3. LITERATURE SURVEY AND RESULTS OF PREVIOUS STUDIES

Hardy (1980) was among the first to study the telephone's role as a contributory agent in economic development. He found from an analysis of data from 45 countries for the period between 1960 and 1973 that the effect of growth in telecommunications was higher in least developed economies as compared to more developed ones, thereby bringing into focus the problem of diminishing returns. Saunders *et al* (1983) discussed not only the economic efficiency aspects of development as justifying a rapid expansion of the telecommunication sector, but also indicated the following arguments used to support increases in telecommunications investment in developing countries:

a) ".....as economic development takes place, some form of telecommunications gradually becomes the most cost-effective means of communications for increasing proportions of the population", and by substituting for other forms of communication like postal service and personal travel, telecommunications being more efficient and effective, more complex and productive communications build up.

b) Some of the physical constraints on organizational communication in various sectors of the economy are removed, thereby permitting increased productivity.

c) Improved efficiency in household communications allows for improved access to goods and services.

d) Telecommunications can reduce the energy input required to sustain a given level of communication.

e) Beneficial effects result from improvement in telecommunications infrastructure.

f) Industry and firm level efficiencies accrue from improved telecommunications services.

g) Finally, telecommunications "contributes to the development of a shared communication environment reaching the country's most remote areas", thereby facilitating political, cultural, economic, and social integration.

3.2 Cronin *et al* (1993b) found on a study of 33 years of United States data between 1958 and 1990 that investment in telecommunications infrastructure is causally related to the nation's total factor productivity[30] and that contributions to aggregate and sectoral productivity growth rates from telecoms advancement are both quantifiable and substantial. Gupta (2000) estimated that a one percent growth in telecommunication services generates a three percent growth in the economy.

3.3 The twin issues of reverse causality and spurious correlation have been subjected to research and analysis in more recent work. Hardy (1980) found the relationship between GDP growth and number of telephones per capita indicated two-way causation. In their analysis of data from the United States over 31 years between 1958 and 1991 that expanded on Hardy's work by using Granger and Modified Sims Tests, Cronin *et al* (1991) found a 'feedback process' in which telecommunications investment enhances economic activity and growth, while economic activity and growth stimulate demands for telecommunications infrastructure investment. A further analysis of localized State and sub-State level data from the United States in

[30] They define 'total factor productivity growth' as changes in final output per unit of combined labour, capital, and materials inputs, drawing from US Department of Commerce, Bureau of Labor Statistics.

Cronin *et al* (1993a) confirmed that the level of economic activity at any point in time is a reliable predictor of the level of telecommunications investment at a later point in time, and further that the amount of telecommunications investment at any point of time is a reliable predictor of economic growth at a later point of time, consistent with national level results.

3.4 Röller and Waverman (2001) were the first to adopt a simultaneous approach to model the two-way causation between telecommunications infrastructure and services development and economic growth, in their study of data from 21 OECD countries over a 20 year period between 1970 and 1990. They specified a structural model which endogenised telecommunication investment by specifying a micromodel of supply and demand for telecommunication investments. They tackled the second problem of spurious correlation that "may arise because regional specific infrastructure investments might be correlated with other growth promoting measures like R&D investments, investments in human capital, taxes, and so forth" by allowing for country-specific fixed effects. Their work established a non-linear causal relationship between telecommunications infrastructure and aggregate output, along with the existence of a "critical mass" that leads to increasing returns on growth at levels approaching universal service, suggesting that "increases in telecommunications infrastructure could create higher growth effects in OECD countries than in the less-developed non-OECD countries". Sridhar and Sridhar (2004) studied the simultaneous relationship between telecommunications and economic growth using data for developing countries. They found that while traditional economic factors explain demand for main line phones, they do not explain the demand for cell phones, and that there are significant effects of main landline and

cell phone penetration on economic growth but lower than those found for OECD countries.

3.5.1 The *Vodaphone Policy Paper Series* (2005) report studying the impact of Mobile Phones in Africa is a significant addition to the research in the area. In their paper in this volume, Waverman *et al* (2005) found using data on 92 high- and low-income countries for the period between 1980 and 2003 that mobile telephony has positive and significant impact on economic growth and that "this impact may be twice as large in developing countries compared to developed countries". They noted that

a) differences in penetration and diffusion of mobile telephony appear to explain some of the differences in growth rates between developing countries;
b) there are increased returns to endowment of telecoms capital as measured by the telecoms penetration rate; and
c) while it is unlikely that large gaps in telecom penetration will persist for ever, differences in speed of adoption (of telephone penetration) will affect the speed with which poor countries converge to the level of rich countries, suggesting the need for regulatory policies that favour competition and encourage speedy rollout of mobile telephony.

