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Information and Communication Technology and Poverty: An Asian Perspective

M. G. Quibria and Ted Tschang

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The emergence of Information and Communication Technologies (ICTs), in particular the Internet, has generated new enthusiasms about the development prospects for poor economies. Many now think that new technologies can provide a faster route to better livelihoods and improved quality of life than the one afforded by the standard process of industrialization. The opposing view holds that the focus on ICTs will detract attention from the more fundamental task of addressing the basic problems of economic development.

This paper attempts an even-handed evaluation of issues relating to the direct and indirect, yet broader economic impacts of ICTs. This is done by evaluating a selection of "case stories" on the direct uses of ICTs to alleviate poverty, and an analysis of the broader issues of ICTs in relation to economic growth, and of the determinants of technology adoption. The paper shows that as far as direct impacts are concerned, the use of ICTs holds significant promise, but existing data do not afford a full-fledged cost-benefit assessment. Similarly, while ICTs can also positively contribute to the broader economy, the realization of such benefits requires a physical and social infrastructure well beyond that existing in many poor countries.

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Additional copies of the paper are available free from the Asian Development Bank Institute, 8th Floor, Kasumigaseki Building, 3-2-5 Kasumigaseki, Chiyoda-ku, Tokyo 100-6008, Japan. Attention: Publications.

PREFACE

The ADB Institute aims to explore the most appropriate development paradigms for Asia composed of well-balanced combinations of the roles of markets, institutions, and governments in the post-crisis period.

Under this broad research project on development paradigms, the ADB Institute Working Paper Series will contribute to disseminating works-in-progress as a building block of the project and will invite comments and questions.

I trust that this series will provoke constructive discussions among policymakers as well as researchers about where Asian economies should go from the last crisis and current recovery.

The conference version of this paper was presented on 8 December 2000 at the ADBI 3rd Anniversary High-Level Symposium on Alternative Development Paradigms and Poverty Reduction held at the Institute.

Masaru Yoshitomi
Dean
ADB Institute

ABSTRACT

Many commentators have extolled the virtues of new information and communication technologies (ICTs) in reducing poverty and improving the quality of life. While such arguments have been used before in relation to many predecessor technologies, including other earlier communications technologies, the promise has often floundered.

This paper attempts to provide a more balanced analysis of the question, by exploring the linkages between the new ICTs and poverty reduction. It examines the linkages in two ways: the potential for direct impacts of ICTs on various areas of poverty and development, and the indirect impacts of ICTs on economic growth, exports and other macro variables in the economy. It also examines direct employment prospects in the ICT industries, particularly in the context of India, which appears to have made some breakthroughs in the software development business. The paper reviews a number of "case stories" to illustrate the potential direct impacts of ICTs in the areas of livelihood, employment, education, health, governance and empowerment of the poor.

The limitations in some of the more detailed "stories" are also evaluated. For instance, many projects highlighted by the case stories are still at a demonstration phase and require a broader evaluation framework.

Further, in many application areas, ICTs have clear trade-offs against other development priorities, while being complementary in others. Governance and education are two areas where ICTs can be significant complements to traditional systems.

The paper also undertakes cross-country statistical analysis of socioeconomic factors influencing the adoption or usage of ICTs. The principle determinants are found to be income and investments in human resources—particularly in secondary and tertiary education—and physical infrastructure. These findings have strong implications for policies. While conventional development thinking emphasizes primary education as a critical ingredient of economic development, the present analysis suggests that taking advantage of the economic opportunities afforded by new ICT industries requires much more beyond primary education. However, many other standard development prescriptions remain valid. These include the importance of a well-developed infrastructure, a strong educational system and fewer government regulations.

The paper's overall conclusion is, however, somewhat circumspect. While there are many direct benefits to ICTs, it is not often clear whether they are more efficient or cost effective than traditional means. It is also not often clear whether the poor have the financial and educational wherewithal to take advantage of the economic opportunities provided by new ICTs.

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1. Introduction

The beginning of the new millennium saw the unfolding of a sad economic paradox. On the one hand, the global economy seems to be on the cusp of a technological revolution that is ushering in a new era of economic prosperity for advanced countries. On the other, many of the world's poor countries find themselves still scourged by massive poverty, which shows few signs of retreat. According to the most commonly employed international definition of poverty—those who subsist on an income of less than U.S.$1 a day, measured in purchasing power parity terms—about 1.2 billion people of the developing world would be considered poor (World Bank, 2000).[1] Of this poor population, a vast majority—about 900 million—is found in developing Asia. That is about twice as many poor people than in the rest of the developing world combined. If a more generous definition of poverty—$2 a day—were adopted, almost three billion people of the developing world would be considered poor. For developing Asia, this would include the majority of its population—about two billion people. If a broader concept of poverty is adopted that includes other aspects of human deprivation such as illiteracy, malnutrition, bad health, poor access to water and sanitation, and vulnerability to economic shocks, the picture becomes far grimmer.

In South Asia, for instance, 50 percent or more of the population is illiterate. In countries such as Cambodia or Viet Nam, fewer than half of all households have access to safe drinking water. In the Central Asian republics, the infant mortality rate is 36 out of one thousand live births, that is 6 times higher than the Organisation for Economic Co-operation and Development (OECD) average. Over the past four decades, however, some parts of Asia, particularly the newly industrializing economies (NIEs)—Hong Kong, China; Republic of Korea; Singapore; and Taipei,China—have achieved spectacular progress in poverty reduction, virtually eradicating abject poverty. Several Southeast Asian economies have also made impressive strides: in Malaysia and Indonesia, the incidence of dollar-a-day poverty between the mid-1970s and mid-1990s fell dramatically, from 17 to 4 percent for the former, and from 40 to 11 percent for the latter.

Unfortunately, not all parts of Asia—particularly, South Asia—have achieved similar success in poverty reduction. Even in East Asia, progress against poverty has stalled in recent years and in some cases has even reversed. The financial crisis of 1997-1998 was a setback for the worst affected countries in East Asia. Although the financial collapse did not cause

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[†] This paper was prepared for presentation at the High-Level Symposium on Alternative Development Paradigms and Poverty Reduction, ADB Institute, Tokyo, 8 December 2000 [www.povpara/papers.htm] and benefited from helpful comments from the participants of the Symposium, in particular Anne Krueger, Kirit Parikh and Muzzammel Huq. However, the authors are particularly thankful to T. N. Srinivasan and M. Yoshitomi for conscientious comments on an earlier version of the paper.

[††] With assistance from M. Arif Al-Mahmood, Mathurot Chuladul and Thuy Thu Le, Research Associates at the ADB Institute.

[1] Poverty and the other data on social indicators cited in this introductory section are all drawn from the World Bank (2000a).

poverty rates to soar, as many had feared; poverty did increase, while improvements in health, education and nutrition stalled.

Notwithstanding this massive poverty, the region has been energized by the advent of the new information technology (IT), or more broadly, information and communications technologies (ICTs), which promise to be a main engine of growth for the developed world in the coming decades. While the power of ICTs is now being most keenly felt in the United States, it clearly has the same potential on a worldwide basis. This raises the question: can the enormous potentialities of ICTs be exploited to enhance the development prospects of poor countries or more particularly the well-being of the poor in those countries? More to the point, can ICTs help poor countries leapfrog the intermediate stages of technological development to the advanced stage and accelerate growth? Or at least, can ICTs provide an effective solution to the pervasive problem of poverty in Asia?

To address these questions, this paper first critically reviews a number of presently available ICTs that have been utilized in Asian economies and elsewhere to *directly* improve the economic well-being of rural and economically disadvantaged groups. In particular, it examines the effectiveness of these technologies in reaching the poor, along with the issues of economic feasibility. The paper then explores whether ICTs can become a powerful driving force for growth and employment for the economy, thereby contributing indirectly, but more potently, to poverty reduction. This can occur in two ways: either the ICT sector can emerge as the leading sector of growth and innovation for the economy,[2] or ICTs can contribute enormously toward productivity growth through their across-the-board adoption in the economy—which is analytically equivalent to leapfrogging. However, these issues require an examination of the critical socioeconomic factors conducive for successful across-the-board adoption of ICTs, and the policies required to foster those conducive conditions. While this paper does not directly address the question on the manner and pace with which ICTs should be introduced in a country, it is implicit in the discussion of the factors required for successful adoption of ICTs. There is no single answer that is applicable to all developing countries, as it would depend on the presence of favorable socioeconomic factors as well policies and institutions.

Addressing the questions posed in this paper in an analytically and empirically satisfying manner was extremely challenging because of the lack of reliable data at both the macro and micro levels. In the absence of such data, we have offered a number of micro-level "case stories" that are suggestive of various economic and social changes that ICTs can bring about, but in no way substitute for more in-depth studies in the future.

The organization of the paper runs as follows. Section 2 deals with the definition and types of ICTs. Section 3 discusses how ICTs can potentially affect poverty, both directly and indirectly. It provides a set of "case stories" that suggest how various ICTs have been applied to directly improve the welfare of rural and economically disadvantaged populations in Asian developing economies. However, these stories need to be viewed in light of their replicability, the economic cost-benefit ratios and their overall success in reaching the poor. This section also reviews how ICTs can be an indirect instrument of poverty reduction thorough their impact on growth. Section 4 discusses the various factors that influence the adoption of

[2] The term leading sector owes to Schumpter (1939). Leading sectors experience rapid productivity growth and concomitant shifts in production and consumption, but such effects are often limited to a small segment of the economy. Such leading sectors include railroads in the 1870s, organic chemicals in the 1890s, automobiles in the 1920s, televisions in the 1950s and airplanes in the 1960s.

various ICTs. Section 5 deals with the policies adopted by developing countries to take advantage of the new ICT revolution. Finally, Section 6 offers some concluding remarks.

2. Definition and Types of ICTs

The new ICTs can be divided into three broad categories: (1) computing; (2) communications; and (3) Internet-enabled communications and computing.

Computing: Computers represent the most significant technological breakthrough of the last half of the 20th century. The cost of computing has declined exponentially and the use of personal computers has increased by leaps and bounds in advanced countries. At the most general level, computers augment and improve our human and organizational thinking capabilities. In this, computers have many different uses and have affected many spheres of economic activity. One important example of how computers have transformed business is in the area of enterprise resource planning (ERP) software, which has boosted efficiency by integrating office functions such as accounting and finance. Another important use is computer-aided design and manufacturing (CAD/CAM). This process has radically improved product lifecycles (particularly, the time from point of conceptualization to when the product enters the market) as well as the quality and complexity of product design.[3]

Communications: Communication is one of the most important aspects of modern life. Typically, it has been classified into one of two forms: one- and two-way communications. The most common form is one-way communications and includes broadcasting media such as radio and television. Two-way communication devices, such as telephones, telegraphs and pagers, constitute perhaps the most important component of the information revolution, having improved significantly over the last two decades or so. The Internet's growth is largely a function of two-way communication links (telephone lines) and personal computers (PCs), as we will examine later. However, in most developing countries, mobile telephones are easier to get than traditional phones based on fixed land lines, so the movement of the Internet and Internet applications onto mobile phone systems will become an important trend in those countries.

Internet-enabled communications and computing: The Internet (including the World Wide Web) is one of the most important technologies to affect not only communication but also computerization. The Internet provides a new communications medium that allows activities such as e-mail or chat lists for group communication. Yet, it also breaks down boundaries between all forms of communication—new and old—by allowing multiple modes of communication. For example, one can now communicate via voice to others through Internet telephony, or use mobile phones to access the Web. The World Wide Web is only one of the technologies that allows people to search for and obtain information. It is now normal for people to post messages, create home pages and communicate with many others. The Internet also provides communities with whole new means of communication (i.e., many-to-many point communication such as chat lists and discussion forums) and collaborative platforms.

The Internet provides people with access to more and better information. It also facilitates new ways of representing information (e.g., multimedia), structuring information

[3] An important advantage of CAD/CAM over conventional procedures is its ability to transfer information regarding designs easily, rapidly and accurately across organizational and national boundaries without distortions. The use of CAD/CAM has become so pervasive that workforces in small and medium enterprises in Singapore had to be retrained in three-dimensional CAD technology in order to remain relevant to the design needs of multinational enterprises.

(hyperlinks), and creating information (collaborative and distance work). Unlike other media that treat users as passive recipients, the Internet is an active media for communication, and demands more sophisticated thinking and logical skills than any other.

The Internet is fast evolving, going beyond PCs and into palmtops, mobile phones and soon, appliances. Already, Bluetooth technological standards and devices will allow any device to "talk" (electronically) to any device through wireless systems, including the wireless Web, cell phones, laptops, or household appliances. The Internet has revolutionized not only communication, but also commerce and computing in all fields, including scientific computing and business automation. With the advent of the e-economy, commerce has undergone radical transformation (with trade in information products growing exponentially). In business, the simple automation of processes such as accounting and payroll, and the integration of these functions via ERP software, is now giving way to Web-based inter-enterprise or intra-enterprise ERP (e.g., outsourcing of most nonessential business functions), supply-chain management, auctions for procuring supplies, etc.

3. How Can ICTs Help Reduce Poverty?

ICTs can potentially enhance the welfare of the poor in two ways: directly and indirectly. *Direct* applications of ICTs to address the welfare of the poor include the following (not necessarily in order of importance):

- Information about markets, opportunities, etc.—information is critical to any well functioning market and the Internet is being used to assist in the collection, and delivery and use of such information.
- Employment—ICTs are being used to provide information on new employment opportunities as well as becoming a source of new employment opportunities.
- Skills and education—new and innovative experiments exist with respect to the provision of both formal (curricula-based or certifiable) and informal education through the ICTs.
- Health care—innovations are being made to deliver health care to the poor through effective utilization of ICTs.
- Delivery of government services—new ICTs are used to enhance the efficiency of governments and reduce corruption.
- Empowerment—ICTs are being utilized to improve communications between the government and the governed, thus allowing the poor new avenues to air their grievances.

