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Digital divide among the Indian households: extent and correlates

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Access to devices is fundamental to appropriate benefits of Information and Communications Technology (ICT). India's ICT adoption has been rapid but with substantial disparities. This study examines the correlates of possession of two ICT devices, mobile phones and computers, using large-sample household surveys from India. The device with a higher level of adoption (mobile phone) was characterised by relatively weak association with socioeconomic and demographic factors whereas the device with a lower level of adoption (computer) witnessed strong association with these factors. Our findings highlight the differences in characteristics of early and late adopters and endorse the theory of diffusion of technology.

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Abstract

Access to devices is fundamental to appropriate benefits of Information and Communications Technology (ICT). India's ICT adoption has been rapid but with substantial disparities. This study examines the correlates of possession of two ICT devices, mobile phones and computers, using large-sample household surveys from India. The device with a higher level of adoption (mobile phone) was characterised by relatively weak association with socioeconomic and demographic factors whereas the device with a lower level of adoption (computer) witnessed strong association with these factors. Our findings highlight the differences in characteristics of early and late adopters and endorse the theory of diffusion of technology.

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1. Introduction

The Information and Communications Technology (ICT) revolution has improved global connectivity and is now amalgamated in most aspects of modern human life. We can now communicate, access information, transact, shop (e-commerce), voice opinion, and avail consumer and government services at a click of a button. ICT aids poverty reduction and boosts economic growth (Norton, 1992; Röller and Waverman, 2001). In fact, it impacts the economic growth of developing economies more as compared to the advanced ones (Waverman, Meschi, and Fuss, 2005; Qiang, Rossotto and Kimura, 2009). The number of mobile phone users globally increased from about 11 million in 1990 to about 7.7 billion in 2017 (ITU 1999, 2017). Worldwide, mobile phone subscriber density stands at 103.5 percent and 47.6 percent households own a computer (ITU, 2017).[1] The disparities associated with digital differences could further intensify if the gaps in ICT adoption are not bridged (Avgerou and Madon, 2005; Wei, Teo, Chan, and Tan, 2011). Further, as services become increasingly available online, there could be equity repercussions if certain segments of the population are excluded.

India lags behind the rest of the world in ICT adoption - while 37.9 percent households worldwide owned a computer in 2011, the same was about five percent in India (Table 1). Also, there are marked disparities across sectors and states within the country.[2] For emerging economies like India ICT is crucial, as it holds the potential to enhance economic growth, improve welfare and create more egalitarian opportunities. A study on Indian fishing community found that adoption of mobile phone improved consumer and producer welfare (Jensen, 2007). The United Nations also recognises the role of ICT in realising the sustainable development goals (UN, 2016) and India, being the second most populous country, cannot be ignored.

The Indian government endeavours to bridge the gap amid ICT haves and have nots and visions using ICT to empower its citizens through provisioning of various services digitally (education, health, finance, land records, justice, etc.). Two ambitions programs launched by the government in 2015 centred on ICT are the Smart Cities Mission envisioning to develop 100 smart cities using ICT and best practices in urban planning and the Digital India programme, aiming to transform India into a connected knowledge economy by 2019 (GoI, 2014; GoI, 2015). Further, after demonetization of about 85 percent of Indian currency in 2016, the government is encouraging the use of plastic money, online banking and mobile phone applications for financial transactions. To enable financial transactions via mobile phones, it is vital to have access to the device. The case of M-PESA in Kenya has shown how mobile phone can improve financial inclusion and citizen welfare (Foster and Heeks, 2013).

This study examines the factors associated with the possession of ICT devices by Indian households. ICT device access is a necessary prerequisite to partake in the digital economy. To prevent jeopardizing of India's developmental objectives it is imperative to understand the factors associated with variations in ICT access. We focus on two ICT devices, mobile phones

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[1] There are substantial gaps between developing and developed countries. Mobile phone density stood at 127.3 percent in the developed world as compared to 98.7 in the developing countries (ITU 2017). Also 82.4 percent households in the advanced countries possess computers as compared to 35.5 in the developing countries (ITU, 2017).

[2] India's tele-density stood at 91.2 percent in September 2018, of which 98.11 percent comprised of wireless mobile phone density. Thus, the contribution of landline phones to India's tele-density is small. The urban tele-density stood at 160.79 percent, and rural tele-density was about three times lower at 58.58 (TRAI 2018). The overall tele-density in Bihar circle stood at about 62 percent, whereas Himachal Pradesh and Delhi had tele-density of about 145.1 percent and 234.97 percent, respectively.

and computers, which are at varied levels of adoption.[3] An analysis of devices at different adoption levels allows examining whether and how socioeconomic and demographic factors are associated with adoption decisions at the initial and advanced device penetration levels. The study uses two recent nationally representative household surveys. To the best of our knowledge this is the first study providing a pan-India profile of the population possessing mobile phones and computers. The paper is organized as follows: Section 2 reviews the literature. Section 3 describes the data, hypotheses, and methodology. Section 4 presents the results and Section 5 concludes.

2. Literature Review

2.1 Digital Divide: Concept

The OECD (2001) describes the term digital divide as differences among individuals, households, businesses and geographic regions at various socioeconomic levels with respect to ICT access and usage. Norris (2001) terms digital divide as a multidimensional phenomenon, and differentiates between the global digital divide (access to Internet), the social divide (information gap among nations), and the democratic divide (engagement in public life through digital resource).[4] Van Dijk (1999) emphasises on four types of barriers to digital inclusion: lack of 'material', 'mental', 'skill' and 'usage' access.

This study focuses on the first order digital divide; the barrier to 'material' access of ICT devices. It takes a binary view of ICT inequalities, concerned with the possession of devices, and does not take into account ICT usage. Though the binary definition is a simplistic way to sort population as being digital included or not, given the bottlenecks with the data availability at a pan India level, it does help in understanding the starting point of Indian digital divide. Gunkel (2003) has argued that though reductive, the binary definition is useful for describing the limits of technological inequalities. Kalba (2008) suggests that it is vital to understand and address the ICT gaps at the household level in developing economies of Africa and India, as ICT devices remain household belongings rather than goods of individual possession and are shared among the household members.

2.2 Determinants of ICT Adoption

Prior research on digital disparities highlights the importance of macroeconomic (income per capita, services sector, foreign direct investment), demographics, infrastructural (telephone density, electricity consumption), institutional (regulation, government effectiveness), and human capital (years of schooling, illiteracy) variables in explaining cross-country ICT disparities (Chinn and Fairlie, 2007; Billon, Marco and Lera-Lopez, 2009; Cruz-Jesus, Oliveira and Bacao, 2012; Pick and Nishida, 2015). Studies have also assessed disparity in ICT access at household and individual levels and highlighted the significance of socioeconomic and demographic factors (Hoffman and Novak, 1998; NTIA, 1999; Venkatesh and Brown, 2001; Wareham, Levy and Shi, 2004; Korupp and Szydlik, 2005; Demoussis and Giannakopoulos 2006; Cruz-Jesus et al., 2012; Nishida, Pick and Sarkar, 2014; Pick et al., 2015; Nishijimaa , Marislei and Sarti, 2017). These studies have mostly used discrete choice models to study the relationship between ICT adoption and its determinants and suggest that mere deployment of telecommunications networks may not bridge the digital gap (for instance,

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3 An estimated 82 percent of households had a mobile in 2011-12; only 5.6 percent had a computer (Table 1).

