

Role of Information and Communication Technology in Economic Development of India

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Abstract: Information and Communication Technology (ICT) stresses the role of unified communication and integration of telecommunications, intelligent building management systems and audio-visual systems in modern information technology. In the information age, using information is a prime issue. ICT includes of all technical means that are used to handle information and aid communication. It includes computer and network hardware, middleware and necessary software. Time accessibility of relevant information is vital for economic development of any country. The improvement of economic activity can be brought by improving capacity in terms of enhancing access to information, while also the technical nature of economic activities required that the knowledge of users are constantly updated which can be achieved through their enhanced information seeking behavior by the use of ICTs. Moreover, use of ICTs lead to innovation which further lead to the enhancement of economic growth and human resource development. Thus, the present paper highlights the role of information technology on economic development of the country as a whole. A period of fifteen years is considered for the study Information and Communication Technology index and Economic Development index has been constructed on the basis of Principal Component Analysis. A simple linear regression has also been conducted to examine the impact of ICT on Economic Development in India. Stationarity of the data set are also checked with the help of appropriate unit root testing technique such as Augmented-Dickey Fuller test. The result shows that there has been considerable impact of ICT on Economic Development in India. Policy suggestions are also given on the basis of the findings of the study.

Keywords: Economic Development, Information and Communication Technology, Principal Component Analysis, Technological Advancement, Innovation,

I. INTRODUCTION

The ICT which is usually called to refer two terms Information and Communication technology. ICT is often used as a comprehensive synonym for information technology stresses the role of unified communication and integration of telecommunications, intelligent building management systems and audio-visual systems in modern information technology.

ICT includes of all technical means that are used to handle information and aid communication. It includes computer and network hardware, middleware and necessary software. According to UNDP, information and communication technologies involve innovations in microelectronics, hardware and software, telecommunications and optoelectronics. These allow the processing and storage of large amounts of information through communication networks. ICTs are of two types: Old ICTs and New ICTs. Old ICTs includes: radio, television, landline telephones, etc. New ICTs includes: computers, satellites, wireless one to one communication including mobile phones, e-mail, internet, etc. Satellite Instructional Television Experiment (SITE) is considered to one of the biggest technological experiments in education and rural development. The one year experiment (August 1975 to July 1976) aimed to provide direct broadcasting of instructional and educational television in 2400 villages in the states of Arunachal Pradesh, Madhya Pradesh, Orissa, Bihar, Karnataka and Rajasthan. Subsequently after television experiment the concept of community radio has started. Country's first community radio station became operational on February 1, 2004 on Anna University, Chennai. The main focus of community radio is on issues relating to health, education, environment, agriculture, rural and community development (Ghosh, 2011). In the information age using information is a prime issue. Timely accessibility of relevant information is vital for economic development of any country. The improvement of economic activities can be brought by improving capacity in terms of enhancing access to information, while also the technical nature of economic activities required that the knowledge of users are constantly updated which can be achieved through their enhanced information seeking behavior by the use of ICTs. The growth model that captures the special role of IT on economic development is the recombinant growth model of Weitzman (1998). In Weitzman's model, all ideas are the same and the rate which potential ideas are converted into new ones depends on success function. The extension of Weitzman's model, to capture the special role of IT in the innovation process, allows the stock of IT knowledge independents affect the success rate. In this case IT gives the growth process an extra kick even beyond that which comes from recombinant growth in general. It thus becomes important to find how use of ICTs important to find how use of ICTs affect economic activities and hence in economic development. Thus, in his paper we have focused basically on assessing the role of IT in economic development in India.

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II. LITERATURE REVIEW

The present study is based on the theoretical framework guided by the UNDP model of 2001 to explain how technological innovations such as ICTs are related to development. The study is also based on Heeks model (2005) which explain the relationship between ICTs and socio-economic development. Heeks model includes the onion-ring, pull and push and the information chain model. The UNDP model 2001 is already mentioned above in the introductory part. Heeks formulated the model for establishing relationship between information technologies and socio-economic development through information chain model and onion ring model. There are a number of studies which establishes a link between ICTs and development. Some of them are mentioned here- Ramirez (2000), Kwakel and Ochollar (2006), Abraham (2007), Chilimo (2008), Ovwighol (2009), Akinbile and Alabi (2010), Chitla (2012), Mehta (2013), Syien and Raj (2015), etc. These studies were made at international and national level. It can be concluded that most of these studies were made at international level than national level. These studies establish a link between the use of ICTs and development by taking different perspectives. Thus, it is the need of hour to do more empirical research on use of ICTs and economic development in India. Thus, the present paper makes an attempt to study the role of ICTs and economic development in India.

III. OBJECTIVES

The objectives of this study are:

- a) To examine the accessibility of ICTs on the basis of selected indicators in India over a period of 15 years.
- b) To examine the pattern of economic development in India on the basis of selected indicators over the same time period.
- c) To examine whether there is any impact of use of ICTs on economic development in India.