ICTs can also enhance the welfare of the poor *indirectly*, although often more effectively, through rapid growth, which has an associated trickledown effect in terms of enhanced income and employment.

3.1. Direct Impacts of ICTs

As noted above, ICT has the potential to improve the welfare of the poor in a number of ways. These include improved availability of market information, creation of new economic opportunities, better access to health and education facilities and by promotion of a more efficient and fairer system of governance.[4]

[4] The literature exploring the interlinkages between ICTs and poverty is sparse. Previous efforts in this regard include Mansell and Wehn (1998), Talero and Gaudette (1995) and the World Bank (1998). However, none of

ICT to Provide Market and Other Information for Improving Livelihoods: ICT can be an important source of market information. It can provide consumers with information on the lowest prices of products or on the lowest and different sources of supply, help reduce transaction costs and barriers to entry, and improve market efficiency. Following the lead of developed countries, but understandably to a considerably much lesser degree, ICTs are being used in various states of India as well as in other developing countries to increase the availability of market information to consumers and producers. This helps improve the efficiency of the markets in which the poor participate and, thereby, improves their economic prospects. A few examples include:

♦ *Information centers*: A number of such information systems exist in India. First, the M. S. Swaminathan Research Foundation (MSSRF) in Chennai has established village information centers to provide rural farmers with data about agricultural practices. These were set up with support of the Canadian International Development Research Center (IDRC) and other aid agencies, to provide poor villagers with various types of information through the Internet in order to enhance their economic well being. This information includes the cost and availability of farming inputs (from distant suppliers), grain and seed prices, health and life insurance, welfare opportunities, and other aspects of their work and daily lives (see case story 4 in Appendix 2). Another such project is the Warana Wired Village in Maharashtra, which has set up information kiosks in 70 villages to allow villagers access over the Internet to agricultural as well as medical and educational information (Bhatnagar, 2000). Third, on a much larger scale, states such as Andhra Pradesh and Karnataka are, through private sector investment, equipping thousands of villages with information kiosks that can access government and other information (see case stories 1 and 2 in Appendix 2).

♦ *E-Marketplaces:* In India, the Internet is being used to market the produce of poor communities. Two examples are particularly notable. First, a US-based nongovernment organization (NGO), PEOPLink, has linked producers of commodities in poor communities in Tamil Nadu to potential markets through the Internet (PEOPLink, 2000). One village in Tamil Nadu—Kizhur—which excels in making traditional cotton saris and other cotton garments, sells its produce through PEOPLink's Web site to consumers all over the world. These types of innovations have the potential of substantially reducing transaction costs by eliminating the layer of intermediaries who often absorb a large chunk of the profits (see case story 6 in Appendix 2). Second, similar functions are performed by an Indian NGO, the Foundation of Occupational Development (FOOD), which promotes the sale of rural women cooperative's products through the Internet. However, success in such efforts is not likely to be easy or immediate as there are insurmountable barriers to Internet commerce, such as trust (between buyers and sellers), payments, security and distribution (see case story 5 in Appendix 2).

♦ *Milk cooperatives:* One successful application of ICTs has been the use of technology to enhance milk collection in Gujarat milk cooperatives, India (Bhatnagar, 2000). Electronic technology is used to measure and transmit the quality and quantity of milk that farmers are delivering. This system makes the collection and evaluation process

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these provides a systematic analysis of how ICTs can provide information services that affect the poor at the project level nor do they explore their macroeconomic implications.

faster and more efficient, and reduces the cheating of farmers that intermediaries have been known to engage in.

♦ *Farmers' task managers:* In some parts of Jammu and Kashmir, farmers can monitor the soil on their fields while sitting at home, thanks to sophisticated computer equipment imported from Austria. ICTs can be used for managing the farmer's timetable, crop scheduling, insect and rodent control, marketing and even water management. There are some Web sites set up exclusively to serve farmers, providing information ranging from crop patterns and weather forecasts to latest government policies on agriculture. Similarly, in Rajasthan, software called "SimTanka" was written to help villagers calculate the amount of water they could expect in their tanks and ponds based on simulations and past records of the area.

As these examples illustrate, there are information lacuna that create opportunities for ICTs. One of the main efforts in this regard has been the establishment of information centers that provide rural populations with access to a variety of services. However, for information centers to be successful, several issues have to be tackled. The first and foremost is the relevance of the center—whether the information content provided is relevant to the needs of the clients. Other issues of similar import relate to the availability of adequate financial and human capital, and physical infrastructure; to the mode of operation of the information center—whether it or some other node in the network has information gathering and other capabilities; and to the cost effectiveness and the degree to which appropriate technologies are used (see Appendix 1 for further discussion on the major issues emerging from the case studies on telecenters).

Needless to say, the Internet is not the only means of disseminating market information to the rural areas or selling produce of the poor. ICT tools such as fixed-line telephones and mobile phones can be as effective at improving business opportunities and transaction efficiency as the Internet (see case story 3 in Appendix 2). As such facilities permeate into rural areas, it is expected, as is obvious from the present trend, they will be increasingly used for such commercial purposes. For instance, the Self-Employed Women's Association in Gujarat helps women in remote villages to support themselves by trading, buying and selling goods using telephones (InfoDev, 1999).

Some of the projects profiled above are innovative and apparently beneficial to farmers and other poor villagers. But many of them, especially the pilot projects, are still financially supported by external donors. What are not clear are the full costs involved, the benefits, the sustainability of the projects, and on larger scales, the amounts of human capital and other support required to make the best use of these facilities.[5]

Nonetheless, it seems that some of the larger-scale projects must be financially viable, even attractive, as some states in India have been able to attract private sector partners. For example, the state governments of Andhra Pradesh and Karnataka are working with private sector telephone companies, such as Reliance, to put fiber optic infrastructure and information kiosks in villages (they also work with mobile phone companies and seek to

[5] The full economic benefits of such innovative projects need to be systematically evaluated. However, such an exercise is not easy as many of the benefits are not easily quantified. These include aspects of social benefits that accrue from the learning of various analytical and other skills, improved access to information that enhances the quality of life for people (e.g., access to information about crops or training programs), and the development of an "IT culture."

provide coverage to urban areas). Reliance is putting 7,500 information kiosks into each of these two states (covering about a quarter of the villages) because it sees an attractive revenue base among the users who can be charged a per transaction fee for accessing government databases, e.g., land registries, through these kiosks. Finally, as we noted earlier, it is also not fully clear whether many of these pilot projects can be replicated and broadened in scope, i.e., whether larger networks of information centers can provide increasing value added to extra users and nodes in the system. It is highly likely that when the system becomes overly complex, central network administration becomes increasing difficult. Consequently, the task of delivering services that everyone would find useful could become challenging.[6]

ICTs for Creating New Employment Opportunities: The need for business information, as well as the inexorable trend toward globalization that even touches the lives of remote villagers in such countries as Bangladesh (in the form of migrant workers), has led to new business opportunities in the ICT sector. We can think of the ICTs helping to create or improve employment opportunities directly through a "rural ICT sector" or "occupation."

One example is the demand for cell phone services in rural Bangladesh**.** The program is a remarkably innovative initiative that makes use of ICT to generate incomes for poor households in rural areas. A study by the Canadian International Development Agency (CIDA) concludes that the program contains many rural development "firsts." It is the first rural development microcredit facility in a developing country to target the creation of microenterprises based on ICT services. It is the first rural development microcredit facility in a developing country to assist in the creation of a village telephone service business using digital wireless telephony**.** It is also the first private sector rural telecom initiative that targets poor village women to establish microenterprises (targeted microlevel program). Finally, it is the first with an explicit purpose of rural poverty reduction (Richardson, Ramirez and Haq, 2000).

The impact of the program on poverty reduction has been significant at the household level since the revenue stream from the telephone business is substantial. In addition, this activity is largely supplemental—the owner of the mobile phone does not have to give up her existing business or household chores while operating the telephone services. This has also enhanced the status of the women (since most village phone [VP] operators are female): it has greatly improved their authority in regards to decision making in the household (especially when the telephone is under the control of the women rather than their husbands). The social status of telephone owners in the village has significantly increased because their houses become a hub of rural activity with people waiting to make phone calls, including the better-off villagers (see case story 3 in Appendix 2).

The success of the Grameen Phone program in Bangladesh has spurred a number of similar programs in other parts of South Asia. These programs allow people to rent out mobile phone services to others in their villages. Such programs can be cost effective in terms of handset cost recovery (although cost-recovery calculations often do not factor in the cost of base stations and other infrastructure). Also, one needs to recognize the inherent limitations of such programs as an instrument of employment creation: however successful these projects are at creating opportunities for some people, they are not likely to be expandable to many. That is, not everyone in a village will be able to make a living by selling mobile phone time. However, other employment opportunities may arise from different applications of ICTs.

[6] The global Internet is an opposing case in point: it is a self-organizing entity to which many people contribute content, and in which many nodes act as information gatekeepers.

It is also possible for ICTs to create employment opportunities for the rural poor *directly* in the IT industries. One possibility that has been discussed is to transfer lower level computer work from the urban to rural areas. Many of these activities, such as data entry, Web site design and some of the back office processing (e.g., call center operation), are labor-intensive and can be low wage, making them prime targets for transfer to rural areas. However, this could very well need fiscal incentives in order to convince businesses to shift their operations to rural areas with telecommunications links. Without such incentives, the work is most likely to gravitate to urban or other areas where existing business ties are strongest.

Another work scheme on the books is the Andhra Pradesh government's goal to convert the "unproductive" part of its workforce (consisting of positions such as attendants) to revenue-generating activities such as data entry. To do this, they are considering partnerships with the private sector to develop these employees' skills.

While these ideas for using ICTs to create employment for the rural and urban poor are interesting and ambitious, there are reasons to be skeptical of them as an important vehicle of poverty reduction. It is not clear how much illiterate farmers or fishermen in the developing world will be able to cope with the demands of sophisticated ICTs and telematics tools.[7] The most basic educational requirement for using ICTs is some degree of literacy.[8] In addition, further capabilities such as interpreting information and creating knowledge will require more domain expertise and some basic IT skills (the latter of which can perhaps be learned in informal ways).

ICTs for Educational and Learning Opportunities: An important distinguishing characteristic of the poor is that they have few assets, including human capital. Most of them also have little or no education. Illiteracy is more the norm than exception among the poor. One way for the poor to escape poverty is to improve their human capital by way of education. Education can be formal or informal. Formal learning requires the support of traditional institutions. There are many variants of formal distance education, as we will see later. For adults, informal education can be more relevant and can be designed to cater to their needs. In this connection, along with conventional literacy programs provided by the community or religious institutions, distance learning can be a powerful mechanism to supplement the educational needs of the poor. Distance education through radios has historically been quite an effective mechanism in many countries and many new ICT programs are being designed around these. Distance education can also offer valuable credential opportunities for commercial employment for workers seeking work in the more modern sector.

Depending on the type of technology and the degree of change in educational practice, the potential impacts of ICTs on education differ. Educational technologies can be classified

[7] However, experience suggests that even uneducated persons can be motivated to learn to use modern tools if they find sufficient benefits. This explains the rapid spread of electronic pocket calculators among uneducated shopkeepers in many developing countries and the rising demand for cell phones among illiterate women in Bangladesh.

[8] It is presumed that where illiteracy is predominant, literate users would serve as bridges to the rest of the user group. This is indeed the underlying assumption behind the Development of Women and Children in Rural Area programs initiated by the Andhra Pradesh government. Some projects such as the MSSRF Pondicherry use secondary school-educated volunteer staff to assist users in their information centers. However, to undertake more sophisticated higher "value added" employment, greater educational preparation becomes necessary. Thus, for positions in IT coding and software development occupations, vocational and university level certifications are essential.

into three broad modes: First, *distance education* via satellite and other traditional means—this involves traditional content (e.g., lectures) in synchronous learning (i.e., all students learning at the same time). Due to the larger scale and synchronous nature, this may be more suited to traditional or formal forms of distance education. Second, *web-augmented learning*—this involves use of the Web for improving content or educational delivery of standard content, e.g., lectures. Often, this may be done asynchronously (i.e., each of the students learning at their own pace). Third, *more advanced ICT-enabled learning environment*—this involves the creation of new learning environments, in which both pedagogy and content take on such new forms as computer tutors and delivery of asynchronously "chunked" Web-based lectures (i.e., lectures that can be accessed in parts in nonlinear sequences) (Brusilovsky and Miller, 2000). These online educational systems may be supplemented or supported by access to Web resources, e-mail, and other communications and collaborative environments. The second and third modes are suited to formal and informal learning.

Many, if not most, distance education systems lie between the first and second modes. Even the more technologically rich systems for students in higher education institutions are mainly offering variants in content or pedagogy. The World Bank's African Virtual University (AVU) is an exemplar of this: it connects African institutions of higher education with universities in the West via synchronous satellite broadcasts of lectures. There may have been some improvements by delivering better quality content (e.g., lectures from the best teachers), but the satellite delivery method is second generation at best, being less interactive or asynchronous than the best Web-based methods. Nevertheless, as a recent evaluation suggests, the AVU can be economically viable, and the content and pedagogy has been appreciated by students (Juma, 2000). This model relies on "foreign" institutional cooperation, and there is a need to ensure that local institutions can be equally successful when foreign cooperation is reduced or ceases.

