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Pattern of Inter-State Digital Divide in India

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Abstract

ICT revolution worldwide has brought immense opportunities in all the sectors of the economy. However, optimum utilization of information and communication technologies requires infrastructure development and human capital investments, overcoming bottlenecks of which will be a challenging task. One of the main challenges is the gap between the information 'haves' and information 'have-nots' what we call the digital divide. In this context, the paper investigates the extent of ICT diffusion in India and also evaluates inter-state technology divide. ICT Diffusion indices have been constructed to measure ICT diffusion in different states of India. For this purpose, Obricom (2003) methodology has been used. The results of ICT diffusion index indicate that Kerala, Punjab, Tamil Nadu, Himachal Pradesh, Karnataka are the top ICT performers and Uttar Pradesh, Bihar, Orissa, Assam are the poor performers. In order to evaluate different determinants of inter-state telecom development, pooled regression analysis was used by taking data at three points of time, i.e., 1991, 2001 and 2011. The results of regression analysis show that telecom sector growth has been positively affected by population and per capita NSDP and policy variable indicating telecom sector liberalization.

Keywords: Digital divide, ICT, Telecom diffusion Index, Obricom Methodology, Pooled Regression analysis,

Introduction

ICT sector has experienced phenomenal growth due to developments in internet technologies and their extensive applications. The rapid growth and proliferation of ICT has accelerated the economic and social change across all the areas of human activity (Nandi; 2002). ICTs have witnessed massive growth across sectors including education, healthcare, financial services, Business Process Organization (BPO) industry, Knowledge Process Organization (KPO),

etc. ICT diffusion has a crucial role in promoting various socio-economic objectives such as universal education, universal access to healthcare, sustainable development, etc. (Saith: 2004). Thus, in the future the digital divide will be an additional hurdle in bringing inter-country as well as intra-country socio-economic divide. However, the global disparities in access to ICT technologies have given rise to the problem of the digital divide. OECD (2001) defines, "the term digital divide refers to the gap between individuals, households, businesses, and geographic areas at different socio-economic levels with regard both to their opportunities to access information and communication technologies and to their use of internet for a wide variety of activities"(Lopez and Vicente: 2011).

This paper analyses the problems of the digital divide in the Indian context and addresses the challenges in bridging the digital divide. This paper comprises of three sections. Section 1 explains the concept of the digital divide and methodology used to measure the digital divide. Section 2 deals with empirical analysis of inter-state digital divide in India.

SECTION 1
Concept of Digital Divide

The term Digital divide seems to have its origin in the United States of America. Many considered Andy Grove one of the creators of digital divide network coined the term. Few others say the credit goes to Larry Irvin. According to Benton Foundation, former President Bill Clinton first used the term in the discussions of the National Information Infrastructure in 1993. Though there is no consensus regarding who coined the term of 'digital divide', but it is generally accepted that gap between information 'haves' and information 'have-nots', has increased over time (Tharayil and Rajeev : 2002). Digital divide primarily refers to differences in individual's access and skills to use digital technologies and gadgets such as mobile phones, television, internet, PCs, laptops etc. The differences in access and capabilities depend upon a large number of factors including economic status, literacy, technological skills, residence location(rural/urban/far off places), race, gender and even age (Rao: 2005). Digital divide can also be categorized as global, national and regional.

(I) **Global digital divide:** The concept of 'global digital divide' focuses on inequalities in computer and Internet penetration across countries, particularly at differences between developed and developing countries (Singh.et.al:2013).

(II) **Regional digital divide:** This refers to differences among countries within a region. For example, there are wide variations in access to information and communication technologies within Asia. Countries like South Korea, China are far ahead of India and Pakistan on internet usage.

(III) **National digital divide**: At the national level, there is often an urban-rural divide. There are also inter-state differences in information technology access and usage within India (Rao: 2005, Furuholt and Kristiansen: 2007).

Studies on inter-state digital divide in India are sparse due to lack of data on ICT indicators in India. In the case of India, inter-state data on internet users and computer users is not available on time series basis. In this study digital divide has been measured by using Diffusion index.

Database and Methodology

The study is based on secondary data taken from *CMIE reports, Indian Census 2011, Data book for the use of Deputy Chairman (Planning Commission 2011), and Handbook of Statistics Indian economy, RBI, 2011.*This paper evaluates the performance of 18 major states in terms of telecom development as measured by teledensity (no. of telephones per 100 persons) as dependent variable. The explanatory variables include population (million), per capita electricity consumption, NSGDP per capita and literacy rate. The study has used Pooled OLS analysis for the period 1991, 2001 and 2011.