IV. RESEARCH QUESTIONS

In order to fulfill the objectives the following research questions are taken:

- a) Whether the accessibility of selected ICTs in India has expanded over the years?
- b) Does the pattern of economic development in India over the years has under-gone any change?
- c) Does there exists any impact of ICTs on economic development in India?

V. DATA AND METHODOLOGY

A. Source of data:

The study is based on secondary data collected from different sources. These sources are- Directorate of Economics and Statistics, Government of India, Central Electricity Authority Ministry of Power, Government of India, Census report 2011, India stats, e-commerce websites, books, journals, newspapers, various websites related to ICT, Comptroller and Auditor General (CAG), government reports, etc.

B. Selection of Indicators

The indicators are selected on the basis of two broad heads viz. ICT and Economic Development. The indicators for ICT are as follows:

- a) Presence of Electricity in Household (X_1)
- b) Presence of Radio in household (X_2)
- c) Presence of Internet access in household (X_3)
- d) Purpose of Internet and PC use (X_4)
- e) Barriers to internet and PC use (X_5)
- f) Use of AI in the industries (X_6)
- g) Development of mobile ecosystem (X_7)
- h) E-Commerce (X_8)
- i) E-Governance (X_9)

The Economic Development is the dependent variable which has been captured by the following indicators are:

- a) Maternal Mortality Rate (X_{10})
- b) Infant Mortality Rate (X_{11})
- c) Expectancy of life at birth (X_{12})
- d) Per Capita Net State Domestic Product (Agriculture) (X_{13})
- e) Per Capita Net State Domestic Product (Manufacturing) (X_{14})
- f) Per Capita Net State Domestic Product (Service) (X_{15})
- g) Literacy Rate (X_{16})
- h) Male Literacy Rate (X_{17})
- i) Female Literacy Rate (X_{18})
- j) Level of Employment (X_{19})

C. Method of Analysis

First of all, the data were normalized using the following formula:

$$Z_i = (X_i - \bar{X}) / X_i$$

In this study in order to assess the status of ICT and Economic Development in India we have constructed ICT index and Economic Development index which is computed by the following equation:

$$\text{Index} = W_1 * Z_1 + W_2 * Z_2 + W_3 * Z_3 + \dots + W_n * Z_n$$

Where, Z_1, Z_2, Z_3 and Z_n are different variables of ICT and Economic Development.

W_1, W_2, W_3 and W_n are weights assigned to the different variables.

To calculate the weights following method is used:

$$W_i = F_{ik} \cdot V_k$$

Where,

W_i = Weights of the i_{th} Variable,

F_{ik} = Factor loading of i_{th} variable and k_{th} Factor, reflecting highest correlation between X_i and Factor k and

V_k = Variation explained by k_{th} factor.

In order to calculate the Factor loading, Principal Component Analysis method (Factor Analysis) is used.

D. Linear Regression Model

For the purpose of the study linear regression model is used. The Regression model used in order to establish the relation between Economic Development index and ICT Index.

$$\text{Ln}Y_t = \alpha + \beta_1 \text{Ln}X_1 + u_t$$

Where, β is the regression co-efficient, 't' is the time period varying from 2001-02 to 2015-16. The $\text{Ln}Y_t$ is the natural logarithm of Economic Development and $\text{Ln}X_1$ is the natural logarithm of ICT.

VI. FINDINGS AND DISCUSSION

Development which is known to be a multidimensional process cannot be evaluated on the basis of a single indicator, while, taking too many indicators and assessing them individually may not provide the correct result. Therefore, in the present analysis 9 indicators are taken into consideration to assess the status of ICT in India and 10 indicators for assessing the status of Economic Development in India. The table 1 below shows the composite indices of ICT of India.

Table 1: Status of Information and Communication Technology over the Period 2001-2016

Years	ICT Index
2001-02	17.9
2002-03	18.61
2003-04	18.9
2004-05	17.5
2005-06	17.9
2006-07	18.3
2007-08	18.7
2008-09	19.1
2009-10	19.8
2010-11	20.7
2011-12	20.5
2012-13	21.0
2013-14	21.1
2014-15	22.4
2015-16	22.09

Source: Authors own computations.