Some countries such as the People's Republic of China (PRC) and India have well developed distance education systems and are moving to the second and possibly even to the third modes. Larger, more established distance education institutions are making the transition to Web-based delivery systems, which should improve pedagogy and content. For instance, the Indira Gandhi National Open University carries a substantial amount of the content of its distance education systems via the Web. Another case is the Indonesian vocational system, which allows students and teachers to communicate via the Internet (see case story 7 in Appendix 2).[9] Other institutions, such as the new breeds of schools in Thailand, and similar "Smart Schools" in many countries such as India, Malaysia and Pakistan, are putting in Internet connections and computers to ensure that their students can have access to new content and learning opportunities (Szczypula, Tschang and Vikas, 2000). Such projects are mostly being carried out in established educational institutions for formal learning, with none located in rural areas. It is also important to recognize that learning with ICTs and trends in distance education are also inextricably associated with the demands of current society for lifelong learning and the training of individuals to "learn how to learn."

For the poorest however, things are changing more slowly and in bits and pieces. A few pilot projects and software development efforts are underway for rural areas. Of these, a

[9] The Indonesian Government has set up an Internet-based information system that connects vocational institutions that are widely spread out across the country's islands. This allows students and teachers to exchange curricular and other information, construct Web sites and even communicate their concerns all the way to top government administrators.

notable example is Andhra Pradesh, where villagers can now gain literacy from computer-based software learning systems. Another example of this is the World Bank's program to train low-income women in computer skills in India. The Grameen Bank is collaborating with Nippon Electric Company (NEC) of Japan in developing an online educational system that would provide "knowledge on demand" for whole families, depending on their demands. People would decide what, how much and the pace at which they would want to learn.

To meet the educational needs of illiterate villagers in Bangladesh, the Grameen Bank is working with media experts at the Massachusetts Institute of Technology (MIT) to develop a voice-operated system. This speech technology would allow a person to speak in Bangla and the computer would reflect the interpreted text instantaneously on the screen. This text can be interpreted back into voice and read out aloud by the computer. With this technology, an illiterate woman can talk to the computer and start learning how to read and write (Asia Society, 2000).

As laudable as these experiments are, it is not clear how replicable they are. Past experience suggests that many potentially good technologies or practices could not be replicated beyond the demonstration phase. In addition, perhaps the more economically viable way to reach these poor communities may still be through traditional means, such as radio, television and print, which are essentially outpost classrooms. Village information shops and kiosks may also provide some learning opportunities, but they are not, in most developing countries, in a position to supplant those traditional means.

While ICTs open up new learning opportunities, most developing countries simply do not possess the financial wherewithal to take the full advantage of these opportunities. Many still lack such basic educational infrastructures as trained teachers and adequate physical facilities (consequently, many students in rural areas still go without desks, writing boards or proper school buildings). Given the paucity of traditional facilities, it is highly unlikely that these countries would be able to sustain a well-developed physical infrastructure that new ICTs demand. It is therefore not clear whether and to what extent ICTs can be an effective complement, or let alone a substitute, for traditional educational tools.

ICTs for Health Care: The poor in developing countries suffer from many disadvantages, one of the most serious being the lack of access to adequate healthcare services. One suggestion to overcome the inadequacy has been to link up medical facilities at home and abroad. For example, hospitals across India—in particular in Mumbai—and other developing regions are making use of systems such as WebMD's Internet system to link health care workers around the world, and to provide access to medical information from other countries about illnesses and treatments (United Nations Foundation, 2000). Grameen Bank and Hewlett-Packard have been working together in a joint venture to bring health services to rural villages through e-Health Care System. It will be self-supporting in operation.[10] The system was due to be operational by the end of 2000 (Asia Society, 2000).

These specialized public databases and communities illustrate the potential value of the Internet, but again, as with other ICT applications, it is far from proven whether investments in such systems are more efficient, or even as efficient, as traditional investments in better equipment, more doctors or hospital wards. It is also unclear as to what extent these Internet-based services can be accessed by the urban poor, let alone the rural poor.

In rural areas, without the assistance of third parties, more often than not, the required

[10] Self-support is highly important as systems dependent on donors or private sector counterparts can be highly unstable. The recent failures or downturns in US dotcom healthcare concerns such as DrKoop.com and even WebMD are cases in point.

expertise would not be there to interpret and use some of the information from sophisticated domain-specific fields such as health services. Again, as with other ICT applications, it will be necessary for policymakers to establish at what point in the health care system's development that such ICT-based systems should be added to complement the traditional system.

ICTs for Good Governance: E-government has become a fashionable word these days. The proponents of this notion argue that greater efficiency, transparency and accountability of government will be achieved by the introduction of an e-government. More important, it is believed, government services to citizens will be greatly enhanced. The citizens will not have to waste time standing in a queue for some paperwork, running around to find the right agencies for their needs or waiting for the papers to be delivered. Everything will be done online, from replacing a lost identification card to registering vehicles. A kind of one-stop shop for satisfying all citizens' needs in the Internet has already been or is being set up in some developed countries such as Austria and Singapore. Many governments in developing countries—such as the PRC and India—are trying to imitate such examples.

In addition to services, an e-government can also be expected to create opportunities for citizens to participate in the decision-making process as well as to check on the operations of their governments.

ICTs are now increasingly being widely applied to improve government efficiency and to decrease arbitrariness and unfairness in the traditional system. Some examples include**:**

♦ The PRC has begun using ICTs to revamp its government services. The "Government Online Program" called for the proportions of government services to be online to be 30 percent, 60 percent and 80 percent by 1998, 1999 and 2000, respectively. This also relates to several "Golden Projects" being carried out by the Government. These include the Golden Tax project, which uses ICTs for tax filing; the "Golden Bridge" project to wire millions of PRC citizens to a nationwide financial network; the "Gold Card" project that uses smart cards to facilitate financial transactions and payments to the government; and the "Golden Customs" project, which will facilitate tariff collection. Similar efforts are underway in a number of other Asian developing countries (Wu and Yuan, 2000).

♦ Another successful early case was the Indian Government's computerized ticketing system for its railways, which has improved efficiency and reduced corruption among ticketing officials (Heeks, 2000).

♦ The latest and most ambitious projects are the Gyandoot project in Madhya Pradesh and Vision 2020 of the Chief Minister Chandrababu Naidu in Andhra Pradesh. These seek to provide a broad range of government services with ICTs, including provision of access to government departments' information, issuance of smart cards, making billing and tax processes electronic, etc. (see case stories 1 and 2 in Appendix 2).[11]

[11] In the Andhra Pradesh case, its government claims that the e-governance scheme is really part of an overarching framework for reducing poverty as well as putting the state on the world IT map. An improved governance system would on the one hand improve the allocation of public resources, and on the other, the participation of the poor. However, the government effort is largely directed toward creating infrastructure, thus leaving few resources for social investments. Ultimately, whether the government's information programs succeeded in helping the poor would depend on the quality of the information, and the success with which the government could eliminate red tape and corruption in the system. No doubt the value of electronic governance (as well as any other applications) would improve significantly if the poor had higher educational attainments.

Critics argue that e-government is just another fancy idea that has little relevance for citizens of developing countries, where basic economic needs remain largely unfulfilled. Moreover, even if it is a good idea, the successful implementation of such an idea is virtually impossible in most developing countries for bureaucratic and political reasons. For instance, in India, earlier attempts to computerize government operations failed due to bureaucratic apathy and lack of implementation capability (Heeks, 2000).

Also, it may be noted that while e-governance can be a source of efficiency for the government, it has its own downside. In the absence of a vibrant participatory political system, e-governance may take Orwellian turns, as comprehensive computerization of individual data can make government omniscient and omnipotent. In addition, if all decisions taken are mechanically based on the government's interpretation or assessment of the data, citizens are likely to lose their voice. However, computers are not necessarily good or bad, much depends on what use is made of them.

ICTs for Empowerment: India's experience suggests that the introduction of ICTs into government operations has partly contributed to the empowerment of poor villagers by enabling them to improve control over their lives. These technologies have made their voices heard, and increased access to local resources and participation in defining public services to serve their own needs. Thanks to ICTs, villagers can fairly easily reach higher-level officials, through electronic mail, videoconferencing or live television programs, to express their needs or report wrongdoings of government officers, especially those at middle and low levels.[12] The Madhya Pradesh government practice of consulting regularly with local citizens to select services provided, and design and test the network system has not only contributed to the success of the project but also opened opportunities to the villagers to take part in the decision-making process.

The rise of the IT industry in India has created a whole new class of rich entrepreneurs, some of whom are dedicated toward philanthropy and appear keen on improving educational and health facilities for the poor. Some IT corporations such as Infosys, one of the largest in India, are funding student scholarships for local universities and providing colleges with grants to buy equipment or fund faculty research.[13] The Infosys Foundation also helps fund hospitals (wards and buildings for urban areas; equipment for rural hospitals), orphanages, books for libraries and science centers. Its *Rural Reach* program seeks to increase awareness of computers among children in semiurban areas. Another program involves the teaching of convicts' children by a group of software professionals out of Bangalore's International Technology Park. While these instances of IT philanthropy are inspiring and praiseworthy, it remains to be seen how substantial an impact they can make on the lives of the poor.

Summary Assessment: This section provided a rough summary of how different types of ICTs can potentially affect poverty. The box opposite summarizes information gleaned from the case studies in Appendix 2, as well as basic facts about development. The box makes clearer that various ICT applications may improve the poor or the lower income groups in different ways, and also indicates the comparative advantage of ICTs over traditional development tools.

[12]A recent survey from Andhra Pradesh computed the perceived corruption levels in various government agencies. The highest level prevailed in the electricity board, which incidentally, became the first service whose data were computerized. The information is based from the office of the Special Secretary for IT to Andhra Pradesh.

[13] For more detailed information, see Infosys (2000) at http://www.itlinfosys.com/corporate/comminv.htm.

Poverty and Types of ICT intervention

Correlates of poverty	What ICTs can do	Category of poor that benefits	Comparative advantage of ICTs over traditional tools
Lack of sufficient nutrition, health, water and sanitation	Information improves delivery of health services. ICTs can do little or nothing for nutrition, water and sanitation	Does not help the poor significantly	ICTs cannot provide basic infrastructure and services, but information can improve them, e.g., medical information
Lack of skills or education	Distance education or learning-assisted ICTs	Potentially all can benefit, but the poorest segment is likely to be excluded. However, some lower income individuals, not necessarily the poor, might be able to take advantage	ICTs can complement traditional teaching resources
Lack of employment or income earning opportunities	Employment in ICT professions (e.g., mobile phone operators, IT industry work); but may be marginal	May benefit the lower rungs of income distribution but not necessarily the poor	ICTs can help in disseminating employment information
Lack of information and social capital	Market information on agriculture and cottage industry produce, labor market conditions and other income earning opportunities	May benefit the lower rungs of income distribution but not necessarily the poor	ICTs can be used in complementary fashion or integrated with traditional media, e.g., radio broadcasting, Internet information
Poor quality of governance	More efficient government	Potentially all can benefit, including the poor	ICTs can be used in conjunction with traditional practices
Lack of voice and participation	E-mail access to decision makers, participation in news, discussion fora, etc.	Potentially all segments of society, including the poor, can benefit	ICTs can be used to complement traditional avenues such as newspapers and other media

As the box indicates, while ICTs can improve the delivery of basic services such as health care, they require an underlying traditional system with trained medical personnel to interpret or make use of that information. ICTs cannot tackle other basic needs such as food, nutrition and access to water supply. There are indeed aspects of such basic needs that require the development of physical infrastructure, to which ICTs may have little or nothing to contribute.

ICTs can improve the employment situation and help in the education arena. The direct employment effect of ICTs in the poorer countries has so far been limited and largely restricted to those with some education. ICTs can improve education through distance education or local (computer-assisted) learning systems. This, however, would require trained and computer-literate teachers.

Information is important for those who are engaged in the production and trading of agricultural commodities. ICTs can contribute to efficient and timely delivery of this information. However, the poor, who are often the landless workers, are unlikely to benefit much from this information irrespective of whether it is provided by the government or NGOs. On the other hand, landed farmers, whether large or small scale, would benefit to varying degrees from this improved availability of information.

Political empowerment is also a potential effect of ICTs, though its magnitude is likely to differ across the classes. Given that the poor suffer from many different disadvantages in the economic, social, cultural and other spheres, it is not clear to what extent they are likely to participate in e-governance. Nor is it clear to what extent this participation will translate into substantive economic or social benefits.

From the case studies, it appears that there are potentially important direct impacts of ICTs that can be beneficial to society, if not necessarily to the poorest segments. Developing countries should creatively use traditional means, in conjunction with ICTs, to alleviate poverty's various facets. However, the role of ICTs is likely to vary from country to country, depending on the stage of development. In societies where basic literacy and numeracy are missing, and infrastructure is primitive, traditional tools to foster basic education are likely to be more effective. Similarly, basic services such as health care, doctors and hospitals have to preexist before ICTs can be utilized to improve their delivery. For more developed societies, ICTs can play a more effective role in improving the economic status of poor and disadvantaged segments of society.

The paucity of hard data suggests that much more micro-level research is needed to assess the impacts of ICTs on the poor: their employment opportunities, their education and skills formation, and their overall empowerment within the society. The raw data for these studies may come from the many ICT programs that are being implemented in poorer countries. These studies would also guide future implementation of such programs, by avoiding the pitfalls of faulty conceptualization and poor implementation and by building on their strong points.