3.5.2 In another paper in the report, Samuel *et al* (2005) investigated through data collected in face-to-face interviews carried out in South Africa, Tanzania, and Egypt the socio-economic impacts of mobile communications on households, rural communities, and small businesses in Africa. They found that mobile telephones have brought considerable benefits to communities and small businesses, and that people at

all income levels are able to access, through owning or sharing, mobile services. They concluded that while income certainly explains the level of usage, lack of income does not prevent mobile use, and that gender, age, and education do not seem to constitute barriers to access. At the same time, "mobiles have reduced travel needs, assisted job hunting and provided better access to business information" for the residents of rural communities. They also reported that a large majority of small businesses said "mobiles have brought higher profits, turnover and increased efficiency, although they are paying higher call charges". In a third paper in the report, Goodman (2005) suggests links between social capital[31] and mobile phone ownership and use in rural communities in South Africa and Tanzania. In the context of women's empowerment, Tasneem (2008) reported that in Bangladesh, "cell phones not only foster connectivity and access but also contribute towards income generation and value-addition". She noted the initiative of *Grameen Telecommunications* in Bangladesh in introducing the village cell phone service that is a small home-based enterprise owned and run by women that now accounts for 30-40 percent of household income and "averages $300 per year in a country where average per capita income is $286". Melhem (2008) supplements the role of mobile telephones in empowering women in Bangladesh by quoting from reports that village phone ladies there always repaid their loans and earned on average between $300 and $785 per year after repayment – for a $284 GDP per capita, and mentions efforts to replicate the Bangladesh model in countries like Uganda, Nigeria, and Rwanda. However, she also noted the absence of gender disaggregated subscriber data with mobile phone companies and the companies' failure to recognize women as "avid absorbers and consumers of the new technologies and technology-enabled services".

[31] The paper indicates that economists are interested in social capital as derived from the works of Robert Putnam, Francis Fukuyama, and Michael Woolcock "for its contribution to productivity, and define it as the spillover from the individual to the group, a sort of social externality or network effect".

3.6 Abraham (2007) noted that there is little available research on whether there is a connection between information and communication technologies (ICTs) and economic growth, and "if indeed a connection can be established, how it works". He tested the assumption that mobile phones in their role as carriers and conduits of information ought to lessen information asymmetries and inefficiencies and increase productivity in markets by using a case-study from the fishing community of Kerala that has adopted mobile phones in large numbers. He found

a) better *market integration* and freer flow of information about supply and demand of fish due to introduction of mobile phones;

b) less *wastage* of time and resources; and

c) reduced *risk* and uncertainty.

He concluded that while mobile telephones have beneficial effects, their impact is possibly lower than the impact of introduction of the telegraph in the United States[32], and further stated that it may take about 10 more years to assess the true impact of mobile telephony in developing countries.

3.7 The interrogation of the relationship between growth in telephony and its economic and social impacts has not been limited to studies such as Abraham (2007) reported above. In an important early paper, Sridhar and Sridhar (2004) investigated the simultaneous relationship between telecommunications and economic growth using data for developing countries and found significant effects of main landline and cellphone penetration on economic growth after controlling for effects of capital and labour. These effects were reported to be lower than for OECD countries, 'dispelling

[32] He draws upon the work of K. D. Garbade and W. L. Silber: *Technology, Communication, and the Performance of Financial Markets,* Journal of Finance, 33 (3): 819-832 (1978) [not referred to in the Bibliography] to draw this parallel.

the convergence hypothesis'. Their estimate that 'India's teledensity will reach 14 by 2006' and 'is expected to reach 15 percent by 2006 well ahead as specified in NTP' has more or less been borne out[33]. They conclude that growth in telecommunications services is not a substitute for economic growth, but 'a good enabler for economic growth to *trickle down* once it occurs'.

3.8 Sridhar and Sridhar (2006) constructed a causal model of telecommunications and growth that explained economic growth (GDP) as dependent upon investment net of telecom investment, labour, and telecom penetration (along three dimensions – main landlines only, mobiles only, and all telephone lines). They further modeled demand for telecom as dependent on income (from economic growth, GDP) and price, with competition in the market place as one factor. Demand for telecom and price further impinge upon telecom investment which has a cause-and-effect link with telecom penetration. They report quantitative findings from Sridhar and Sridhar (2004) that are in tune with Röller and Waverman's estimate of a one percent increase in main telephone lines per capita resulting in a 0.15 percent increase in economic growth in OECD countries, without controlling for fixed effects[34].