4 The World Information Society Report (WIS, 2007) observes that digital inequalities exist at multiple levels: among nations, between different regions of a country, within organizations, between men and women, among the elderly and the young, among various religions, etc.

Mariscal, 2005).

Those with access to ICT devices were found to be usually richer and better educated (NTIA, 1995; NTIA, 1999; Nishida et al., 2014; Demoussis et al., 2006; Nishijimaa et al., 2017). Households from disadvantaged social groups are less likely to be digitally included (Hoffman et al., 1998), though some such groups (like African Americans) were able to adopt mobile phones faster than the rest (Wareham et al., 2004). Occupational structure also matters; persons employed as sales and executive professionals are more likely to own an ICT device (Wareham et al., 2004; Narayana, 2011). Demographic features such as age, gender, and family size influence the household's ICT device possession decision (Schumacher and Morahan-Martin, 2001; Venkatesh et al., 2001; Korupp et al., 2005; Demoussis et al., 2006; Nishijimaa et al., 2017). The general level of modernization (GDP per capita), urbanization, and network infrastructure also support digital inclusion (Goolsbee et al., 2002; Nishida et al., 2014).

A few studies have assessed ICT disparities in India. Thomas and Parayil (2008) found that variations in literacy levels and land ownership are associated with disparities in ICT adoption in Andhra Pradesh and Kerala. Narayana (2011) using a survey of 1100 households in Karnataka observed that demand for telecommunication services is positively impacted by income, while emphasising the role of caste, education, occupation, age of household head and family size. Based on a survey of 578 respondents from Uttar Pradesh and Chhattisgarh, Gupta and Jain (2015) found that adoption of mobiles varies by gender, age, and region.

Adoption of innovation or technology follows a sigmoid S-shaped curve (Vernon, 1966; Rogers, 1983) (Figure 1). The S-shaped curve embodies that, when a product is initiated in the market, it is first adopted by the innovators and early adopters, then by early majority, followed by later majority and finally by the laggards before reaching the saturation level. Rogers (1983) distinguishes various adopter categories on the basis of socioeconomic and demographic characteristics. The literature on the correlates of technology diffusion reasons that socioeconomic and demographic factors affect the technology adoption differently depending upon the penetration levels of the technology (Schumacher et al., 2001; Nishijimaa et al., 2017). During early phases of introduction of a new technology, the initial adopters are generally male, but over time as the technology diffuses, the gender gap wanes (Schumacher et al., 2001). Nishijimaa et al. (2017) observe that household income in Brazil was more strongly linked with Internet access, which has rather lower adoption than mobile phones.

Thus prior research on ICT adoption mainly focuses on the advanced countries with a few studies on emerging ones like India. Among the studies on India none have documented the household ICT divide for the entire country. This study aims to assess the first order correlates of India's ICT divide and seek to answer the following questions: (1) What is the extent of digital divide in India? (2) What are the socioeconomic, demographic, and geographic factors associated with ICT disparities? (3) Are these factors associated differently with ownership of ICT devices at varying adoption levels?[5]

3 Data and Methodology

3.1 Data

The two nationwide household level surveys used for the study were conducted in 2009-10 (66th round) and 2011-12 (68th round) by the National Sample Survey Office (NSSO) of India. Both the survey rounds contain questions on main variables of our interest: whether on the day of survey the households own the following ICT devices–personal computer/ laptop

[5] One reviewer suggested that substitution possibilities between computer and mobile phone can be examined. We believe that technology substitution could be examined separately.

and mobile handset. The surveys also offer information on socioeconomic and demographic characteristics of households and their members. The NSSO data is considered to be nationally representative and covers the whole of Indian union except the villages of Nagaland situated beyond five kilometres of the bus route and villages in Andaman and Nicobar Islands, which remain difficult to access.[6] The NSSO uses a multistage stratified probability sample design (see GoI, 2011, 2013, for details). The sample in the 66th round comprised of 59,119 rural and 41,736 urban households and in the 68th round, it covered 59,695 rural households and 41,967 in urban (Table 1).

3.2 Hypotheses

Based on the review of literature, various factors associated with possession of digital device have been grouped into the four categories, depicted in Figure 2 (see Table 3 for summary statistics). Higher income enhances the affordability of the ICT devices, thus households with higher income are more likely to own ICT device (NTIA, 1995; NTIA, 1999; Demoussis et al., 2006; Nishida et al., 2014; Nishijimaa et al., 2017). Given the unavailability of data on income in developing countries, often the monthly expenditure is used as a proxy for income. We too use the monthly per capita consumer expenditure (MPCE), which is divided into ten equal decile groups, where the highest decile (10th) represents the richest households (Table 2). Better-educated people may find it easier to operate the ICT devices, thus education level is found to be significantly and positively associated with possession of an ICT device (NTIA, 1995; NTIA, 1999; Narayana, 2011; Nishida et al., 2014; Nishijimaa et al., 2017). We use household head's education level, which is grouped into five categories. The ethnic or social group is also a deciding factor in household's device possession (Hoffman et al., 1998; Narayana, 2011; Nishijimaa et al., 2017). Social groups are sorted into four categories (Table 2) and it is expected that the scheduled tribes and scheduled castes, being among the most deprived groups in the Indian society, to have a lower probability of owning ICT devices. Religion is grouped into three categories.

The occupational structure of the household members also determines if the household owns an ICT device (Wareham et al., 2004; Narayana, 2011). The occupation variable has been categorized into three groups based on the likelihood of possessing computers. The first comprises the occupations that have least probability to own a device and the third, the occupations most likely to own the device.[7] Household demographics also impact digital inclusion (Demoussis et al., 2006; Narayana, 2011). Household with a higher proportion of members in the age group of 14-29 years, with a higher proportion of male members, and with more family members are expected to have better chances of owning digital devices.

On the supply side, access to infrastructure facilities such as access to electricity availability of telephone network, etc. impact the chances of owning a digital device (Chinn et al., 2007; Nishida et al., 2014). Electricity availability to the household is critical, as ICT devices work with electricity. Household device-density in the NSS region is taken as an alternative variable to account for the ICT infrastructure such as network and telecom towers. A NSS region level household device-density variable is constructed for urban and rural

[6] A study by Agrawal and Kumar (2017) points out that the NSSO survey data lack representativeness for Jammu and Kashmir and for Nagaland. We therefore ran two sets of regressions – one without the two states and the other, after including these. It was observed that the parameter estimates from the two sets do not differ perceptibly; hence the results are reported with all the states included.