Pooled Regression Analysis

Pooled Regression analysis has been used to analyze various factors responsible for telecom sector development in the selected states in India. The objective of the regression analysis is to obtain and test for significance of the parameters in the model. For this purpose, the OLS method which yields unbiased, consistent and efficient estimates have been used.

$$Y_{it} = \beta_1 + \beta_2 x_{1it} + \beta_3 x_{2it} + \beta_4 x_{3it} + \beta_5 x_{4it} + \beta_6 x_{5it} + \mu_{it}$$

$_i$ stands for *i*th cross-sectional unit and t stands for the time period

Y_{it} = Teledensity

X_1 = population (in millions)

X_2 = per capita NSDP

X_3 = literacy rate

X_4 = per capita electricity consumption

X_5 = dummy to see the impact of liberalization on telecom sector,

x_5 = 0, for 1991

X_5=1, for 2001 and 2011

Telecom Diffusion Index

In order to measure the inter-state diffusion of ICTs across Indian states, Diffusion index has been constructed by using three indicators including cellular subscribers per 100 persons, teledensity of states, and percentage of villages under Village Public Telephones(VPTs). We have considered eighteen major states for our analysis. Index has been calculated by adapting the methodology used by Bhibundidas (2010)

1. In the first step, values of all indicators have been normalized by using the formula;

$$\text{Indicator Index} = \frac{actual\text{-}minimum}{maximum\text{-}minimum}$$

2. Next, we have computed the index by taking weighted average of normalized values for each indicator, coefficient of variation in each indicator being the respective weight. We can write the Index as:

$$DI = \frac{\sum_{J-1}^{N} W_j I_{ij}}{\sum_{J-1}^{N} W_j}$$

the Index constructed is IIij= indicator index for the ith state and jth symbol, where, i=1,2,3.....18 and j=1....3 (indicator) and W_j= Weight given to each indicator.

Obricom (2003) has developed a methodology to capture variations in digital divide overtime. International Telecommunication Union later used same methodology (2009). We have applied this method for inter-state analysis in India. First, states have been grouped according to their index values by using a reference value. In this paper, the overall average index value has been used as a reference value. After splitting the states into various groups, in the next step we have computed the average index values for each group and this value has been used for showing the evolution and magnitude of differences between different groups. In the third step, we have standarlized the average values for the year 2001 as an absolute index values may not give the real picture of the digital divide. For instance, suppose we are considering two states: developed and underdeveloped. The technologically advanced states may not show much growth in comparison to those which started from a lower level of ICT usage. The differences have been calculated first within a year then between the years. We have standardized all the three groups' values by using the following formula.

Suppose, we are normalizing the high group values, for 2001 then the formula is

$$\frac{2001 \text{ average high group's value X } 2006 \text{ overall average value}}{2001 \text{ overall average value}}$$

Finally, these standardized scores are used to see the magnitude of differences between the groups. The size of the digital divide is calculated by subtracting the group's 2001 normalized index values from the corresponding 2006 values and group's 2012 normalized values from corresponding 2006 values. Changes in the digital divide were measured by subtracting the value of 2006 digital divide measure from the 2001 corresponding value. The sign of the values shows the evolution of the differences. A negative value indicates a closing gap between the two groups, while a positive value indicates a widening divide.

SECTION 2
Telecom Diffusion Index

The diffusion index values for the three years 2001, 2006 and 2012 are reported in the Table 1. The ranks are in descending order from best to worst.From the analysis, as expected, it is clear that the diffusion of telecommunication is not same for all the states and the differences among the states persist. First step is to divide the states into different groups by keeping a