3.9 A robust econometric analysis of the Indian scenario, with focus on sub-national factors, has been attempted by Kathuria, *et al* (2009). They notice that explosive growth of mobile telephony has been the driver of development of Indian telecommunications infrastructure, what with the 'compound annual growth rate (CAGR) for mobile between 1999 and 2008 in India has been 83% while that of fixed lines has been just 7.5%'. They note that the triggers for mobile growth include price,

[33] See *Table 1.1*
[34] Sridhar and Sridhar (2004) found the same impact for total teledensity (landline plus mobile).

income, and tastes, and highlight the 98% decline in effective price per minute of an outgoing mobile call to about INR 0.68 from the 1998 level of INR 15.30, as well as the decline in Average Revenue per user (ARPU) from INR 1550 per month in 1998 to about INR 250 today. They also note that income measured by GDP per capita in India has doubled since 1998, and increased competition engendered by the liberalized telecom policy regime has further added impetus to the growth story. Following the Röller-Waverman framework, they model the level of output (Gross State Domestic Product at current prices) for each State in India as a function of the total investment net of telecom investment, a measure of human capital, and the mobile penetration rate. Simultaneously, they model the level of mobile penetration as a function of the GSDP per capita, mobile price with average revenue per user (ARPU) as proxy, and fixed line price. They use a three stage least square procedure to estimate the system of equations, and arrive at the following key conclusions:

a) 10% increase in mobile penetration delivers on average a 1.2% point annual increase in output;
b) Mobile demand is highly sensitive to price (own-price-elasticity is minus 2.12);
c) Fixed line prices do not have any impact on mobile demand;
d) Mobiles are 'technically' a luxury good as income elasticity of demand is 2.45 (>1); however this needs to be correlated with micro level survey evidence that points to higher share of expenditure on telecoms than on other necessities;
e) There is a threshold ('critical mass') after which network effects have important additional significance for growth; their study reveals important

differences when States are divided into low and high penetration groups based on a 25% median penetration level achieved in 2008.

3.10.1 Other studies have tried to analyse the differential impact of mobile telephones in qualitative terms in different sectors of the economy. TRAI study paper (2008) lists the following constraints for example as inhibiting the growth of rural telephony:

a) Difficulties in land acquisition for mobile infrastructure
b) High cost of and difficulties in acquiring right of way for robust backhaul connectivity
c) Lack of infrastructure sharing among operators
d) Lack of / intermittent power supply for mobile infrastructure, and prohibitive maintenance and operation costs
e) Low ARPU/absence of affordability given low income levels
f) Lack of locally relevant content and applications

3.10.2 Specifically with regard to mobile telephony, the study paper recognizes efforts by Non Governmental Organisations to supplement efforts to localize content and find relevant applications for end users. For example, the paper refers to the 'Fisher Friend' project pioneered by M S Swaminathan Research Foundation along with Qualcomm, Tata Teleservices, and Astute that runs on 3G CDMA phones and empowers fishing communities with real time access to market information thereby enhancing livelihoods. It also provides weather information that potentially can save lives, and increases community knowledge base by delivering policy and programme information of relevance and interest to fishing communities.

3.11.1 In three other papers in the *Vodaphone Policy Paper No. 9* (2009), the impact of mobile telephony on agricultural productivity, in poor urban areas, and in the SME (small and medium enterprises) sector has been explored.

3.11.2 Gandhi, *et al* (2009) postulate that deficits in *physical infrastructure,* availability of *agricultural inputs,* and *access to information* in the communications and logistics environment of agricultural productivity have hampered growth and potential gains. They conducted field investigations for four months in 2008 in four major Indian States and New Delhi to assess information needs of farmers and the impact of mobile telephony on productivity through fulfilling needs related to *know-how*, such as crop choice and seed variety, to *context* as in weather, plant protection, and best practices in cultivation, and to *market information* as in market prices, market demand, and logistics. Based on studies of communities linked to products specifically tailored for them, they conclude that *easily accessible and customized* content, *mobility benefits* in isolated circumstances, and *improved convenience, time and travel savings* are important drivers of mobile phone impact in agriculture. They recognize further that "farmers often need highly personalized solutions that benefit from back and forth dialogue in person", and that mobile phones did not "replace the need for face to face communication". They flag the importance of information (content) being available in the local language, in addition to being "relevant, timely, and reliable". They caution that leveraging the full benefit of the underway impact of mobile telephony on agricultural productivity would require concerted effort to reduce other rural sector constraints such as *lack of access to formal credit*, and *a lack of capacity for risk-taking*. The second constraint as perceived by them offers interesting

possibilities for further research, given the largely risky nature of agricultural activity as a whole in the country.