[7] The NSSO surveys use the National Classification of Occupation (NCO) codes published by the Directorate General of Employment and Training for identifying the occupational structure of the population (GoI, 2004). We have used three-digit NCO classification to construct a variable capturing occupational status. The classification is more relevant for computers, but has also been used for mobile phones to ensure comparability of the results.

sectors.[8] Higher density would imply better ICT infrastructure in the region. Better the infrastructure, more likely are the households to possess ICT devices. Such a variable has also been used by studies to account for network or learning effects, which positively impacts ICT adoption (Goolsbee et al., 2002; Demoussis et al., 2006). Some studies find positive association between GDP and digital inclusion (Billon et al., 2009; Nishida et al., 2014). Consumption increases in a growing economy. The rate of growth of NSDP is used to control for this effect. To rule out fluctuations in the growth, mean of growth rate for past three years is used.

3.3 Econometric Methodology

This section presents the econometric model used to estimate the probability of households possessing an ICT device. Following Greene (2012), the random utility framework is used. Let $\overline{U}_i$ denotes the utility derived by the i^{th} household if s/he possesses device and $\widetilde{U}_i$, the utility if s/he does not. The (indirect) utilities can be expressed as follows,

$$\overline{U}_i = X_i\bar{\beta} + \bar{\varepsilon}_i$$
$$\widetilde{U}_i = X_i\tilde{\beta} + \tilde{\varepsilon}_i$$

where. X_i denotes the vector of characteristics for the i^{th} household and $\bar{\beta}$ *and* $\tilde{\beta}$, the corresponding parameter vectors. The i^{th} household shall choose an ICT device if the utility associated with the possession exceeds that without it, viz., if $\overline{U}_i > \widetilde{U}_i$. If we define y_i such that it assumes the value 1 if the i^{th} household possesses the device and 0, otherwise, then,

$$Prob\ (y_i = 1) = Prob\ (\overline{U}_i > \widetilde{U}_i) = G(X_i\bar{\beta} - X_i\tilde{\beta}) = G(X_i(\bar{\beta} - \tilde{\beta})) = G(X_i\beta)$$

Depending on whether the error term $\varepsilon_i = \bar{\varepsilon}_i - \tilde{\varepsilon}_i$ follows the logistic or normal distribution, G(.) corresponds to the cumulative distribution function of the logit or probit model. To decide between the two, penalized likelihood approach is used. The better model is the one with minimum deviance and penalty; Akaike information criterion (AIC) and Schwarz Bayesian information criterion (BIC) are employed to determine the better-fit (Chen and Tsurumi, 2010). We estimate separate equations for the two digital devices, for the two sectors (rural and urban) and for two survey years (Table 5).

4. Results

4.1 Descriptive statistics

About 63 percent of households owned mobile phones in 2009-10, which increased to 81.97 percent in 2011-12 (Table 1). The proportion of households possessing computers was low at 3.85 percent in 2009-10 and improved to 5.58 percent in 2011-12, which is abysmally low as compared to the world average of 40 percent in 2012 (ITU 2016). The chances of households possessing mobile phones are superior to owning computers, which could be attributed to lower cost, utility, and ease of operating a mobile phone device.

A positive correlation is observed between income (MPCE) and the possession of the two ICT devices (Figures 3a and 3b). However, the speed at which increase in income is associated with the possession of two digital devices differs. A concave curve indicates that as income increases the possession of mobile phone increases at a decreasing rate, whereas the convex curve indicates that as income increases the possession of computer increases at an increasing rate. Over time the level jump in the concave-shaped curve of mobile possession and income during the two years demonstrates that the impact of income on household ownership of mobile phones has weakened. Beyond a point increase in income does not impact

[8] The NSS regions are sub-state level geographical domains. In the 68th round, there were 88 NSS regions.

mobile phone possession in the urban sector as indicated by the flattening of the curve from the sixth MPCE decile group onwards (Figure 3a). During the two survey years, the population in the bottom four MPCE decile groups in urban sector and the bottom eight MPCE decile groups in rural were unlikely to own a computer. Computer remains a device accessible only to the rich, as the convex-shaped curve of computer possession and MPCE picks up only at the fifth decile group in urban areas and the ninth MPCE decile group in rural areas. In 2011-12 the households belonging to the richest MPCE decile group had 9.57 percent chance of owning a computer as compared to 5.95 percent chance in 2009-10 (Figure 3b).

Education of the household head is positively related to the possession of both the ICT devices (Table 4). In 2009-10, the base group of illiterate cohorts had about 45 percent chance of owning a mobile phone that improved to about 69 percent in 2011-12. Compared to the base group, graduate or above were twice more likely to possess a mobile phone in 2009-10. Thus, during the two years education as a barrier in possession of mobile phones too did show signs of weakening. However, education of the household head remains a strong deciding factor for the possession of computers. During the two years, the base group of illiterate cohorts had practically no chances of possessing a computer whereas graduate or above had 25-32 percent chance. The data shows disparities in possession of ICT devices across social groups. The scheduled tribes and scheduled castes have lesser likelihood of possessing the ICT devices.

There are also noticeable variations in the chances of household's ownership of ICT devices by their residence (Figures 4-5). During the two survey years households located in Delhi, Chandigarh, Himachal Pradesh and Haryana had the highest chances of possessing mobiles and those in Chhattisgarh and Orissa had the lowest. Bihar and Jharkhand witnessed sizable improvement (about 30 percentage points) in household mobile density. As regards computers, households from Delhi, Chandigarh, Kerala, Punjab, Haryana and Maharashtra had a better chance of possessing computers while those from Bihar, Orissa and Chhattisgarh had the least chances. Stark variations were also seen in the possession of ICT devices between sectors, though the rural-urban gap in mobile phone possession did decrease over time by about 10 percentage points (Table 1). Further, the urban-rural disparity in case of mobile phones is lower for states with high household mobile phone density; a similar association is observed in case of computers, though not as strong as in case of mobiles (Figures 6a, 6b).

4.2 Regression analysis

We find the logit model to be more appropriate as consistently the AIC and BIC values for the logit regression were lower than those for the probit. Thus, we present the logit models results, which were run separately for the two devices, sector wise (rural and urban), and for both the survey rounds (Tables 5a, 5b).[9]

There is a significant positive association between income (MPCE) and the device possession. In the case of mobile phones, income seems to be less of a deciding factor over time as indicated by the decrease in magnitude of its marginal effect in 2011-12. In case of computers, however, an ICT good with low levels of adoption, income seems to have become a stricter constraint over time for possession. Education level of the household head positively and significantly influences the adoption of digital devices by households in both the sectors. However, education as a determining factor for mobile phone(s) possession weakened during the two years. For computer(s) possession, education was a significant deciding factor across sectors and this effect grew stronger over the two years. Further, the main occupation of the

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[9] To test for multi-collinearity we use the variance inflation factor (VIF). The maximum VIF value was 2.11 during 2009-10 and 2.07 in 2011-12. As the VIF values are below 10, multi-collinearity may not be a serious problem (Greene, 2012). The explanatory power of models seems good with the models classifying around 79-98 per cent observations correctly. To account for possible hetroskedasticity, we use robust standard errors.

household significantly influences household's choice of possessing a digital device.

