpful indicator of growth across different periods. It may be regarded as the growth rate that brings you from the beginning value to the finishing value if you assume that the sales compound during the period.

In order to improve the country's global competitiveness, World Economic Forum research found that ICTs (information and communication technologies) are essential. Using data from the World Economic Forum's (WEF) Networked Readiness Index 2009-2010, the Indian IT sector is projected to be over USD 50 billion and is the country's biggest employer. For example, the country has a large pool of English-speaking IT professionals, a comprehensive and expanding domestic market, and an increasingly central role for ICT in the government's development strategy, which positions it well to leverage ICT to leapfrog to higher stages of development, reduce poverty, and strengthen its competitiveness foundations for enhanced prosperity for all Indians. One of the most important enabling technologies for economic diversification and expanding access to quality public services is information and communications technology (ICT). The country's progress and difficulties linked to ICT development are focused on the country. Comparisons with other nations,

such as the United States of America and Brazil, demonstrate significant discrepancies in the country's performance. The study's detailed results will be presented and debated during the forthcoming New Delhi Summit on November 14-16. ITeS-BPO is only one example of how far India has come in the previous two decades, becoming a worldwide player while also expanding the use of technology across the country. However, it also explores how India may better use its competitive advantages in networked preparedness by highlighting and discussing the difficulties. According to the Networked Readiness Index 2009-2010, India ranks 43 out of 133 nations, with mixed performance across the nine measured areas. It helps bridge the digital gap between rural and urban regions and India's future job issues via the use of ICT.

5. Conclusion

An increase in the value of GDP is the focus of policymakers of every nation on the planet. In every budget government of every nation tries to push the factors that will increase the value of the nation's GDP. The policymaker and many researchers in this field try to identify the variables that can act as a springboard for the nation's growth. This research finds that if India focuses on improving the quality of import of computer communication and other related services, then GDP is moved on the path of trajectory. However, this research has certain limitations: the results obtained after the data analysis are true for India only. The researchers can conduct further research by using the same research methodology to check the universal applicability of the relation between the variables.

Author Contributions: For research articles with several authors, a short paragraph specifying their individual contributions must be provided. The following statements should be used "Conceptualization, EO, M and ST.; methodology, M,ST.; software, M,ST; validation, EO.,ST; formal analysis, M.ST; investigation, EO, M, ST.; resources, M, ST.; data curation, EO.; writing—original draft preparation, EO, M, ST.; writing—review and editing, EO, ST.; visualization, EO. M.; supervision, EO.; project administration, EO,M,ST.; All authors have read and agreed to the published version of the manuscript."

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