The table shows the ICT index (ICTI) of India for the period 2001-2016. In the modern era science and technology, ICT has been playing significant role in different spheres of human life. The ICT index shows the use of ICTs in India and the indicators which are chosen basically based on the assumption that they directly or indirectly associated with the Economic development of the country. The table shows ICT index developed as per the chosen indicators. The ICT index is developed as per the following equation

$$ICT\ index: X_1*W_1+X_2*W_2+X_3*W_3+X_4*W_4+X_5*W_5+X_6*W_6+X_7*W_7+X_8*W_8+X_9*W_9$$
Where the X_1, X_2, \dots, X_9 are the indicators of ICT and W_1, W_2, \dots, W_9 are their respective weights. The table shows that there has been an increasing trend of the use of ICT in India for the period 2001-2016

Table 2: Economic Development in India for the period 2001-02 to 2016

Years	Economic Development Index
2001-02	362.90
2002-03	399.76
2003-04	400.05
2004-05	400.92
2005-06	401.21
2006-07	401.55
2007-08	402.16
2008-09	401.56
2009-10	401.68
2010-11	402.38
2011-12	402.89
2012-13	403.32
2013-14	404.92
2014-15	406.19

2015-16	409.30
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Source: Authors own computations

In the above table, the values for the Economic Development index have been computed on the basis of the following equation:

$$Economic\ Development\ Index = X_{10}*W_{10}+X_{11}*W_{11}+X_{12}*W_{12}+X_{13}*W_{13}+X_{14}*W_{14}+X_{15}*W_{15}+X_{16}*W_{16}+X_{17}*W_{17}+X_{18}*W_{18}+X_{19}*W_{19}$$

Where the $X_{10}, X_{11}, \dots, X_{19}$ are the indicators of Economic Development and W_1, W_2, \dots, W_9 are their respective weights. The table shows that there has been an increasing trend of the use of ICT in India for the period 2001-2016.

Table 3: Factor Analysis Results of ICTs in India

Indicators	Factor 1	Factor 2	Communalities	Weights	Weights (%)
Presence of Electricity in Household (X_1)	0.047	-0.0120	0.933	0.578	15.673
Presence of Radio in household (X_2)	0.575	-0.964	0.930	0.158	5.666
Presence of Internet access in household (X_3)	0.41	-0.312	0.604	0.501	12.907
Purpose of Internet and PC use (X_4)	0.05	0.33	0.955	0.173	6.183
Barriers to internet and PC use (X_5)	0.51	0.21	0.984	0.153	5.459
Use of AI in the industries (X_6)	0.822	0.70	0.940	0.564	5.455
Development of mobile ecosystem (X_7)	0.55	0.14	0.945	0.552	15.177
E-Commerce (X_8)	0.89	0.77	0.867	0.637	18.261
E-Governance (X_9)	0.81	0.56	0.887	0.03	15.181
Variance (%)	70.346	19.279	Total	2.797	100
Cumulative Variance (%)	70.346	89.625	CV (%)	69.224	

Source: Authors own computations

Kaiser-Meyer-Olkin Measures of Sampling Adequacy= 0.716

Significance Level of Barlett's Test of Sphericity = 0.0

Table 3 shows the result of factor analysis of ICT in India. In order to test the suitability of factor analysis for the data, KMO and Barlett's test statistics are computed. It is observed that the Kaiser-Meyer-Olkin (KMO) and Barlett's test is significant, thus application of factor analysis is possible. First and Second factor explained 74.346 per cent and 19.279 per cent of variance respectively. These two factors together explain 89.625 per cent of total variance. Communalities of all the factors except Presence of Internet access in household (60.4 %),

are more than 70 per cent suggesting the two factors derived are sufficient to account for most of the variation

Table 4: Regression model of India (2001-16)

Model	Co-efficient	t-value	p-value
Constant	-2.228	-2.890	0.016
Log ICTI	-0.890	2.923	0.015
R-Squared	79.8%	-	-
F-Statistics	291.859	-	-
P-value	0.00	-	-

Source: Authors computation on the basis of data collecting from different sources

Note: Log ICTI is the Logarithm of Information and Communication technology index

In the table 4, the regression model is carried out to determine the determinants of economic development (Economic Development index is computed as mentioned before which comprises of ten selected indicators for this analysis) from 2001-02 to 2015-16 with independent variable viz. the ICT index which comprises of 9 variables in this analysis. The results of the table 4 indicate that the p-value of t-statistics is found to be less than 5% level of significance in case of ICT index of India. Hence, it is inferred that with 95% confidence level, there exists a significant impact of the ICT index on economic development of India.

VII. CONCLUSION

From the above analysis it can be concluded that over the years the use of ICT in India is increasing. Though initially the pace of use of ICT was more or less stable but over the years as can be seen from the ICT index which comprises of 9 indicators in this particular study started increasing steadily after 2011-12. Though this analysis mainly focused on 9 indicators for computing the ICT index, there is further scope for enhancing the index by incorporating some relevant and new variables. This index is constructed on basis of the indicators on the assumption of data availability constraint. In the analysis, it is found that the use of ICTs has been growing significantly over the period 2001-2016 along with the progress of Indian economy. From this analysis we also found that with 95% confidence level, there exists significant impact of ICT on Economic Development of India. Hence it is required that the stage should facilitate more use of ICTs which can enhance economic development of the country. Moreover, due the use of artificial intelligence and e-governance can play significant role in this direction.

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