Household demographics also significantly impact possession of the ICT devices. Possibility of mobile phone ownership improves with increase in the share of household male members. But over the two years influence of proportion of male members in mobile phone possession has faded. The share of household male members is not a significant variable impacting household's computer ownership. Greater the number of household members in the younger age group better are its chances of possessing the two ICT devices. Interestingly, over time, the importance of population in the younger age group weakened for mobile phone(s) and increased for computer(s). The population belonging to vulnerable social group was less likely to possess ICT devices. The scheduled tribes were least likely to own mobile phone(s) while for computer(s) those from the scheduled castes were least likely to have the device.

Electrification significantly increases the chances of household possession of ICT devices. Better network infrastructure facilitates adoption of the ICT devices. The growth rate variable is not statistically significant; this could be because the growth is not accounted for separately for rural and urban sectors.

As discussed, the two ICT devices being examined, mobile phones and computers are at drastically different levels of adoption. The relationship of income with the possession of computers is convex and with mobiles, it is concave. In case of education too, we get a pattern that is broadly similar. Rogers (1983: 251) suggests that the early adopters (Figure 1) have more years of education and better income than the late adopters as innovations in early stages are costly, which only the rich can afford. The better economic status also enables them to absorb the losses, if any, and education aids them to try new ideas. The results further indicate that possession of the good, which is at high level of adoption (mobile phone) is characterised by the weakening association with socioeconomic and demographic factors over time as observed by falling magnitudes of correlates. Nonetheless, these factors remain significant and explain the variation in possession as full potential adoption is yet to be achieved. As the level of adoption of these devices approaches the full potential the significance of the socioeconomic, demographic factors is likely to diminish further. On the other hand, in case of computers, which are an ICT good with a lower level of adoption, the importance of socioeconomic and certain demographic factors have become stronger over time, and the pattern may continue till a substantial level of adoption is reached. Our findings, thus corroborate the theory of diffusion propounded by Rogers (1983).

5. Conclusion

This study assesses the first order digital inequality in India, by undertaking an empirical investigation on differences in ownership of ICT devices–mobile phones and computers–among Indian households. The study uses a basic dichotomous approach of possession of digital devices at household level to this aim. In agreement with the literature we find that the pre-existing socioeconomic and demographic differences (variation in caste, household income, education, gender, and residence) contribute to variations in possession of digital devices. This demands attention as several studies have pointed out that digital inequality could intensify the pre-existing inequalities. The findings suggest for a discerning policy to ensure ICT access to the population groups without access, based on socioeconomic profile of the population. A discriminatory policy focusing on disadvantaged groups, lesser educated, lower income group and rural people is crucial.

We study the adoption of two ICT devices at different adoption levels–mobile phones at high adoption levels and computer at low levels. The results indicate that mobile phone adoption was characterised by weakening of the socioeconomics and demographic correlates over time. Contrastingly, for computers, the association with the socioeconomics and demographic correlates strengthened over time. While income and household's head education significantly improve the likelihood of possession of the two devices, the importance of the two variables seem to have waned for mobile phones and increased for the computers. Our finding highlighting the differences in socioeconomic characteristics of early and late adopters lends support to Rogers (1983) theory of diffusion.

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Tables

Table 1 Characteristics of households in the NSSO samples

Characteristic	**2009-10**			**2011-12**		
	Rural	**Urban**	**Total**	**Rural**	**Urban**	**Total**
Number of households	59119	41736	100855	59695	41967	101662
Number of persons	287139	181412	468551	285796	179164	464960
% Households possessing						
Computer(s)	0.84	10.81	3.85	1.42	14.73	5.58
Mobile(s)	54.79	81.37	62.83	77.29	92.24	81.97
At least one of the above	50.93	78.33	59.03	77.07	92.19	81.79
Both of the above	0.67	9.91	3.4	1.38	14.63	5.52
Households having computer with mobile	89.85	98.63	97.3	98.02	99.8	99.49

Source: Authors' computations using the NSSO 66th and 68th round surveys.

Table 2 Variable definitions

List of variables	Definition
Dependent variable	
Possession of digital devices	=1, if the household possesses the device; 0, otherwise
Independent variables	
Income	As measured by monthly per capita consumption expenditure (MPCE) divided into ten equal decile groups
Education level	Education of the household head divided into following five categories: Illiterate; Literate but less than primary; Primary until secondary; Above secondary but less than graduate; and Graduate and above
Social group	Divided into following three categories: Scheduled Tribe; Scheduled Caste; Other Backward Classes; and Others
Religion	Divided into following three categories: Hinduism; Islam; and Others
Occupation structure	The occupation of the household is classified into three categories: least likely to own a device, likely to own a device, and most likely to own a device
Share_males	Share of male members in the household, that is the proportion of male members in the household to total household members
Share_14_29	Share of household members in the age group of 14-29 years
Household size	Number of members in the family/household
Electricity access	=1, if the household has access to electricity; 0, otherwise
Regional device density	Percentage of households having the device (mobiles or computers) in the NSS Region
SGDP growth rate	Average growth rate of State Gross Domestic Product during three years preceding to the survey (calculated based on the SGDP data from GoI, 2015a)

Table 3 Descriptive statistics

Variable	2009-10				2011-12			
	Rural		Urban		Rural		Urban	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Education of household head								
Illiterate	0.31	0.46	0.17	0.37	0.29	0.45	0.15	0.36
Literate but less than primary	0.12	0.32	0.08	0.27	0.12	0.33	0.08	0.28
Primary until secondary	0.44	0.50	0.43	0.50	0.43	0.49	0.42	0.49
Above secondary but less than graduate	0.07	0.26	0.13	0.34	0.08	0.27	0.14	0.35
Graduate and above	0.06	0.25	0.19	0.40	0.08	0.26	0.21	0.40
Social group								
Scheduled Tribe	0.17	0.37	0.08	0.27	0.17	0.37	0.09	0.28
Scheduled Caste	0.18	0.39	0.14	0.34	0.17	0.38	0.13	0.34
Other Backward Classes	0.38	0.49	0.36	0.48	0.40	0.49	0.38	0.49
Others	0.27	0.44	0.42	0.49	0.26	0.44	0.40	0.49
Electricity access	0.74	0.44	0.93	0.25	0.82	0.38	0.95	0.21
Religion								
Hinduism	0.77	0.42	0.75	0.43	0.76	0.42	0.75	0.43
Islam	0.11	0.31	0.14	0.35	0.12	0.32	0.15	0.35
Others	0.12	0.32	0.11	0.31	0.12	0.32	0.11	0.31
Share_males	0.51	0.19	0.53	0.22	0.51	0.18	0.53	0.22
Share_14_29	0.29	0.24	0.31	0.28	0.29	0.24	0.31	0.28
Household size (ln)	1.46	0.52	1.32	0.58	1.45	0.50	1.30	0.58
SGDP Growth rate	7.71	2.63	7.83	2.18	7.65	3.11	7.68	2.68
Regional device density								
Computers	1.63	2.64	8.56	5.25	3.25	3.67	13.66	6.95
Mobiles	60.76	13.76	75.96	8.72	83.31	9.48	91.91	4.55
Occupation								
Least likely	0.83	0.38	0.65	0.48	0.81	0.40	0.64	0.48
Likely	0.07	0.26	0.10	0.29	0.07	0.26	0.09	0.29
Most likely	0.10	0.30	0.26	0.44	0.12	0.33	0.27	0.45

Note: 'SD' denotes the standard deviation.
Source: Same as Table 1.