3.2. Indirect Impact of ICTs

Empirical evidence suggests that economic growth is found to be the most effective means to alleviate poverty (see, for example, Pernia and Quibria, 2000, and Srinivasan, 2000). ICTs can potentially alleviate poverty in significant ways if they lead to rapid growth in income and employment. This income growth can occur either through a boom in sectoral production (with little or no economy-wide efficiency spillovers) or through an economy-wide efficiency

gain.[14] A sectoral production boom may result from success in the export of a particular ICT product (for example, software) and may be bereft of any efficiency effect on traditional sectors of the economy. On the other hand, a successful across-the-board adoption of ICTs may lead to economy-wide efficiency gains akin to those in advanced countries.

With respect to the first possibility, some developing countries have found a niche in the ICT domain for promoting their export and economic growth. One such ICT product in India is software,[15] which has been a significant stimulus of growth for the economy. Total software exports in India reached $4 billion in 1999. The Indian IT industry grew at a compounded annual rate of 40.5 percent between 1994 and 1999 and constitutes about 1.5 percent of the economy (NASSCOM-McKinsey, 1999). A widely cited recent study by NASSCOM and McKinsey suggests that if India can continue this momentum of growth, the country can expect to earn about $87 billion from the export of software by 2008 and employ 2.2 million more workers (exceeding the 280,000 workers in 1999).[16] But if these economic projections were realized, software exports would be the main engine of growth for the economy and might hold the key to future transformation and modernization of the economy. Such growth is likely to have a salutary impact on poverty reduction through its various linkage effects in production and consumption.

Another area in which developing countries are likely to excel because of their comparatively low wages is IT-enabled services such as remote data processing. Data processing work is labor intensive and requires as a starting basis not much more than a secondary education and familiarity with English. Many multinational companies have been using offshore services of this type of work from such diverse countries as the Caribbean, PRC, India, Philippines and Sri Lanka. In 1999, such services in India employed some 46,000 people and contributed about $500 million to export earnings. They are expected to contribute about $17 billion in export earnings in 2008 and generate more than one million more jobs (NASSCOM-McKinsey, 1999). It was expected that with further integration of the global economy and improvements in the telecommunications infrastructure, a large chunk of business-related data-processing services would move to developing countries. These services, which are growing at a rapid pace, can potentially play a role in poorer countries' economic transformation in the post-industrialization era similar to that played by labor-intensive

[14] ICTs have been classified as "General Purpose Technologies" (GPTs). These GPTs are a form of drastic technological innovation used in a wide range of sectors that dramatically change existing modes of operations (Helpman, 1998).

[15] Analysis of the Indian software industry is drawn from a variety of sources (Arora et al. [1999]; Heeks [1996, 2000]; NASSCOM [2000], NASSCOM-McKinsey [1999]) as well as primary research in the forthcoming ADBI Working Paper Code: 13/2001, Ted Tschang, "The Basic Characteristics of Skills and Organizational Capabilities in the Indian Software Industry" [www.adbi.org/publications/publicat.htm].

[16] As with many such projections, they are based on assumptions of rapid growth in three new or high value added areas: $10 billion in software products, $17 billion in IT-enabled services (e.g., call centers, back office services such as customer relations management and human resources), and $4 billion in e-business. They also assume slowing growth (but still with a dominant share—$30 billion) in IT service-like enterprise applications and maintenance of legacy systems. However, these rosy projections will not come to pass if Indian industry fails to make that transition, in snagging its share of the international IT-enabled services, in making traditional industry more efficient with e-business or in making inroads in the international software products market (NASSCOM-McKinsey, 1999). All these efforts require, at the minimum, massive amounts of skilled labor (which in turn require educational system reforms from the basic to the highest university levels), yet also imaginative and risk-taking corporate capabilities and a strong domestic user base. This is in addition to the traditional requirements of growth, such as better infrastructure, and social and political stability. McKinsey cites other reports that state that India's lagging telecommunications infrastructure alone could contribute to the loss of $24.5 billion per annum and 650,000 jobs out of the projected numbers.

manufacturing such as textiles, garments and footwear in the earlier round of industrialization in East Asia.

Another potential route to enhance growth in developing countries—and thereby reduce poverty—is through comprehensive adoption of new ICTs throughout the economy, a strategy of economic leapfrogging. This would help modernize their economies and accelerate growth if successfully implemented. The United States and a number of other developed economies have apparently succeeded with the help of ICTs in overcoming the "speed limits" set by the historical growth rates trend. While the contribution of ICTs to the growth of these economies is now universally acknowledged, the precise extent and nature of this contribution is contentious. In particular, the contribution of ICTs to an economy-wide productivity in the United States has been the subject of a good deal of recent empirical studies.[17] These productivity studies are fraught with many conceptual and data difficulties. Keeping this caveat in mind, the important empirical finding that emerges is that the rapid pace of the US economy in the second half of the 1990s was made possible through the rise in labor productivity induced by ICTs.[18] In particular, several of these studies note that for the US economy, IT contributed between 44 and 73 percent of the acceleration in labor productivity, which was estimated at between 0.7 and 1.5 percent during the second half of the 1990s. For the whole economy, total factor productivity (TFP) due to production of new technologies is estimated to have contributed between 0.2 and 0.3 of a percent to the increase in productivity growth. These studies find some spillover TFP effect outside from the IT sector with the notable exception of Gordon (2000) (see Table 1 for various productivity estimates for the US economy). While many other developed economies experienced similar measures of productivity growth, acceleration in labor productivity growth has been most pronounced in the United States.

Importantly, this growth in the United States and elsewhere was made possible through significant changes in the skills composition of the labor force, managerial practices and firms' organizational structure. These changes were able to accommodate the advantageous features of the new technology.[19] However, they involved a significant time lag between the introduction of new technology and yields in productivity.

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[17] These productivity studies were largely spurred by the Nobel laureate, Robert Solow. In 1987, Solow, in a book review, famously stated: "You can see the computer age everywhere but in the productivity statistics." The failure of massive investment in information technology to boost productivity growth has now come to be known as the *productivity paradox*.

[18] Recent work by Paul David (1999) shows that productivity growth did not accelerate until 40 years after the introduction of electric power in the early 1880s. It was not until 1920 that the adoption rate for electricity reached half of US industrial machinery. Industries also required time to reorganize their factories around electric power to reap the efficiency gains. By contrast, half of the population in the US already uses a personal computer, 50 years after the invention of computers and only 30 years after the invention of the microprocessor. The Internet recently achieved a 50 percent diffusion rate in the US, only 30 years after it was invented and seven years after it was launched commercially in 1993.

[19] There is a lively debate in the US as to whether the "new economy," embodied in ICT innovations, measure up to a second industrial revolution that encompasses electricity, automobile and air transport, radios, motion pictures and indoor plumbing. There is no unambiguous answer to this query. On the one side of the spectrum are economists like Gordon (2000) who doubt whether such a comparison is valid. He thinks that these ICT innovations "fail the hurdle test as a Great Invention." He goes on to argue: "Internet surfing may be fun, but it represents a far smaller increment in the standard of living than achieved by the extension of day into night achieved by electric light, the revolution in factory efficiency achieved by the electric motor, the flexibility and freedom achieved by the automobile, the saving of time and shrinking of the globe achieved by the airplane, the new materials achieved by the chemical industry, the first sense of live two-way communication achieved by the telephone, the arrival of live news and entertainment into the family parlor achieved by radio and then television, and the enormous (*cont.*)

Table 1. United States: Sources of the Acceleration in Labor-Productivity Growth 1974-1999 (percent)

	Study 1	Study 2	Study 3	Study 4	Study 5
	Jorgenson & Stiroh	Oliner & Sichel	Whelan	Council of Economic Advisors	Gordon
	1990–95/ 1995–98	1990–95/ 1995–99	1974–95/ 1996–98	1973–95/ 1995–99	1972–95/ 1995–99
Acceleration in labor productivity	0.90	1.00	1.00	1.50	0.7
Of which:					
Capital deepening	0.30	0.50	...	0.50	0.30
IT sector	0.20	0.50	0.50	...	...
Other sectors	0.10	0.00	...	...	...
Labor quality	–0.1	–0.1	...	0.10	0.10
Total factor productivity	0.70	0.70	...	0.90	0.30
IT sector	0.20	0.20	0.30	0.20	0.30
Other sectors	0.50	0.50	...	0.70	0.00
All other factors	...	...	0.30	...	0.00
Memorandum					
% of acceleration in labor productivity related to IT	44	64	73	...	...

Notes: Study 1: Dale Jorgenson and Kevin Stiroh, "Raising the Speed Limit: US Economic Growth in the Information Age," Brookings Papers on Economic Activity (Washington, DC, 2000); Study 2: Steven D. Oliner and Daniel E. Sichel, "The Resurgence of Growth in the Late 1990s: Is Information Technology the Story?" *Journal of Economic Perspectives* (forthcoming); Study 3: Karl Whelan, "Computers, Obsolescence, and Productivity," Board of Governors for the Federal Reserve Working Paper 2000-6 (Washington, DC: Federal Reserve Board, May 2000); Study 4: Council of Economic Advisors, Economic Report of the President (Washington, DC: US Government Printing Office, 2000); Study 5: Robert J. Gordon, "Does the 'New Economy' Measure up to the Great Inventions of the Past?" *Journal of Economic Perspectives* (forthcoming). Study 3 looks at computer equipment only. All others incorporate data on communications equipment and software.

Source: IMF (2000), *World Economic and Financial Surveys: World Economic Outlook,* http://www.imf.org/external/pubs/ft/weo/2000/02/

improvements in life expectancy, health, and comfort achieved by urban sanitation and indoor plumbing." On the other hand, Cohen, DeLong and Zysmari (2000, p.66) go on to argue that "modern information technologies…magnify and focus our brain power in a way analogous to the way the tools of the Industrial Revolution magnified and focused muscle power…Information technology is the most powerful tool-set yet: in addition to enabling wholly new things (e.g., bio-technology, wireless communication), information technology significantly enhances the power and finesse of all previous tools."

It is suggested that developing countries would also experience a similar, even a greater, shift in productivity if they incorporated ICTs more comprehensively in their production structure. How realistic is such an idea? As data on ICT diffusion indicate, the diffusion rates in most Asian poor developing economies remain abysmally low to make such a transition to the new technology regime feasible in the immediate future (see next section). Diffusion would require substantial investments in related physical infrastructures as well as human capital much beyond the present capacities of many developing countries. Even if such resources were available, the impact would be far from immediate. These economies would need a considerable amount of time to assimilate the technology, reorganize their production structures, reconfigure their organizational structures and adjust management practices in line with the new technologies. In the transition period, there are likely to be substantial adjustment costs in terms of production disruptions and unemployment.

In short, however tantalizing the idea of technological leapfrogging may be, it will entail a radical development strategy involving an across-the-board adoption of ICTs in the economy. However, such a strategy may not be feasible or desirable for all developing countries.[20] It may not be feasible because it may entail changes in skills and organizational structures of these economies much beyond their present capacities. It may not be desirable because many of these activities entail substitution of one medium with another, with different implications for labor demand. Many of these substitutions would reduce the demand for unskilled labor, which may not be desirable for a country struggling with a large unemployment problem. This is not to denigrate the important role ICTs are likely to play in the future economic transformation and modernization of poor economies. The process needs to be carefully crafted with due consideration of the various social, economic and other constraints.

4. Determinants of ICT Adoption

How are developing countries faring in ICT adoption and what are their future prospects? To gain insights into these important issues, it is important to study the economic determinants of ICT adoption. This section discusses these issues primarily in the context of Asian countries for two reasons. First, poverty is more pronounced in developing Asia than anywhere else in the world; second, relevant data were more easily available for these countries than many other parts of the world. However, despite the focus of the present analysis, it is hoped that the insights gained would be equally applicable to other parts of the developing world.

Where do Asian countries stand in terms of their adoption of ICTs? An examination of the present status of ICT adoption is important because it provides an idea of the potential of an economy to exploit the economic opportunities afforded by new technologies—or more generally, the prospects for transition to the "new economy."

[20] In India, anecdotal evidence suggests that the operations of certain industries, such as financial services, automobile manufacturing and textiles, have made some productivity gains due to the diffusion of ICTs. Yet labor productivity remains low in a large majority of firms in traditional manufacturing. They do not have sufficient financial resources to undertake an organizational overhaul, which requires investments in hardware and software as well as complementary skills.

Table 2: ICT Diffusion in Selected Economies (per 1,000 people) s

Economies	Telephone main lines	Cellular phones	Personal computers	Internet users
	1999	1999	1999	2000
Newly Industrializing Economies				
Hong Kong, China	577.5	636.1	290.5	260
Korea, Rep. of	441.4	504.4	189.2	323.1
Singapore	482	418.8	527.2	419.1
Taipei,China	545.2	522.4	180.7	288.4
Other East Asian Countries				
People's Republic of China	85.8	34.2	120	13.4
Southeast Asia				
Indonesia	29.1	10.6	9.1	1.8
Malaysia	203	137	68.7	68.8
Philippines	39.5	36.6	16.9	6.2
Thailand	85.7	38.4	22.7	16.5
Viet Nam	26.8	4.2	8.9	1.3
South Asia				
Bangladesh	3.4	1.2	1	0.2
India	26.6	1.9	3.3	4.5
Nepal	10.6	..	2.6	1.4
Pakistan	22.2	2.1	4.3	8.5
Sri Lanka	36.4	12.2	5.6	3.4
Central Asian Republics				
Kazakhstan	108.2	3	..	4.2
Kyrgyz Republic	76.2	0.6	..	2.1
The Pacific				
Papua New Guinea	11.4	..	..	0.4
Developed Countries				
Japan	494	449.4	289.6	213.8
US	681.8	311.5	510.5	537.20

Data sources: International Telecommunication Union (2000) and Nua Internet Surveys (2000).