3.11.3 In their paper surveying the usage of mobile phones in poor urban areas, Sarin and Jain (2009) try to go beyond anecdotal evidence to try and systematize learning about benefits of mobiles for poor people. They conclude that

a) Users are better off than non-users
b) Users are more likely to be involved in self-employed and regular-wage activities
c) Users and non-users have different levels of networks of contacts
d) There are disparities of usage within households, with evidence of gender divide and youth preference
e) The poor spend significant amounts on communications – with INR 2700 (USD 54) being the start-up cost that is nearly 40% of the household savings per month.

3.11.4 Sarin and Jain (2009) conclude that mobile phone usage delivers tangible benefits to the urban poor in terms of bringing about *positive changes in both their economic situation and their ability to maintain social ties,* and in decreasing *transaction costs* and increasing *work efficiency*, and that households that use mobile phones differ from those who do not in terms of *earnings, household size, education, and literacy status* as well "the economic and social networks in which they live and work". While these conclusions are by themselves significant, they leave the question of *causality open*, even as the authors admit that "the estent to which the positive experiences of the users can be replicated by non-users if they were to start using

mobiles and in the absence of other changes is debatable". A second imponderable is the study's conclusion regarding how mobiles are changing social interactions in slum areas that "might decrease physical contact and substitute it with more 'virtual' contact". Whether this aids or detracts from anomie in slums, and whether current definitions of slums that ignore completely the communications dimension[35], unless 'other infrastructure' includes telecommunications within its ambit. It is also interesting that informal home ownership that is a direct consequence of proliferation of slums is an obvious incentive for proliferation of the 'location neutral' mobile telephone access, that nevertheless has been complicated by security occasioned requirements for formal identity proof to obtain activation of mobile telephone connections. However, it is perhaps necessary to note here that 'connections to telephone infrastructure' reported to be about 25.4% in informal settlements of both Asia-Pacific and All Regions in UNHSP (2003) may have gained considerable traction in the intervening 5 years in view of the ubiquity and reach of mobile telephony in this period.

3.11.5 Uppal and Kathuria (2009) in the last paper in the volume on 'The impact of mobiles in the SME sector' find that the following three impacts are well illustrated by the case studies:

a) *"Increased income and revenues* due to improved access to consumers;

b) *Better control of costs.....;*

c) *Improved quality* of products and services....."

[35] See for example the 'operational definition of slums' from *The Challenge of Slums: Global Report on Human Settlements 2003* (United Nations Human Settlements Programme) (2003) *p.12* that offers an operational definition of a slum as combining the characteristics of inadequate access to safe water, sanitation and other infrastructure, poor structural quality of housing, overcrowding, and insecure residential status.

3.11.6 They suggest that there are numerous opportunities in mobile use for SMEs especially from *disintermediation* and better *coordination*, but also recognize that their conclusions draw heavily from urban examples that may not be directly applicable in rural areas where teledensity is still very low. They also acknowledge external factors such as low rural literacy in limiting the positive impact of mobile telephony for SMEs in rural areas, and leave the analysis with the thought that until such time that rural areas do not increase their base of consumers with mobile phones so as to reach a critical threshold in all of India's 600, 000 villages, "the mobile phone may well exacerbate not eliminate the rural-urban divide".

3.12 Thus we can see from the literature surveyed above that the impact of telephony, and later, that of mobile telephony, has been studied both along an economic-econometric dimension and the social dimension in different country settings. The early 1980s saw pioneering work in understanding and assessing the role of telephony in economic growth, and in subjecting the analysis to economic principles. Simultaneous trends towards deregulation, de-monopolization, and standardization of technology were important drivers in the quest for a better understanding of growth in the telecommunications sector that gained increasing importance in ushering in globalization. Later work at the turn of the century including the trendsetting econometric analysis of Röller and Waverman (2001) in the context of the OECD countries gave important pointers in harnessing the growth of telecommunications for the common economic good. Subsequent efforts in India and Africa have deepened the understanding of the two-way interaction between growth in telecommunications and the larger economy. The late 1990s were a period of massive investments in developing countries' telecommunications sectors in their

urgent action to catch up with the rest of the world, and the fast-changing technology and general paucity of investible resource saw a shift in paradigm from license-control to deregulation in the telecom sector as in other sectors of the economy. The twin imperatives of globalization and liberalization played a positive role in unleashing the telecom boom in India, characterized by intense growth and competition, shadowing the step-up in the pace of economic growth. Various Indian studies have shown that growth in telecommunications has an important positive effect on overall economic growth, though on a scale far lesser than what was initially speculated upon. The role of mobile telephony has been central to this growth story, and there now exists significant evidence in the Indian context of the social and cultural dimensions as well of the positive impact of mobile telephones, notwithstanding some concerns regarding the effects of impersonal, 'always-on' communication that may serve to further exacerbate the rich-poor, gender, and age divides.