Table 4 Share of households having access to mobile and computers

Population sub group	2009-10 Mobile(s)	2011-12 Mobile(s)	2009-10 Computer(s)	2011-12 Computer(s)
All	63.83	81.97	3.85	5.58
Education level of the household head				
Illiterate	44.13	68.97	0.29	0.56
Literate but less than primary	54.6	77.34	0.63	1.23
Primary until secondary	69.09	87.38	2.23	3.5
Above secondary but less than graduate	86.65	95.12	9.14	11.59
Graduate and above	94.29	98.47	25.24	32.91
Social group				
Scheduled Tribe	41.64	63.12	1.08	1.6
Scheduled Caste	51.29	75.32	1.32	1.75
Other Backward Classes	64.16	84.38	2.26	3.69
Others	74.5	88.55	8.5	12.12
Religion				
Hinduism	62.32	81.49	3.78	5.5
Islam	62.13	83	1.93	3.48
Others	72.34	87.37	8.86	11.77
Gender of the household head				
Female	52.47	68.66	3.31	4.51
Male	64.13	83.78	3.91	5.73

Source: Same as Table 1.

Table 5a Correlates of possession of mobile(s)

Variable	2009-10		2011-12	
	Rural	Urban	Rural	Urban
Education of household head				
Illiterate	Base category		Base category	
Literate but less than primary	0.049***	0.031***	0.023***	0.006***
Primary until secondary	0.105***	0.050***	0.046***	0.013***
Above secondary but less than Graduate	0.178***	0.074***	0.063***	0.017***
Graduate and above	0.206***	0.084***	0.071***	0.021***
Social group				
Scheduled Tribe	Base category		Base category	
Scheduled Caste	0.034***	0.006	0.014***	0.003**
Other Backward Classes	0.068***	0.014***	0.022***	0.004***
Others	0.071***	0.015***	0.020***	0.005***
Religion				
Hinduism	Base category		Base category	
Islam	-0.016**	-0.003	-0.017***	-0.001
Others	-0.093***	-0.005	-0.040***	-0.002
Income (MPCE)				
Decile group 1: poorest	Base category		Base category	
Decile group 2	0.164***	0.243***	0.097***	0.100***
Decile group 3	0.245***	0.364***	0.139***	0.131***
Decile group 4	0.325***	0.420***	0.162***	0.146***
Decile group 5	0.400***	0.457***	0.177***	0.158***
Decile group 6	0.459***	0.484***	0.197***	0.165***
Decile group 7	0.508***	0.502***	0.203***	0.167***
Decile group 8	0.546***	0.514***	0.217***	0.172***
Decile group 9	0.590***	0.524***	0.224***	0.172***
Decile group 10: richest	0.624***	0.529***	0.233***	0.172***
Share_males	0.082***	0.037***	0.026***	0.011***
Share_14_29	0.128***	0.033***	0.048***	0.012***
Household size (ln)	0.313***	0.111***	0.090***	0.028***
Electricity access	0.114***	0.063***	0.051***	0.018***
Regional mobile density	0.003***	0.001***	0.002***	0.001***
SGDP growth rate	-0.002***	-0.001	0.000	0.000
Occupation				
Least likely	Base category		Base category	
Likely	0.147***	0.038***	0.054***	0.010***
Most likely	0.126***	0.037***	0.041***	0.011***
N	54818	39514	59437	41829
Percentage correctly classified	78.94%	85.57%	87.73%	93.56%

Notes: The figures reported above are the marginal effects, calculated at means for continuous variables. For categorical variables they are calculated at the following values: education of household head = Primary until Secondary; social group = base category; religion = base category; income (MPCE) = 6; NCO = 2.

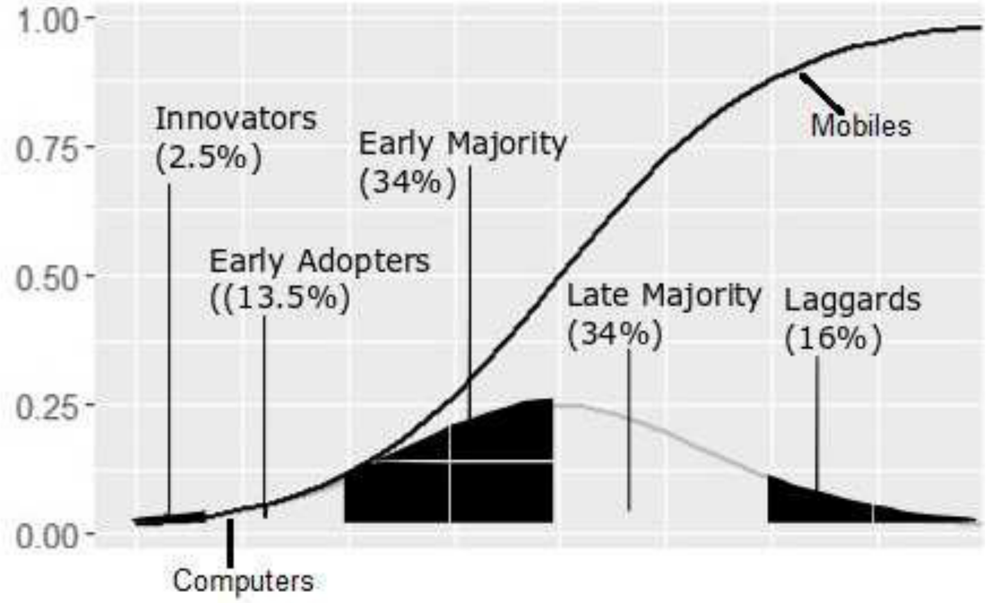
Table 5b Correlates of possession of computer(s)