Table 1. Inter-State Telecom Diffusion Index for 2001, 2006 and 2012

States	Index (2001)	Rank	Index (2006)	Rank	Index (2012)	Rank
Andhra Pradesh	0.189175	9	0.200163	9	0.211889	10
Bihar	0.076611	15	0.094169	17	0.114638	18
Assam	0.007306	17	0.123307	13	0.135327	16
Gujarat	0.237594	7	0.247697	8	0.195657	12
Haryana	0.238522	6	0.300202	6	0.27464	7
Himachal Pradesh	0.219314	8	0.327827	5	0.41461	3
Jammu & Kashmir	-	-	0.088219	16	0.190329	11
Karnataka	0.496727	2	0.331857	4	0.360662	6
Kerala	0.383373	3	0.395014	3	0.398832	4
Madhya Pradesh	0.173959	10	0.09099	18	0.163254	14
Maharashtra	0.160738	11	0.178365	10	0.214707	9
Orissa	0.054482	16	0.103591	14	0.133943	17
Punjab	0.340328	4	0.45968	2	0.390961	5
Rajasthan	0.10061	13	0.070566	15	0.22423	8
Tamil Nadu	0.280494	5	0.299366	7	0.456901	2
Uttar Pradesh	0.121612	12	0.151684	12	0.167146	13
West Bengal	0.088877	14	0.162035	11	0.14315	15
Delhi	0.998388	1	0.993471	1	1.004663	1
Average values	0.244		0.245		0.287	

Authors' calculation
Note: Data for the Jammu & Kashmir is not available for the period 2001
Data for 2001 is from the CMIE report, Infrastructure 2002

reference value. Here we have considered the overall averages for the three year as a reference value. We have divided the eighteen states into three groups as high, medium and low for the years 2001, 2006 and 2012 respectively. The overall average index value for the year 2001 and 2006 and 2012 is 0.244, 0.245 and 0.287 respectively. The states that score more than 0.244 value come under the large group rules, and remaining are the medium and low group states for the year 2001. Again we estimated the average index value of remaining states and the states having indices greater than average are categorized as medium states while the remaining are weak states for the year 2001. Same procedure has followed for 2006 and 2012.

We describe here the grouping of states in detail in Tables 2, 3 and 4. For 2001, five states (Delhi, Karnataka, Kerala, Punjab, and Tamil Nadu) are coming under high index values group. The minimum Index value in large group states is 0.280, and the maximum value is 0.998. In the year 2006, 6 states are coming under little group and six under medium group. The respective minimum index values for medium and low group are 0.151 and 0.090 while the maximum index values are 0.200 and 0.200. Similarly in 2006, eight states (Delhi, Punjab, Kerala, Karnataka, Haryana, Himachal Pradesh, Tamil Nadu and Gujarat) are coming under high group. The maximum and minimum index values are 0.993 and 0.247 respectively. Further, four states are coming under medium group and six under low group. Further, in 2012, six states (Delhi, Tamil Nadu, Himachal Pradesh, Kerala, Punjab and Karnataka) are coming under large group. The minimum and maximum index values for the large group are 0.360 and 1.00 respectively. For the medium and large group, the minimum and maximum values are 0.114 and 0.190, 0.167 and 0.274 respectively. Results show that inter-state digital divide has narrowed down during the period 2001 to 2012. In 2012, only one state that is Himachal Pradesh turned from medium type to high type. States in low category are same except the state of Rajasthan, that moved from low to medium category in 2012.Overall results indicate that the inter-state digital divide persists in India throughout the study period.

Table 2: Categorisation of States

Group	Number of states (2001)	Number of states (2006)	Number of states (2012)
High	5	8	6
Medium	6	4	6
Low	6	6	6

Source: Author's calculations, Note: Data for J&K is not available for the year 2001

Table3: Diffusion Index Values for 2001, 2006 and 2012

Group	2001 Minimum index value	2001 Maximum index values	2006 Minimum index value	2006 Maximum index value	2012 Minimum index value	2012 Maximum index value
High	0.280	0.998	0.247	0.993	0.360	1.00
Medium	0.160	0.238	0.151	0.200	0.190	0.274
Low	0.007	0.121	0.090	0.200	0.114	0.167

Authors' calculation

Table 4: Categorisation of States under High, Medium and Low Values of Diffusion Index

Year	Low	Medium	High
2001	Uttar Pradesh, Rajasthan, West Bengal, Orissa, Bihar, Assam	Haryana, Gujarat, Himachal Pradesh, Andhra Pradesh, Madhya Pradesh, Maharashtra,	Delhi, Karnataka, Kerala, Punjab and Tamil Nadu
2006	Assam, Orissa, Madhya Pradesh, J&K, Rajasthan, Bihar	Andhra Pradesh, Maharashtra, West Bengal, Uttar Pradesh	Delhi, Punjab, Kerala, Karnataka, Haryana, Himachal Pradesh, Tamil Nadu and Gujarat
2012	Uttar Pradesh, Madhya Pradesh, Assam, Orissa, West Bengal, Bihar	Haryana, Rajasthan, Maharashtra, Andhra Pradesh, Gujarat and J& K	Delhi, Tamil nadu, Himachal Pradesh, Kerala, Punjab and Karnataka