As would be expected, the adoption of ICTs varies significantly across countries. Like anywhere in the world, Asian countries have also experienced a rise in the use of personal computers, though the degree of expansion has varied. Table 2 shows the most recent estimates of the numbers of personal computers among Asian developing countries. The NIEs are, quite expectedly, heading the pack among Asian countries and their figures are comparable to those of advanced countries. For example, Singapore had 527.2 personal computers per 1,000 people in 1999, which is 1.8 times the figure of Japan in the same year. The rest of the developing countries, including India, which has achieved a large measure of international success in software development, have far fewer numbers of personal computers per capita. South Asian countries appear to have the lowest per capita computers in the list, ranging from one computer per 1,000 people in Bangladesh to 4.3 in Pakistan. In other words,

the picture of personal computer usage in Asia is an extremely diverse one, one of haves and have-nots, representing a stark digital divide.

What are the basic economic determinants of ICT diffusion?[21] Are the determinants of adoption and diffusion different in developing Asia from the rest of the world? To address these queries, we undertook a set of elementary regression exercises. While the quantitative results are tentative, they are highly suggestive and seem to be in broad sympathy with the results available from developed countries such as Japan and the US.

How do country characteristics such as income and population size affect the use of ICTs? Simple regression analysis of ICT usage against these country characteristics suggests the following results. First, computer usage is strongly correlated with GDP per capita, with an income elasticity of computer usage more than unity (see Table 3). Similarly, Internet use is highly correlated with income, with income elasticity being nearly 2. The usage of other types of ICTs such as fax machines, telephone lines, televisions and cellular phones—all are highly income elastic. Second, as far as population size is concerned, regression analysis does not suggest any additional benefit from a larger size as far as personal computer, telephone line and Internet use is concerned. However, when income is controlled, the use of cell phones and televisions appears to increase with a rise in population. This may reflect the simplicity of the technology involved and their easy availability for purchase in most countries. Third, in all cases, the Asia dummy was insignificant, implying that these relationships are not substantially different in Asia compared to the rest of the world.

Table 3: ICTs, Income and Population

Variables	Population	Income	Asia	R^2	Observations
Cellular phone	1.065*** (25.617)	1.882*** (25.310)	–0.191 (–0.810)	0.86	145
Fax machine	–0.152 (–1.783)	1.524*** (11.698)	0.007 (0.017)	0.60	75
Internet use	0.009 (0.220)	1.897*** (28.904)	–0.335 (–1.536)	0.81	153
Personal computer	–0.098 *** (–2.999)	1.613*** (27.035)	0.024 (0.222)	0.88	90
Telephone line	–0.056** (–2.319)	1.441 *** (31.807)	0.083 (0.563)	0.86	144
Television	1.061*** (8.664)	2.657 *** (15.132)	0.492 (1.573)	0.86	57

Notes: 1) T statistics are in parenthesis; ***, ** and * indicate statistical significance at 1 percent, 5 percent and 10 percent level, respectively. 2) Standard errors are corrected for heteroscedasticity by using method proposed by White (1980). 3) All variables are in per capita and in logarithms. 4) For Asia dummy, Asia equals 1 and 0 otherwise. Income is per capita income in purchasing power parity.

Data sources: International Telecommunication Union (2000) and Nua Internet Surveys (2000).

[21] The present discussion does not make any distinction between different usage of ICTs—whether they are used as a consumption or production item—for lack of disaggregate data.

How does education affect the adoption of various ICTs? Simple regression results, as reported in Table 4, suggest the following. First, the relationship between computer usage and education is statistically significant at the 10-percent level with tertiary education. The same is true as far as Internet use is concerned. For Internet use, secondary education is also significant at the 1-percent level. It may be noted that firm-level evidence from the US and Japan confirms the complementarity of college level (tertiary) education with ICT use (Bresnahan, Brynjolfsson and Hitt, 1999; Economic Planning Agency, 2000). For other types of ICTs, such as cellular phones, fax machines and television, education does not play any significant part.

Are there any complementarities between different types of ICTs? Again, simple regression analysis suggests the following (see Table 5). First, telephone use is strongly correlated with personal computers and Internet use. Internet has a high correlation with telephones largely reflecting their complementary nature.

Second, as would be expected, there is no complementarity between telephone use and television use, nor telephone use and cellular phone use. Third, the connection between Internet usage and income level increases when controlled for telephones. This suggests that when the telephone infrastructure exists, income level becomes the principal determining force.

Table 4: ICTs, Income and Education

Variables	Income	Primary	Secondary	Tertiary	R^2	Obs
Cellular phone	1.882*** (9.148)	0.004 (0.812)	–0.008 (–1.174)	0.007 (0.800)	0.85	106
Fax machine	1.652*** (5.688)	0.014 (1.548)	–0.013 (–1.071)	0.015 (1.560)	0.70	59
Internet use	1.490*** (6.481)	–0.001 (–0.007)	0.012 (1.252)	0.028*** (2.921)	0.88	56
Personal computer	1.443*** (15.725)	0.004 (0.661)	0.001 (0.376)	0.008*** (2.804)	0.93	68
Telephone	0.917*** (9.412)	0.001 (0.145)	0.018*** (4.169)	0.001 (0.194)	0.89	107
Television	2.479*** (4.521)	0.018 (1.209)	0.002 (0.210)	–0.007 (–0.534)	0.85	49

Notes: 1) T statistics are in parenthesis; ***, ** and * indicate statistical significance at 1 percent, 5 percent and 10 percent level, respectively. 2) Standard errors are corrected for heteroscedasticity by using method proposed by White (1980). 3) All variables are in per capita and in logarithms, except percentages. 4) For Asia dummy, Asia equals 1 and 0 otherwise. All regressions include a population control, which is not reported. 5) Income is per capita income in purchasing power parity. All regressions include an Asia dummy, which was statistically insignificant, and a population control, both of which are not reported.

Data sources: International Telecommunication Union (2000), World Bank (2000b) and United Nations Educational, Scientific and Cultural Organization (UNESCO) (2000).

Table 5: Complementarity between Technologies

Variables	Income	Telephones	R^2	Obs
Cellular phone	1.884*** (7.451)	0.030 (0.173)	0.87	133
Internet use	1.251 *** (6.009)	0.459 *** (3.475)	0.83	138
Personal computer	1.206*** (6.670)	0.344** (2.219)	0.90	85
Television	1.653** (2.421)	0.680 (1.496)	0.87	56

Notes: 1) T statistics are in parenthesis; ***, ** and * indicate statistical significance at 1 percent, 5 percent and 10 percent level, respectively. 2) Standard errors are corrected for heteroscedasticity by using method proposed by White (1980). 3) All variables are in per capita and in logarithms. 4) For Asia dummy, Asia equals 1 and 0 otherwise. 5) Income is per capita income in purchasing power parity. All regressions include an Asia dummy, which was statistically insignificant, and a population control, both of which are not reported.

Data sources: World Bank (2000b) and International Telecommunication Union (2000).

Last, we found that there is a nonlinear relationship between income and telephone lines. There is a threshold point after which telephones become relatively commonplace. Figure 1 represents this relationship, which is a third degree polynomial with statistical significant coefficients. Among Asian economies, the NIEs have the highest per capita availability of telephones, comparable to other advanced countries. There may be two different reasons for this distinct separation between countries. First, the well-connected countries may have a well-developed infrastructure. The second may be due to the benefits of the so-called network externality: the benefit of getting a telephone rises as the number of people with telephones in the economy increases.

In summary, it appears that the principal determining factors for diffusion of ICTs in developing countries are income and investments in human resource and infrastructure development. However, the degree of influence of these variables is not uniform across the types of ICTs.

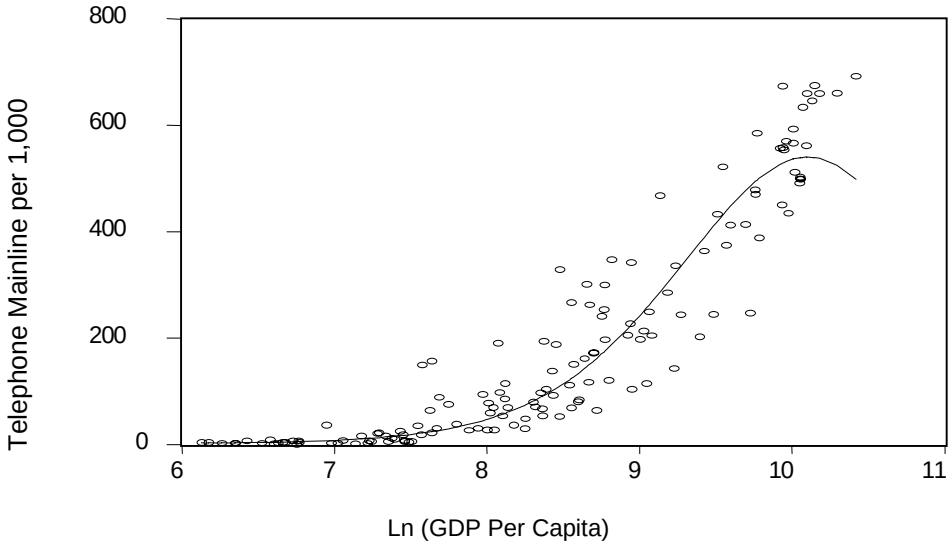
5. Policies to Promote ICTs

As is clear from the earlier discussion, income as well as social and physical infrastructure play a critical role in the adoption of ICTs. With economic development, ICT adoption will no doubt increase. This is borne out by the linear relationship between GDP per capita of countries and the adoption of the Internet, the principal component of the new ICT revolution, as shown in Figure 2. The line AB is the international adoption line, which was derived by regressing the adoption of Internet against per capita income of the countries expressed in purchasing-power-parity terms. It shows the international average adoption rate for that particular level of income. Some countries have done better than the international average (i.e., what is warranted by their per capita income), while countries have done worse than expected from their income levels (see Table 6). This deviation from the average is largely the result of relevant physical and social investments promoted by these countries. Some countries have underinvested compared to the international average for that income level.

These countries need to increase their investment levels in such activities if they are to catch up in the adoption and diffusion of ICTs. That would require, among other factors, getting their relevant policies and institutions right.

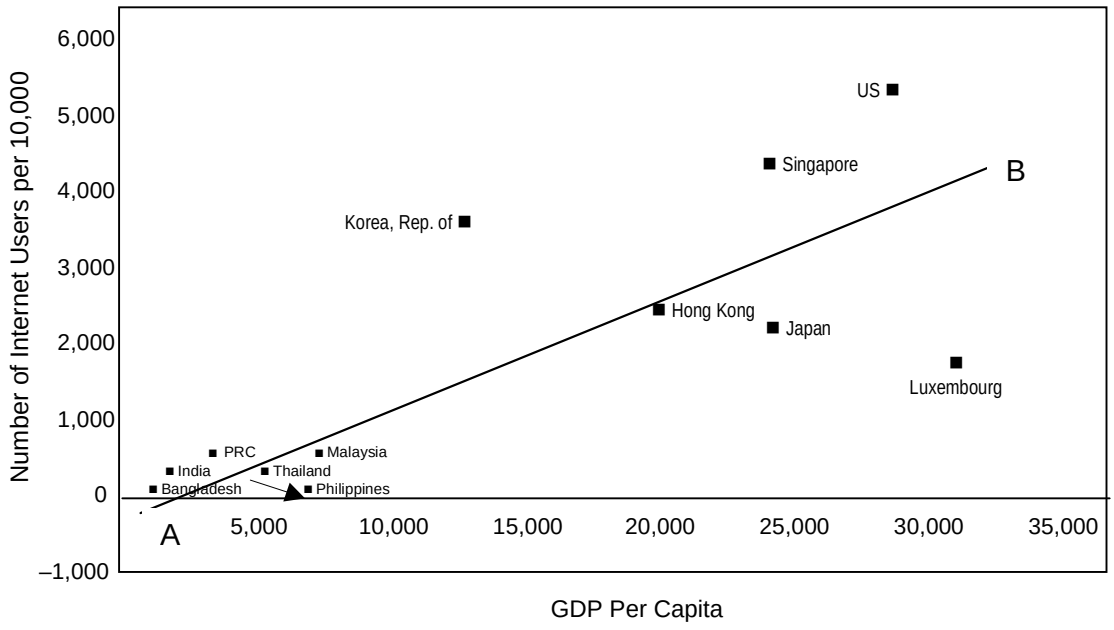
Figure 1: Relationship between Telephones and Income Per Capita

$y = 39.1 – 17.58\ln x + 2.52\ln x^2 – 0.11\ln x^3$



Data sources: World Bank (2000b) and International Telecommunication Union (2000).

Figure 2: GDP Per Capita and Internet Users



Note: The straight line in Figure 2, which shows the positive relationship between Internet use and GDP per capita in purchasing-power parity exchange rate, has been derived from a cross-country regression analysis for 157 countries. The estimated equation is $y = 0.144x - 360.02$, with $R^2 = 0.75$. The coefficients are also statistically significant at conventional levels.

Data sources: World Bank (2000b), International Telecommunication Union (2000) and Nua Internet Surveys (2000).