Variables	2009-10		2011-12	
	Rural	Urban	Rural	Urban
Education of household head				
Illiterate	Base category		Base category	
Literate but less than primary	0.000	0.001	0.001	0.014***
Primary until secondary	0.001**	0.016***	0.002***	0.036***
Above secondary but less than graduate	0.003***	0.040***	0.006***	0.070***
Graduate and above	0.005***	0.080***	0.012***	0.131***
Social group				
Scheduled Tribe	Base category		Base category	
Scheduled Caste	0.000	-0.017***	0.000	-0.016***
Other Backward Classes	0.000	-0.008**	0.002***	-0.005
Others	0.001**	-0.002	0.003***	0.009**
Religion				
Hinduism	Base category		Base category	
Islam	0.000	-0.011***	0.000	-0.006
Others	0.000*	0.011***	0.001***	0.011***
Income (MPCE)				
Decile group 1: poorest	Base category		Base category	
Decile group 2	0.000	0.003***	0.000	0.003**
Decile group 3	0.002	0.009***	0.001	0.011***
Decile group 4	0.001	0.014***	0.002	0.023***
Decile group 5	0.001	0.023***	0.002	0.042***
Decile group 6	0.001	0.042***	0.003**	0.060***
Decile group 7	0.003**	0.061***	0.005***	0.097***
Decile group 8	0.004***	0.101***	0.008***	0.144***
Decile group 9	0.007***	0.185***	0.021***	0.240***
Decile group 10: richest	0.037***	0.403***	0.079***	0.475***
Share_males	0.000	-0.007	0.000	-0.008
Share_14_29	0.001**	0.025***	0.004***	0.045***
Household size (ln)	0.002***	0.070***	0.006***	0.100***
Electricity access	0.001***	0.015**	0.003***	0.027***
Regional computer density	0.000***	0.003***	0.001***	0.003***
SGDP growth rate	0.000	0.000	0.000	0.001
Occupation				
Least likely	Base category		Base category	
Likely	0.000	0.013***	0.002***	0.019***
Most likely	0.002***	0.029***	0.004***	0.039***
N	52680	37842	59205	41647
Percentage correctly classified	98.19%	91.98%	96.75%	89.11%

Notes: see Notes to Table 5a.

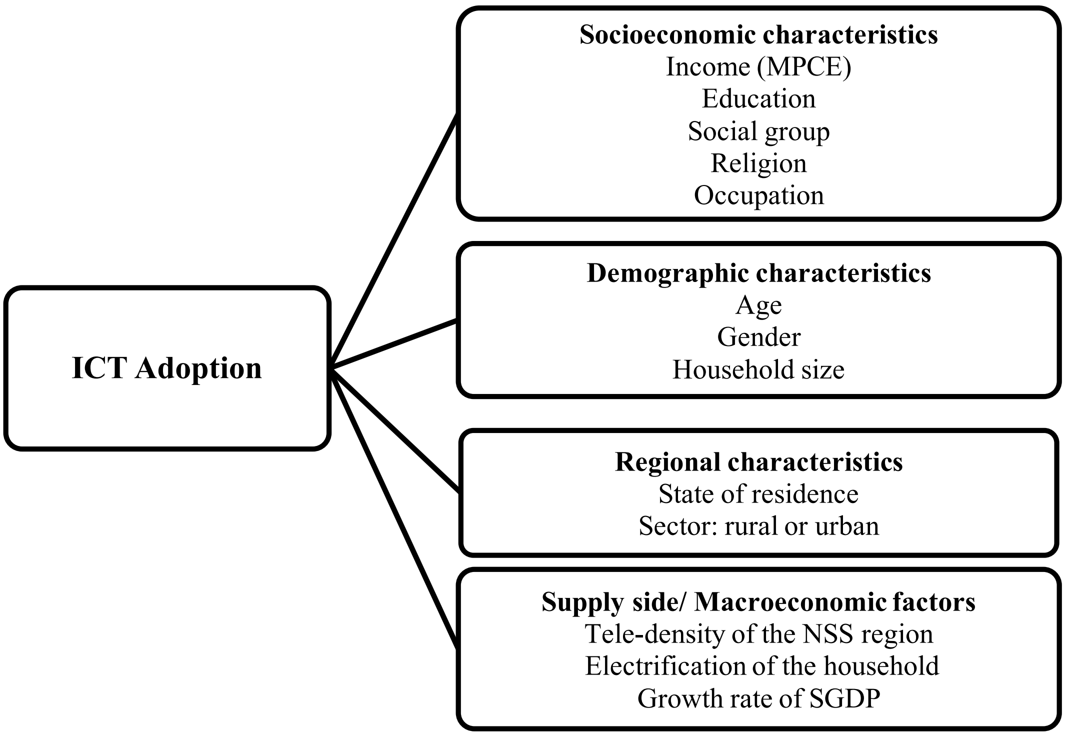
Figures

Figure 1: The Sigmoid S-shaped curve of diffusion of innovation/technology



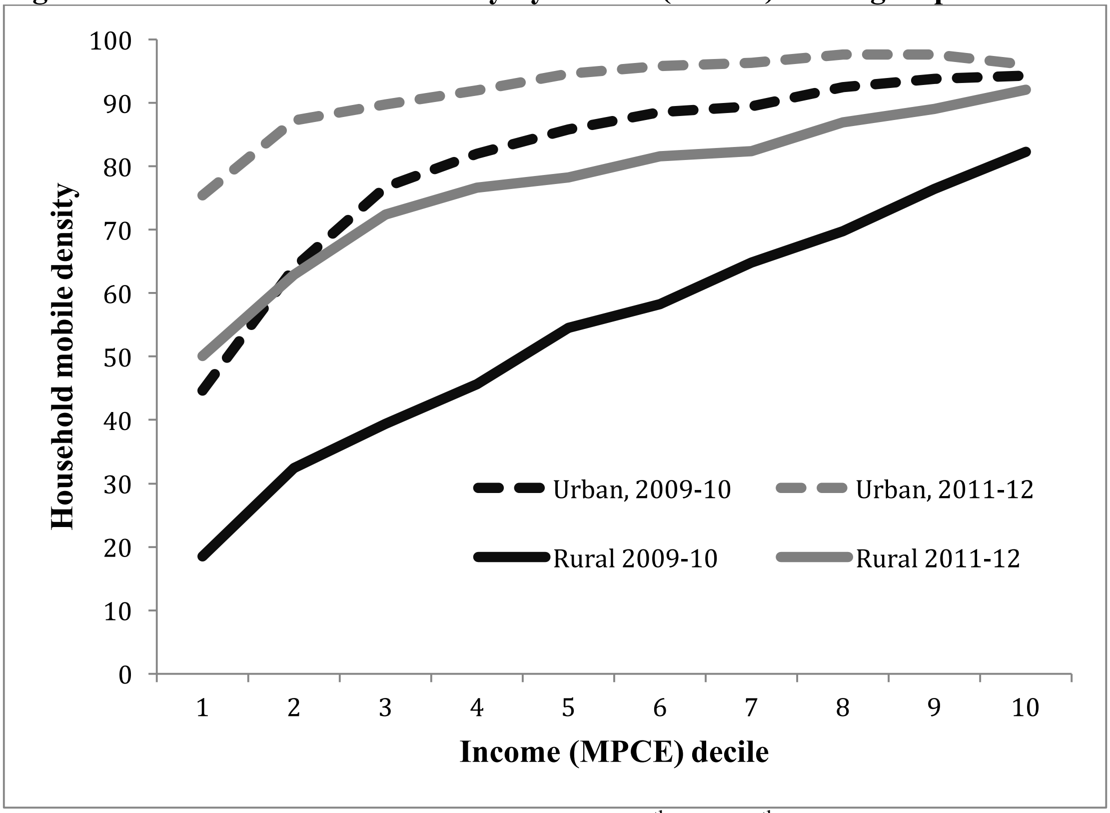
Note: The vertical axis indicates the percentage of adopters and the horizontal, time.
Source: Created by the authors based on Rogers (1983: 243).