Authors' calculation

Table 5: Average Index Value for each Group of States

Group	Average Index value 2001	Average Index value 2006	Average Index value 2012	Percentage change over (2001-2006)	Percentage change over (2006-2012)
High	0.499	0.418	0.503	16.23	20.33
Medium	0.202	0.172	0.218	14.85	26.74
Low	0.074	0.094	0.142	27.02	51.06
All States	0.244	0.245	0.287	0.409	17.14

Authors' calculation

Table 5 presents the average index values for the three groups. The immediate observation from table 5 is that the index value for all the groups has decreased in 2006 in comparison to 2001 value. However, Index value has increased in 2012 in case of medium and low group states. Second, the percentage change shows that the low groups and medium groups have made more progress in reducing digital gap, and high group grew less comparatively.

Table 6: Magnitude of Inter-State Digital Divide

Difference	Magnitude of Digital Divide			Changes in Digital Divide	Changes in Digital Divide
	2001	2006	2012	2001-2006	2006-2012
High- low	0.427	0.379	0.361	-0.048	-0.018
High-Medium	0.299	0.288	0.285	-0.011	-0.003
Medium-Low	0.128	0.091	0.076	-0.037	-0.015

Authors' calculation

It is evident from table 6 that the magnitude of the digital divide is shrinking between large group states and weak group states as well as between high group states and medium group states. From all the three groups, the magnitude is less between low and medium. For a medium and low group, the difference in the magnitude of the digital divide is -0.015 which means that the digital divide between those two groups has also declined. As the changes in the digital divide are coming negative between rest two groups, it implies that the digital divide among the groups is shrinking. Hence, when we apply Obricom methodology, we find that inter-state digital divide is narrowing down in India.

Pooled Regression Results of Inter-State Telecom Development

Teledensity is the best available indicator of telecommunication development in selected countries and India as a whole. Telecom development of a region depends upon a large number of factors, of which the measurable ones include population, per capita income, literacy rate and per capita electricity consumption. In the case of India there was a major policy shift in 1991 and in the case of the telecom sector it came with NTP of 1994 when this sector was liberalized, privatized and FDI in the telecom sector was allowed. In order to measure the impact of these variables on telecom development in states, multiple regression analysis has been used for 18 major states.

Table 7: Results of Pooled Regression analysis

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-35.16916	1.755147	-20.03773	0.0000
X_1	0.001258	3.38E-05	37.26041	0.0000
X_2	0.173081	0.017438	9.925356	0.0000
X_3	-0.000181	4.87E-05	-3.720325	0.0002
X_4	-0.026864	0.005442	-4.936112	0.0000
X_5	29.30017	1.405746	20.84315	0.0000

R-squared	0.569364	Mean dependent var	27.58585
Adjusted R-squared	0.568558	S.D. dependent var	40.81723
S.E. of regression	27.72696	Akaike info criterion	9.484782
Sum squared residual	2195648.	Schwarz criterion	9.497275
Log likelihood	-13566.72	F-statistic	668.8247
Durbin-Watson stat	1.902164	Prob(F-statistic)	0.000000

The results of the Table 7 indicate that five explanatory variables explain about 57 percent of telecom sector growth in various states. Telecom sector growth has been positively affected by population, per capita NSDP and dummy variables. Thus, fast telecom sector development in India is caused by these three major factors. Teledensity is significantly related to literacy and per capita energyconsumption. This is because most of the telecom development during the post-1991 period has taken place in case of mobile telephones that are not much dependent on education and power consumption. Reason being low cost of mobile handsets, low mobile phone tariffs, easy to use and operate technology of mobile phones and availability of mobile phone services in all places of the country.

Conclusion

The explosive development of ICT, its applications, and the emergence of a global information society are changing the lifestyle, learning processes and interaction. Results of the telecom diffusion index indicate decline in inter-state digital divide in India. Further, the results of telecom diffusion index show that size of the digital divide is shrinking between large groups and little groups as well as between high groups and medium groups. From all the three groups, the magnitude is less between low and medium. The changes in the value of the digital divide is negative for all categories of states during 2001-06 as well as 2006-12, thereby indicating that digital divide is narrowing down during the study period. The lagging states coming under low groups during the entire period including Uttar Pradesh, Orissa, West Bengal, Bihar and Assam need to develop their socio-economic infrastructure so as to reap the benefits of digital technologies. The issues of 'digital divide' are posing a herculean task before the government of India.

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