Table 6: Internet Access in Selected Economies: Actual versus Predicted

Economies	Internet access: Actual	Internet access: Predicted	Difference: Actual-predicted
	Per 10,000 people		
Newly Industrializing Economies			
Hong Kong, China	2,600	2,629.85	–29.85
Korea, Rep. of	3,231	1,580.81	1,650.19
Singapore	4,191	3,126.22	1,064.78
Other East Asian Countries			
People's Republic of China	134	87.10	46.90
Southeast Asia			
Indonesia	18	21.72	–3.72
Malaysia	688	811.71	–123.71
Philippines	62	151.90	–89.90
Thailand	165	425.64	–260.64
Viet Nam	13	–116.80	129.80
South Asia			
Bangladesh	2	–164.04	166.04
Bhutan	2	–138.84	140.84
India	45	–60.93	105.93
Maldives	6	227.93	–221.93
Nepal	14	–193.41	207.41
Pakistan	85	–113.06	198.06
Sri Lanka	34	68.96	–34.96
Central Asian Republics			
Kazakhstan	42	270.41	–228.41
Kyrgyz Republic	21	–26.37	47.37
The Pacific			
Papua New Guinea	4	–20.32	24.32
Developed Countries			
Japan	2,138	2,988.99	–850.99
US	5,372	3,903.10	1,468.90

Note: The predicted values for Internet use in column three are derived from the regression analysis reported in Figure 2. Positive numbers in column four in the table indicate that the economies are actually using more Internet services than they are predicted to use at their income levels in relation to international average for those income levels. It appears that countries such as Bangladesh, PRC, India, Republic of Korea, Kyrgyz Republic, Nepal, Pakistan, Papua New Guinea, Singapore and Viet Nam are doing better than the international average values expected for their income levels. On the other hand, economies such as Hong Kong, China; Indonesia; Kazakhstan; Malaysia; Maldives; Philippines; Sri Lanka; and Thailand are doing worse than the international average values expected for their income levels. While the US lies above the international average line, Japan falls significantly below the line.

As our earlier analysis suggests, the relationship between education and IT is critical. Education is important because it teaches the skills required for using such technologies. This is not to deny that even the illiterate or near-literate can take advantage of certain computer applications. But to go beyond elementary applications, education becomes increasingly important. Indeed, international evidence suggests that education is a strong complement to IT and the relevant educational levels are secondary and tertiary levels.[22] Therefore, if a country aspires to exploit in significant ways the opportunities offered by ICTs, the creation of new industries in particular, it needs to emphasize secondary and tertiary education. This lesson is in contrast to the conventional wisdom that poorer countries should emphasize primary education to yield a higher rate of social returns (Psacharopoulos, 1994). However, in most poor developing countries where illiteracy abounds and the importance of ICT-related industries has not reached a significant level, it may be premature to overturn conventional wisdom.

Developing countries that have already attained universal primary education for their citizens should place more emphasis on secondary and tertiary education if they want to take advantage of ICT opportunities. Nevertheless, one does not need to rely exclusively on government for promoting secondary and tertiary education. Many individuals who would like to take advantage of IT opportunities are economically well off and may not need government financial assistance. For others, improved functioning of the financial market and the availability of student loans can be a major help in financing educational expenses.

For a country to succeed in the ICT arena, one critical element is physical infrastructure such as telecommunications links. Government has an important role in creating such infrastructure, especially in poorer countries. This role stems from a number of important considerations. First, in very poor countries, because of the lack of effective demand, market forces may be shy. Therefore, government may have to make investments to build the necessary physical infrastructure for ICTs.

Second, even in countries where the private sector is not shy, government has to play the role of catalyst and regulator. From our cases, it appears that there are potentially many opportunities for fostering partnerships in the creation of infrastructure. To attract the private sector, government may have to play the role of a catalyst by instituting various innovative incentive mechanisms such as build-own-operate, build-own-transfer, etc. Even when the private sector is already active, government has an important function as a regulator. It may be noted that the telecommunications industry, which constitutes the basic infrastructure for ICTs, is a natural monopoly.

Third, despite the strong case for a free market in ICTs, many countries still maintain strong barriers against entry. This entry barrier, along with heavy government involvement in such ICT-related sectors as telephones, has spawned pervasive corruption in many developing countries. Privatization would be the most efficient response to such a conundrum.

Government can play an important role in ensuring a telecoms network standard. In many developed countries such as those in Europe, fortuitous outcomes have come out of the dominance of a single company or the cooperation of several strong companies. But there are other instances of a totally chaotic outcome, as in the United States where several

[22] Much Internet-based information is textual and expressed in English. In most developing countries, a large chunk of the rural population is either illiterate or has an education no higher than primary level. With this level of education, a large segment of the rural population will not be able to access and comprehend Web-based information.

incompatible mobile communications standards exist. In developing countries, there is still plenty of room to ensure that socially optimal standards are developed and chaotic outcomes are avoided.

For countries that seek to play an important role in the development and export of ICT items such as software, they need to foster an institutional environment conducive to such development. An important element that would foster investment and harness creativity relates to adequate protection of property rights, enforcement of contracts, rule of law and personal autonomy, etc., without which the economic incentives of firms to invest or innovate would be largely eroded. These institutional aspects, which are an important prerequisite for successful adoption of the new ICTs but are often weak in poorer countries, need to be improved. But, at the same time, new ICT ideas are often interconnected and draw on each other's concepts, which makes the task of defining the ownership of the intellectual product, as well as appropriating the benefits, all the more difficult.

The task of defining intellectual property and the appropriate mechanism for protection has been the subject of a good deal of discussion. When such "property" can be defined, one well-known method is the granting of patent rights, which offers the right incentives to the creators but may produce a large distortion because of the monopolistic nature of production (and would perhaps act as stumbling blocks to future innovations). Of many other proposals in this regard, a recent by Kremer (1998) suggests a system of prizes be introduced based on what the private firms would pay for the monopoly to produce the item in question. But this would involve substantial public expenditure on rewards for countries otherwise financially constrained. In any case, micromanagement would be the wrong approach for government in managing innovation.

If certain ICTs are considered socially desirable merit goods (for example, those items related to education, etc.), a case can be made for wide diffusion among the populace. However, diffusion of useful ICT technologies is likely to involve substantial externality. In these circumstances, a case may be made for subsidization of ICT use. Similarly, research suggests that ICTs have been most productively used in firms with a flat and less hierarchical organization structure. This type of organization is more common in the US than elsewhere. One way to promote such organization is by keeping markets open and competitive (Cohen, DeLong and Zysman, 2000). Government policy should, therefore, avoid a closed and monopolistic structure in the name of "nurturing the infant industry."

One particular instrument of government intervention in the ICT area, to encourage investments in the innovation and development of software and other IT products, has been the creation of science parks. These parks offer superior infrastructure (such as uninterrupted power supply, satellite downlinks, etc.), provide many fiscal incentives (tax holidays, etc.), and assure investors of expeditious government approvals and other processing. India has developed a number of such parks in Bangalore, Chennai and Hyderabad. Another notable example was Taipei,China's Hsinchu park. Malaysia's Multimedia Super Corridor is a more recent example, although one that appears to be slow in maturing. From the experiences of these parks, several important lessons seem to have emerged. First, infrastructure matters and it should be easily available to ICT-entrepreneurs if a country aspires to succeed in this area. Second, government should provide the appropriate environment and not micromanage it. Superior flexibility and autonomy are considered critical elements of a successful e-economy environment (Cohen, DeLong and Zysman, 2000). Third, availability of human capital in the form of skilled IT workers is tremendously important for the success of such a park.

While these parks are widely considered successful, a number of questions remain. First, in all these cases, there has not been any comprehensive evaluation of their true economic costs and benefits. Second, it is not yet clear how much of a local spillover these parks create for the local economy. The Indian experience so far suggests little or no spillovers beyond the regional clusters in Bangalore, Chennai, Hyderabad, Noida and Pune.

In addition to national efforts, international organizations can perhaps play a role in promoting ICTs in poorer countries. This role may include the creation of uniform standards through technical assistance and policy advice. However, premature standardization can become impediments to technological innovations. Second, in many developing countries, the telecommunications sector is a government monopoly. International organizations can play a role in deregulating this sector as well as ensuring free entry of the private sector, including foreign firms. Also, as noted earlier, there are instances where there is an economic case for government subsidization or fiscal involvement. In poorer countries, where the government is fiscally constrained, international organizations can provide financial assistance to create the basic necessary infrastructure as the private sector, both domestic and foreign, may not be forthcoming for obvious economic reasons. There is also a need to undertake more research in order to assess the cost benefits of various ICT interventions that have been made in the context of developing countries as well as the lessons derived therefrom.

6. Concluding Remarks

The ICT revolution has opened up new possibilities of economic and social transformations from which developed and developing countries can potentially benefit. Unlike previous technological innovations, developing countries today have almost immediate access to new technologies and the benefits they can bestow. This raises the tantalizing possibility that ICTs may soon herald a new era of economic prosperity to the global economy, greater than anything that has been achieved by previous technological innovation. In particular, ICTs can bring about a more seamless integration of the global labor markets than was considered possible before. This integration is likely to be facilitated by the confluence of a number of factors: the dwindling trade barriers from multilateral trade negotiations and rapid dissemination of market information, as well as the efficient delivery of services due to the new ICTs. All this should help to bring about a more efficient allocation of labor—including unskilled workers—across the global economy.

ICTs can be used selectively and innovatively to directly enhance the welfare of the poor. However, to reap the full benefits of the ICT revolution and reduce poverty, countries need to address the main impediments to economic development. Improving infrastructure, opening up markets, breaking telecommunication monopolies and improving education for all: these are fundamental to economic development as well as success in exploiting the economic opportunities that ICTs offer. Indeed, without addressing these issues, attempts at securing Internet access would not lead to the same economic dividends—at times they can become a recipe for financial disaster. A recent analysis by Pohjola (2000) that investigated the relationship between IT investment and growth in 39 countries over the period 1980-1995 found a paradoxical result. Whereas IT investment appears to boost growth in developed economies, the same is not necessarily true in developing countries, which need to institute other complementary policies to reap economic benefits from such IT investments.

In the presence of favorable policies and institutions, the Internet can assist development and the process can be further helped by globalization, which tends to magnify the benefits of ICTs. Yet ICTs are by no means a panacea for lack of growth or pervasive poverty. These new technologies may have created a window of economic opportunity for the developing world to foster growth and escape the scourge of poverty. Nevertheless, to seize this opportunity, they would require sufficiently well developed social and physical infrastructure as well as conducive policy and institutional frameworks. While ICTs have generated a new wave of enthusiasm among developing countries to embrace new technologies and benefit from them, unfortunately many of them do not seem to have the necessary prerequisites to take full advantage of this window of opportunity.

Appendices

Appendix 1: Major Issues from Case Studies on Telecenters

Telecenters (or information centers or kiosks) are a crucial element in government and NGO efforts to bring ICTs and access to information into rural areas, given the inability of the poor or many rural people to afford ICT equipment or the supporting infrastructure needed.

Because of this importance, it is worth examining a few salient points implicit in the case studies discussed: (1) the factors causing success or failures in telecenters; (2) the existence of different telecenter models of operation; and (3) some points relating to technology.

1. Factors underlying success or failure: What are some of the factors underlying the telecenters' success or failure? A common design methodology proposed by the World Bank (Hanna, Guy and Arnold, 1995) supplemented by other ideas suggests that the following may be necessary for successful operation:

- Sufficient resources, including financial and human resources.
- Information requirements analysis, to design the center to users' needs.
- Ability to convert data and raw information into useful information (analytical capability).
- Ability to sustain the center (little or no financial return on its usage, possibly because of low utility).
- Ability to scale up the network, i.e., to larger numbers of centers or users.
- Adequate policy support, e.g., to combat inadequate telecom deregulation or lack of basic underlying infrastructure.

Many of the failures seen in IDRC's case studies of the African telecenters arose because factors in this list were not properly addressed (Odedra, Lawrie, Bennett and Goodman, 1997). In the Indian cases examined in this paper, some of these factors were also seen. In the MSSRF project, appropriate design took into account the users' information needs; volunteers and paid NGO staff were required to maintain information systems and databases; and external financial resources were necessary to maintain the staff centers and supporting infrastructure. It was also recognized by MSSRF that staff needed to have minimum educational levels (at least primary or secondary education for telecenter volunteers) and that community ownership had to be involved. Eventually, for the centers to be self-sustaining, promotion of users' self-development may have to be encouraged (i.e., the ability to improve the quality of their contributions over time). We can presume that the more education a user has, the more they can make use of the information as well as contribute to the information system's development.

To ensure community and individual acceptance of ICTs, we also need to ensure the usefulness of the systems and the information to which they provide access. Thus, one particular aspect pertaining to the *usefulness* of centers to the poor is that of *content*. That is, what can the rural poor derive from these systems? Aside from learning, which has a structured content that is applicable to all circumstances, much of the information is situation-specific (e.g., food prices). The information content of the centers catering to adult workers remains in a state of flux. Government information centers usually provide information that is government related, e.g., information on ownership certificates for land, subsidy schemes, government expenditure plans, etc. The MSSRF value addition center (VAC), on the other hand, provides a different kind of livelihood-oriented content, determined by a bottom-up requirements analysis, gearing it more to local conditions and needs. This, however, is more labor intensive, requiring information specialists to sort through data. As the economy

develops, the needs of the people become more sophisticated. In order for these information systems to be continuously useful, these specialists will have to become domain experts. An intermediate scheme is one where the government programs start to make use of their local experts, e.g., government agricultural extension officers. For instance, in one variant proposal to scale up its scheme, MSSRF has suggested the use of government officers—most of whom are at least university trained—to manage the rural development information centers set up by the government.