Figure 2: Factors influencing ICT adoption



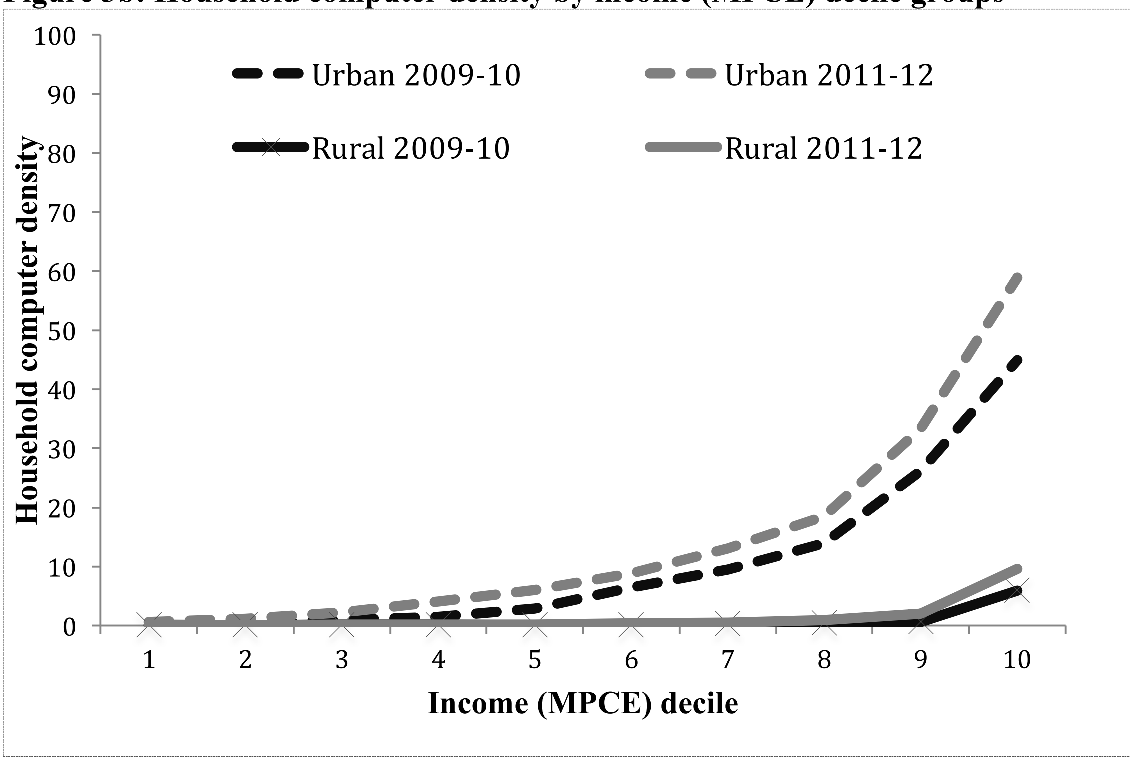
Sources: Hodge and Siegel (1968) and Authors, see Table 2 for description.

Figure 3a: Household mobile density by income (MPCE) decile groups



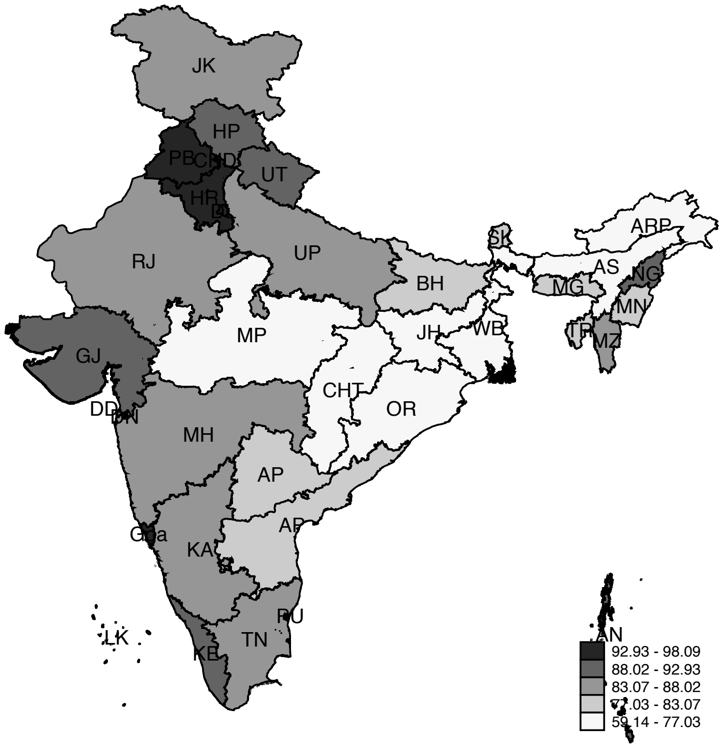
Source: Authors' computations using the NSSO 66th and 68th round surveys

Figure 3b: Household computer density by income (MPCE) decile groups



Source: Same as Figure 3a.

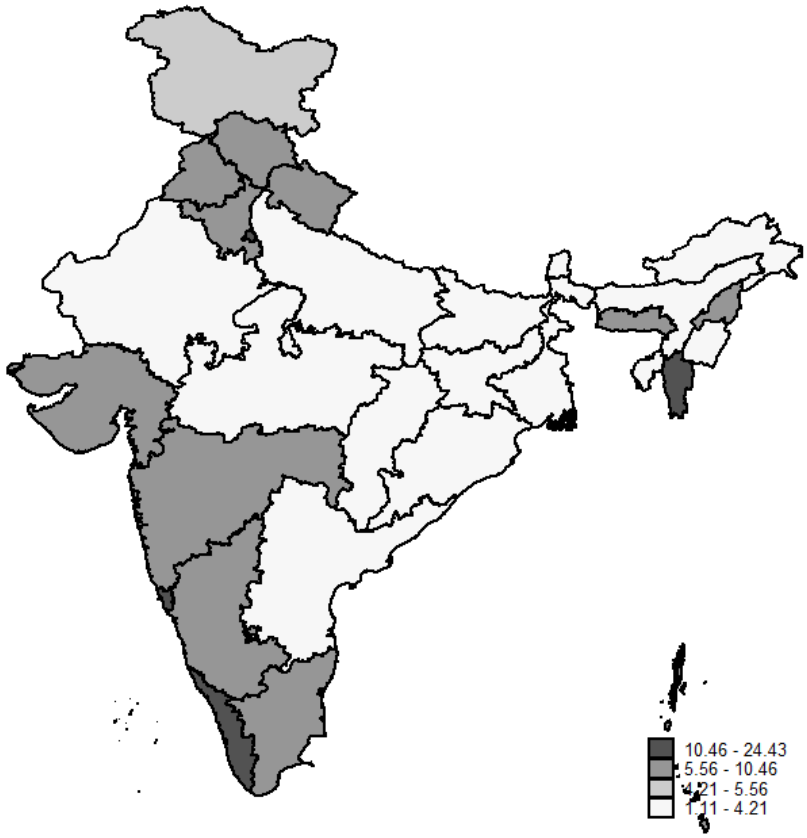
Figure 4: State wise household penetration of mobile during 2011-12