One important issue not seen in the analyzed projects is that of scalability or the growth of the systems' size. Scalability is important because even though a set of telecenters may look viable on a small scale, on larger scales, they may become unwieldy or ineffective. Scalability can be thought of as the ability to scale up systems along multiple dimensions, such as: (1) technical (larger and more complicated networks); (2) information (how useful the same information is to larger groups of people, or whether new types of information or information structures have to be developed); and (3) social processes, i.e., will new ways be needed for larger groups to communicate and collaborate.

As an example of problems: some telecenter information may not be "scalable" because information for one region (e.g., food prices) may not be particularly helpful to another region. It is in this that the conversion of *information* into *knowledge* can help. That is, information that is *contextualized in the solving of a problem* can help another region when that practice is made available, because the region with the problem can then connect their problem to the already solved problems and solutions. Ultimately, the usefulness of these information centers would depend on such factors as: who is controlling and facilitating the information flow? What content do they make available? And how does that information help improve people's livelihoods and quality of life.

2. Different Telecenter Models: The second issue involves the fact that different models of telecenters actually exist, and that each model has particular advantages or disadvantages, especially for a given environment. Each model should be evaluated on its merits for the different benefits that accrue to users, the different cost (and cost recovery) structures, and the different degrees of involvement of the various actors involved.

For instance, the MSSRF and FOOD telecenter models rely on third party intermediaries to design information systems to help individuals or entrepreneurs to access information. The information kiosks promoted by the various state governments in India are representative of a second type of telecenter: one that involves a centralized government portal that may be operated like long distance telephone booths, although with access to government information.

Whereas the MSSRF center resembled an umbrella with one center acting as a "mother" that helped to screen and structure information to the other centers, at least some telecenters operating in South Africa operate more as a "network," without that central hub. This "network" model may cause problems if the centers do not have any of their own local capability to screen information. Many of these centers were also left ineffective because detailed requirements analyses were not carried out prior to their operation, and thus they did not conform to user communities' needs (Benjamin, 1999). These have sought to build links between parties on top of a centralized system, but some of them failed because of ineffective community leadership, lack of community participation and the need for continuing subsidization. Failure was partly due to too much centralized management of the system and lack of attention paid to "anchor" services to ensure a critical mass of users (Benjamin, 1999).

3. Technology: A third issue relates to *technology*. From the case stories, it appears that some of the organizations that developed ICT systems did not view technology as the

critical issue. This is because there is already a large stock of commercially available off-the-shelf technology that is cheap and scalable, and because given the level of government interest, funding for many efforts has so far not been a binding constraint. In addition, there are also NGOs that are helping to create software applications for rural areas (e.g., Cooption Technologies in Andhra Pradesh is developing applications for farmer cooperatives and loan processing). The localization of knowledge and its representation (i.e., use of local scripts such as Tamil, Kanada and Bangla) are also important for reaching the rural masses.

Some technologies can be considered to be leapfrogging technologies, that is, technologies that allow you to skip intermediate states of development. Mobile phone systems are often held up as a good example. However, mobile phones do not convey the same information as PCs, so they do not fulfill all of the same uses.

In this connection, flexibility and adaptiveness in system design and evolution are also important. Each village may be different in its infrastructure and human capital endowments. As such, different levels of technological, human and other resources are necessary. Technologically speaking, multiple transmission modes are needed—from telephone modems to wireless and broadband—because of the variety of conditions and needs in rural areas.[23] The more technologies can be made seamless, integrated across disparate systems (e.g., connecting mobile phones to information from PCs on the Internet) and user-friendly, the more likely they are to see immediate and fruitful use.

[23] In Karnataka state, villages in the South have literacy rates of 98 to 100 percent, while those in the North have literacy rates ranging from 20 to 40 percent. Clearly, the latter areas may need more than just infrastructure, and would take more than one generation to change economic and social conditions.

Appendix 2: Case Stories

Case Story 1: Gyandoot Project in Madhya Pradesh, India

Gyandoot (meaning messenger of knowledge) is a unique e-government project in Dhar district, Madhya Pradesh State in Central India. The project began in November 1999 and is serving more than 500,000 people. Important information of this population such as income, caste, domicile, land ownership and records, and loan records is computerized. An intranet network connects the computerized system from the district headquarters to 21 privately-run cyber-cafes (called *Soonchanalays*, meaning information centers) across the rural tribal district of Dhar. From the cyber-cafes, villagers are offered a number of different services such as the provision of domicile certificates, land-ownership certificates, the most up-to-date prices of agriculture products (such as soybean and wheat) and information on welfare services available in the district. The cyber-cafes can be accessed easily since their locations are often at the roadside of the central villages where people normally pass.

These certificates are crucial for villagers in accessing various benefits in the community. For example, a caste certificate for those from the lower caste can help them to get loans at a cheaper rate, obtain subsidies or gain priority in jobs. Similarly, land records are critical in getting bank loans in every crop season. Prior to the establishment of the project, obtaining such certificates could be expensive and time consuming. A villager had to make several trips to the district headquarters because the record clerk was not often available or allegedly wanted a bribe for not making it difficult for villagers to get the desired certificates. Some farmers report having had to pay a minimum bribe of Rs200 plus Rs100 for transportation, not to mention the loss of working days. With the availability of cyber-cafes, they can get these papers for Rs15 each and pick them up at the cyber-cafes or have them delivered at home through online application for a small fee within a maximum period of one week.

Farmers can also get daily updates on market prices of locally produced food grains and vegetable crops such as potato, maze, tomato or soybean in various markets around the district for Rs5. Local traders told the farmers in Bagadi village that the price for one quintal of potato was Rs300, whereas the rate farmers got from the cyber-cafe was Rs400 per quintal in the Indore market. They then decided to bring their potatoes to Indore instead of selling them to the local traders. They now realize that it is better to pay Rs5 to check the price than lose hundreds of rupees to the intermediary.

Similarly, Rathod, a 35-year-old illiterate woman from Dehrisarai, and other vendors in her village keep track of the latest rates of fruits and vegetables in the wholesale markets in the neighborhood of her village cyber-cafe. If the prices are lower than in the village market, they pool their resources and catch a bus to the place with the cheapest price and then resell them in their home market. Even after paying the transport costs, they still make a profit from the sale.

The idea started from Rathod's sheer curiosity in the Pentium Celeron several days after her village became "wired." "I asked for the price of apples at the Dhar wholesale market. The operator pressed some buttons, and there it was on the screen! I cannot read, but he told me it was Rs50 cheaper per crate than the rate in the village market. Next morning, I traveled to Dhar to buy fruits," said Rathod, recalling her first encounter with the computer.

In addition to these services, villagers can also file complaints to top officials of the district administration about nondelivery of public services such as absences of teachers, malfunctioning pumps, irresponsible officials or poor seed/fertilizer provided by certain

traders. These complaints can be sent through an electronic form online and replies are guaranteed within seven days.

"It works," said Mahendra Sahdu, a schoolteacher in Tirla village in Dhar. He lodged a complaint several days earlier about a malfunctioning hand pump in the village. An online reply from the official at the district headquarters ensured that a mechanic was soon dispatched.

Another remarkable feature of the project is its financial sustainability and customer orientation. An initial fund of Rs2,500,000 (equivalent to $55,000), borne by the elected village councils, was invested in the whole network of 21 cyber-cafes—an upshot of the decentralization drive embarked on by Madhya Pradesh. The selection of services, operators, and the design and testing of the network were all performed through regular consultations with the local villagers prior to operation. The operators (called *soonchaks*) selected by the council were mostly youths from the village and a government employee. They were trained at their own expense to run the cafes (equipped with a computer, a modem and a printer) at their own cost. Each has to pay the councils 10 percent of the income earned through user fees. Some operators do business better than others depending on their enterprise skills and creativity. For example, 20-year-old Deepak Patel from Bagri village has created other way of earning income by buying another computer and giving lessons to village children. He already has five students, each paying less than $10 a month for a computer lesson one hour a day, six days a week.

The Gyandoot project can be applied to other rural communities because of its enormous benefits to local villagers, low initial investment and financial viability. It is also considered financially sustainable as a result of its community-based orientation, with local people taking full charge of operation, development and support of the network as well as taking care of their own knowledge and technology needs. In Madhya Pradesh itself, the government issued a statewide tender in late January 2000 for setting up such cyber-cafes across the state. In order to wire the whole state, the government was hoping to exploit public-private partnerships by encouraging private investment in these future cyber-cafes. However, it is important to note that the state government has been playing an important role in the project's success. Besides the effort to develop a computerized system of local information, the local government has also created various incentives to promote the software industry, invested in telecommunications and power industry infrastructure, and fostered a favorable environment for private sector participation.

Source: *The Indian Express*, "PC is their Magic Box, Mouse a Friend," 25 January 2000; Sholay Special, "Rural Folk Get Net Savvy in Madhya Pradesh," 27 February 2000; MSNBC, "Internet Takes Root in India's Villages: Village Cyber-cafes Save Time, Money and Red Tape," 27 February 2000.

Case Story 2: ICT-Savvy Chief Minister of Andhra Pradesh

When Chandra Babu Naidu was elected in 1995 as the Chief Minister of one of the poorest Indian states, Andhra Pradesh, its capital Hyderabad was an old decaying city. Today the city is buzzing with construction and has been transformed into a spanking new hub of information technology where global giants such as Microsoft, Oracle and IBM have opened offices. Within just the last four years, the state has increased its software exports more than tenfold. Hyderabad, nicknamed "Cyberabad," has become a rival to the famous IT city, Bangalore, in the neighboring state of Karnataka in its fight to attract capital available for the IT industry. A large part of this is due to Naidu who believes that ICTs are the key to prosperity. His Vision

2020 is to establish “Andhra Pradesh [as] a state where poverty is totally eradicated; where every man, woman and child has access to not just basic minimum needs, but to all the opportunities for leading a happy fulfilling life; a knowledge and learning society built on the values of hard work, honesty, discipline and a collective sense of purpose.”

While Hyderabad forms what is called the “Silicon Triangle” together with Bangalore and Chennai, it is still essentially catching up with the other two. Nevertheless, the plans laid down appear sound, and it has been equally successful at attracting foreign investment and domestic enterprises. There is a likelihood of convergence among these three regions in terms of their capabilities and total output, at the same time, developing their individual industrial strengths. The most likely scenario is that each region will leverage its strengths in other areas through linkages with the IT industry. For instance, Andhra Pradesh has a strong film industry, which may allow a fusion of IT with media applications.

With this vision, Naidu started to computerize his state’s government, promote efficiency and champion high-tech projects as the key to prosperity. Naidu and his chief IT architects plan to institute a Web-based government with all its information online, making its operations efficient and transparent (and, therefore, corruption free). With such a government in place, the Chief Minister plans to wage a decisive fight against poverty and illiteracy. Services such as distance education can be used to increase literacy and skills, which will help reach the target of eliminating illiteracy within 10 years, as well as prepare the people for employment in the IT and other industries.

In order to attract private investment to build up the infrastructure to these high-tech projects, Naidu has created various incentives and motivations for business. Complicated regulations and rules were simplified, red tape was cut short and anti-corruption efforts were intensified. Almost all of the fiber optic backbone infrastructure across the state and information centers are being funded by telephone carriers such as Reliance. The government also has plans to add mobile and other modes of communication. As part of the administrative reforms, ICTs are being used to provide better quality of governance to citizens. In May 2000, an e-government was introduced to his state. Villagers sitting 250 kilometers away from Hyderabad spoke of their problems in a videoconference with Naidu, his ministers and officials. In a breakthrough leap toward transparency, Naidu questioned his officials and asked villagers to check their responses about various development projects. The decision-making process of the government has also been shortened, thanks to the teleconferencing system, which has been effective in overcoming routine bureaucratic delays. The state government is planning to move toward the concept of paperless offices using workflow concepts and enterprise-wide computing. At the same time, it is in the process of setting up value added network services—to provide greater convenience to the public in transacting business with government—in association with Singapore network services.

In many areas of India, people have to bribe corrupt low-level officials to get minor things done. By hooking up villages to the Internet, there will be less room for corruption and government business will be opened to public scrutiny. Soon, citizens across Andhra Pradesh will be able to get trade licenses, birth certificates, property certificates, and pay electricity, water and sewerage bills online. Farmers can get the most up-to-date commodity prices from village information kiosks’ computers, thus saving themselves from being exploited by intermediaries. All government projects and allocations, as well as their tenders, are already available on the state’s Web site and people can keep an eye on any leakage.

Another innovative program initiated by Naidu is a live “Dial your Chief Minister” television program every Monday. On this, the Chief Minister addresses a large number of issues. For each show, a subject is identified one week in advance and citizens come up with

their own problems and communicate them to the Chief Minister. People from all parts of the state call up with their problems, mostly complaints about negligent officials. Some villagers also seek advice on various matters from storing water to sending children to schools and Naidu patiently answers each question while his aides take notes.

The government is also developing a portal that will serve as the gateway to all its services. It is computerizing large databases, starting with the electricity pricing and billing system, and following with household census-type information (to help properly allocate poverty reduction resources).

There is a strong presumption that e-government will lead to efficiency gains and improved governance. First, the cost of obtaining official documents through cyber-cafes will be much cheaper than through conventional ways because of the savings in transaction costs. These costs include transport expenses, lost work time as well as bribes for corrupt officers. For example, if a farmer in Dhar district orders a certificate of land ownership from a nearby cyber-cafe, all he has to pay is Rs15 to pick it up. However, if he has to go to the district headquarters to get the paper, besides the usual fee, he will have to pay a transport expense of about Rs100 and Rs25 for a half-day absence from work. For a typical Rs50-a-day wage earner, the saving gained per certificate is significant: Rs125. If each farmer has to get some kind of certificate four times per year, after one year the saving from 5,000 farmers can build up another Gyandoot project (costing Rs2,500,000), wiring one district serving around 500,000 people.