Note: AN: Andaman & Nicobar; AP: Andhra Pradesh; ARP: Arunachal Pradesh; AS: Assam; BH: Bihar; CHD: Chandigarh; CHT: Chhattisgarh; DN: Dadara & Nagar Havelli; DD: Daman & Diu; Goa: Goa; GJ: Gujarat; HR: Haryana; HP: Himachal Pradesh; JK: Jammu & Kashmir; JH: Jharkhand; KA: Karnataka; KE: Kerala; LK: Lakshadweep; MP: Madhya Pradesh; MH: Maharashtra; MN: Manipur; MG: Meghalaya; MZ: Mizoram; NG: Nagaland; DL: NCT of Delhi; PU: Puducherry; PB: Punjab; RJ: Rajasthan; SK: Sikkim; TN: Tamil Nadu; AP: Telangana; TR: Tripura; UP: Uttar Pradesh; UT: Uttarakhand; WB: West Bengal; OR: Odisha

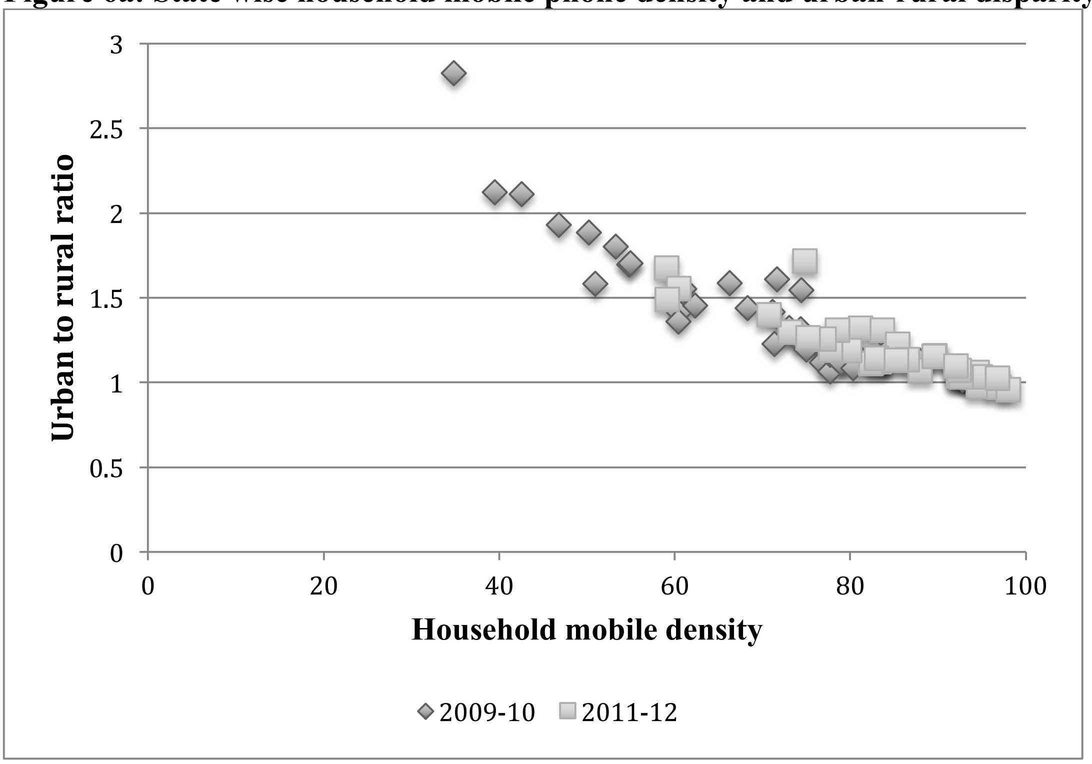
Source: Authors' computations using the NSSO 68^{th} round surveys.

Figure 5: State wise household penetration of computer during 2011-12



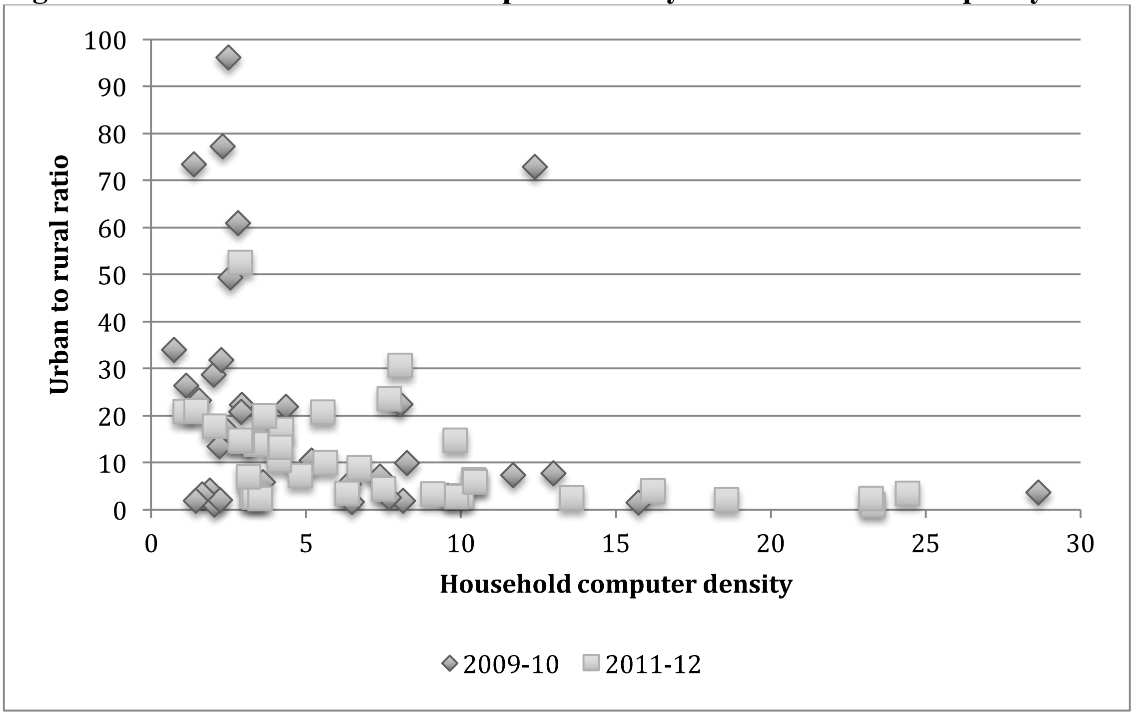
Source: Same as Figure 4.

Figure 6a: State wise household mobile phone density and urban-rural disparity



Note: Urban-rural ratio is the ratio of urban household mobile phone density to that of rural; greater the ratio greater is the disparity between urban and rural areas.
Source: Same as Figure 3a.

Figure 6b: State wise household computer density and urban-rural disparity



Note: Urban-rural ratio is the ratio of urban household computer density to that of rural; greater the ratio greater is the disparity between urban and rural areas.
Source: Same as Figure 3a.