The availability of daily commodity prices through the government Web site has also helped many poor farmers to sell their products at higher prices.

The emphasis so far in Andhra Pradesh has been on connectivity, and on the government's own data and operations. Not much has been achieved in the area of poverty reduction. However, poverty reduction is a huge challenge that requires the concerted efforts of government, the private sector and NGOs. As the experience of Singapore suggests in IT-based industry development, government can play an important role but it should not supplant that of the private sector. In Singapore, the true new economy was built on many thousands of private impulses, more than the government itself could muster.

Source: Field Research; *Newsweek* Special Issue, "Wiring the Village," July-September 2000.

Case Story 3: Grameen Bank's Village Phone (VP) Program, Bangladesh

In this program, a number of Grameen Bank (GB) members—the majority of them poor women in rural areas of Bangladesh—are granted a revolving loan valued at Tk15,000 (equivalent to $310) in the form of a VP package containing a Nokia 1610 cellular phone, a battery, a fast charger, a sign board, a calculator stopwatch, a user guide in Bangla and a price list for calling different locations. This loan is paid back within two to three years through an existing weekly payment system as with any other microcredit program of the GB. However, the airtime bills are paid monthly. After being trained to use the equipment, these women (hereafter referred to as VP operators) start to run their business by renting out the mobile phones to anyone around the village wanting to make or receive a telephone call. Since the majority of the calls (61 percent) are received—proportionately most of those calls originate from outside Bangladesh—and are not dialed by phone users, it is important for VP operators to charge for received calls.

The income derived from the VP was reported to be about 24 percent of the household total on average; in some cases it was as high as 40 percent. On average, a VP operator earns an income of Tk14,400 or roughly $300 per year from providing telephone services. This exceeds the average per capita income of Bangladesh (of around $286) by $14. Most of the VP operators interviewed

implied that income earned through the VP was a supplement to household income earned from other sources, mainly from nonagricultural activities.

However, it is important to note that VP operators were carefully selected among GB members based on a set of stringent criteria such as having a good loan repayment record, experience of running a profitable small business (preferably a village grocery store), being literate or at least having children who can read and write, and residing near the center of the village. These criteria were set to assure the success of the program at the beginning period. Nevertheless, they imply that VP operators are not necessary the poorest of the poor and are doing better than average GB members. It is expected that future VP operators will come from poorer-than-average households in the village. Yet, it is reported that in terms of social indicators the VP operators' households seem to be leaders in literacy, child immunization rates, use of safe drinking water and sanitary latrines thanks to their long membership of GB.

Although the VP program has proven to be a successful way to generate income from ICTs, it is not easy to replicate in many poor communities around the world, such as with other GB microcredit programs that have been successfully replicated. This is partly due to the fact that the majority of customers of GB phone operators in many Bangladeshi villages are migrant workers working abroad or in other regions of the country - who need to communicate with the family members at home. Without such sources of "demand", the overall demand for using telephones in many poor communities may be too small to generate sufficient revenues for VP operators to survive.

Source: TeleCommons Development Group, Grameen Telecom's Village Phone Programme in Rural Bangladesh: A Multi-Media Case Study, Final Report for CIDA, prepared by Don Richardson, Ricardo Ramirez and Moinul Haq, 2000.

Case Story 4: Pondicherry Village IT Project (M. S. Swaminathan Research Foundation)

MSSRF—a nonprofit foundation in Chennai (Madras) dedicated to improving rural areas through a "pro-nature, pro-poor and pro-women," as well as job-led growth strategy—has been involved in a research/pilot project to investigate the opportunities that ICTs can provide to the rural poor. A similar project that developed an online supermarket based on local information centers was implemented by another Chennai-based NGO, FOOD (see case story 5).

The MSSRF project developed five telecenters—called information centers—in the Pondicherry region of India, with IDRC funding. One called the hub or VAC collected and filtered information for the other four centers. The total population of the villages was about 11,000, of which 4,700 residents were illiterate. Some villages had only one public telephone and, at most, a few private telephones. On the other hand, the villages had anywhere from dozens to hundreds of TV sets.

Both MSSRF and FOOD projects note that connectivity alone is not sufficient (PANAsia, 1999). On the other hand, connectivity was not much of an issue, given that commercially available hardware could be used to equip the centers for no more than $4,000 for the hub, and $750 per center (with two PCs per center).

An independent report based on a site visit identified 24 success stories from villagers. Surveys of villagers were conducted to determine their needs. The Information needs ranged from agricultural commodity prices to fishery weather information, lists of government welfare programs, references, discussions and daily news. In a sense, some of this information replaced what would normally have been released in newspapers, government documents, radio and other media. Locality-specific databases were created, some with the

help of local professionals (e.g., doctors) and domain experts. The value of the information was in the timeliness and relevance to the villagers' local livelihoods.

The operation of the VAC was considered by MSSRF to be a key component in the whole operation, because the staff—consisting of graduate-level MSSRF employees trained in development and village volunteers—were dedicated to the finding of information relevant to the needs of villagers around all five centers.

Other characteristics considered important by MSSRF were the use of local Tamil script, which most villagers could read, and the participatory development scheme used, i.e., the communities' provision of space, and staffing of centers with local volunteers. The volunteers possessed a mixture of lower-to-middle secondary schooling. They helped illiterate villagers or those who could not undertake their own searches, while MSSRF staff ensured that the equipment was operating properly.

Villages were selected for participation based on their willingness to support the centers in kind, as well as to subscribe to the ethical principles outlined by the Foundation. Some villages were removed because they failed to meet or maintain those principles, such as through damage to equipment or irregular operating hours.

The information centers were contrasted with Internet-only or traditional telecenters, such as some earlier operations in Africa, which appear not to have been designed with village users' requirements in mind. The looseness of operations in such centers apparently contributes to their reduced usefulness. In contrast, the local needs addressed by MSSRF and the business-like approach by the FOOD centers ensure that the centers continue to be used by the villages. In fact, there were a total of 10,656 users of the MSSRF centers between 1 January 1999 and 31 March 2000, of which 2,985 were repeat users, 309 were illiterates and 2,581 were assetless families. There were about nine users per day per center. Of the data accessed, 33 percent were government data, 20 percent were education data, 14 percent were agricultural and fisheries data, 10 percent were health data, and 3 percent were employment and training data (MSSRF material).

In sum, the main benefits from the centers were improved access to information, which helped make livelihoods more secure, sustainable (profitable) and safe; and development of skills. The skills developed included simple information seeking skills, while others were more complex, e.g., some volunteers learned Hypertext Markup Language (HTML) (needed for Web site development). This may be the first sign of progression to higher levels of technological sophistication. The access to opportunities, skills and information also illustrated the value of ICTs—as a means of putting some people on the path to careers with greater incomes.

In the future, more sophisticated schemes may be developed and tested, such as formal distance and other learning programs, health services, etc. The remaining issue concerns the scalability of the project, i.e., whether whole regions could be scaled up with the same degree of care, whether these regions would exhibit network economies of scale and scope, and whether coordination problems would be overwhelming. Further, MSSRF acts as a strong supportive intermediary that may be hard to duplicate consistently. There is also an issue of whether sustainable growth in user capabilities can be achieved. That is, at some point, users may need to take matters into their own hands and start to create and structure the content. Last, while sufficient funding for other village information centers may be available theoretically (e.g., through the reallocation of existing development budgets), ICTs may have lower prioritization in the meantime until basic needs of rural development are met.

Source: Based on field research, MSSRF Web site reports, PANAsia (1999).

Case Story 5: Foundation of Occupational Development (FOOD India) ICT Projects

FOOD is a nonprofit organization based in Chennai that conducts research on social development and implements welfare programs in cost effective housing, electronic NGO networking, employment generation, energy conservation, education, health, environmental sanitation, poverty alleviation, E-commerce, ICTs, and institutional and capacity building for women. However, target groups are not limited to women but to those living in rural, semi-urban and urban slum areas.

In the area of ICTs, FOOD takes on the role of a value-added Internet service provider similar to that of MSSRF under the PANAsia Networking Project, a partnership with IDRC (see case study 4). FOOD established electronic networks in the form of telecenters in remote areas that enable more than 400 NGOs and community-based organizations working in rural and tribal regions to network with other regional, national and international NGOs, and partner organizations. It subleases Internet access to these organizations by allowing them to connect to the FOOD host. FOOD networks already cover 14 remote areas in other southern states of India along with a few in the north.

An external evaluation conducted onsite for the MSSRF and FOOD telecenter projects found that both have a unique way of instituting formal mechanisms for adding value to connectivity (PANAsia Report, 1999). Both encourage active searches for information relevant to the users' work and lives delivered in a usable format. IndiaShop and Herb Gathering and Cultivation are two examples in the case of FOOD. The report further suggests that FOOD's entrepreneurial approach to development incorporates sustainability as an objective of the project from the start. The approach also aims at creating employment opportunities through creative deployment of ICTs among communities that possess few other technologies. Further, the provision of operator training, and technical and content support adds value to the connectivity by contributing significantly to capacity building and sustainability of operations. It provides computers and communications equipment to the telecenters until they become self-sufficient (requiring around 100 users). So far, each telecenter has between 100 and 300 users.

IndiaShop is an online supermarket developed by FOOD to promote sales of crafts produced by women cooperatives and NGOs in rural areas. FOOD staff advise producers on marketing, pricing and packaging of their products. Shortly after launching the service, one village producer was able to sell a hand-embroidered silk sari for $1,000, reputedly more than what she would have received if sold through a shop in Madras. At the end of 1999, there were at least 100 cottage industries preparing to participate in this electronic market. FOOD also introduced a new concept of employing Internet telemarketeers to introduce IndiaShop to potential customers. This creates marketing and employment opportunities for those interested in operating from any networked computer in their own time to market for IndiaShop and earn commission from each purchase made through their order. Since this marketing concept was still in an experimental stage during the evaluation, the effectiveness of telemarketing via the Internet is still unknown.

Herb Gathering and Cultivation is a telecenter project based out of Thandarai village in the Union of Pondicherry. The villagers were advised by WomanKind Worldwide, a UK NGO, that their means of earning a living was not sustainable. Formerly collecting and selling snakes from the local area for a living, they were alerted by environmentalists that this could lead to possible extinction of the local snake species. The WomanKind Worldwide then encouraged the villagers to turn to herb gathering and cultivation after discovering that they

have considerable knowledge of local herbs and how to use them to treat a variety of diseases. For example, one shepherd was able to identify 360 separate species of herb and ways to treat sheep for various illnesses. Therefore, the NGO helped the villagers set up a telecenter, with connectivity support from FOOD, to look up information on how to package and market local herbs. Thandarai village now boasts several buildings that host the telecenter with a huge library on herbs and a herbal processing center. It also employs about 300 women in the herb preparation process and plans a book that records local knowledge about herbs. The telecenter service was instrumental in sensitizing the villagers to the value of their local knowledge and empowering them to use their knowledge for their livelihood.

The value-added services of the telecenters have contributed to the first two projects' success in attracting the participation of target groups. Moreover, empowerment seems to be a target benefit of telecenter activities as users actively seek and use information to improve their livelihoods. While it is evident that the training, technical and content support that FOOD provides have contributed significantly to capacity building, it remains to be seen whether the villagers will acquire the skills to initiate new activities and develop content without help in the future. The extent to which villagers improve their livelihoods through the telecenter services will determine how ICTs can contribute to building local capabilities for sustainable development.

Although these two projects have yielded promising results, a third project in the report—the Internet Kiosk—was not as successful in realizing its objectives. The Internet Kiosk was introduced to provide e-mail access to anyone. Each kiosk is fitted with a telephone that can be used to call the nearest telecenter and dictate an e-mail message and address over the phone. The kiosk operator charges users (about Rp1) per message. Meanwhile, the telecenter charges the operator and also dictates incoming messages back to the kiosk operator. Although the kiosk makes e-mail available to anyone and allows small operators to enter the business for a minimum investment, the project did not meet with much success. Because targeted end-users associated e-mail activities with a computer, they could not adapt to the fact that the kiosk did not need a computer for e-mail access. The result was a decrease from 50 original subscribers to around 10 kiosk operators processing only a handful of messages weekly. The result indicates that despite creative deployment of ICTs in an area possessing limited technologies, the community needs to be fully informed and understand the technologies employed in order to increase chances of success. Even so, the project was evaluated to be a partial success because it offered a valuable lesson that taking human factors into consideration will increase the success of ICTs in rural development.

Source: Based on an external evaluation of FOOD India on its Web site; PANAsia (1999). *Success Stories of Rural ICTs in a Developing Country*. Report of the PANAsia Telecenter Learning and Evaluation Group's Mission to India. IDRC.

Case Story 6: PEOPLink: Alternative Distribution Channel for Artisans in Remote Areas

PEOPLink is a nonprofit "fair trade" organization formed in 1995 and incorporated in Maryland in 1996. It helps artisans in remote areas around the world to forgo a conventional intermediary for an alternative distribution channel by selling their products over the Internet. Artisans traditionally have had to depend on a long commercial chain of intermediaries that paid them much less than their crafts were worth in the market. Due to distance and intermediaries, local artisans suffer from limited or no access to markets (local and

international), information, technical skills or financial services. In an effort to help them overcome these challenges, PEOPLink facilitates the process of building entrepreneurial capabilities at the grassroots level with the cooperation of its "trading partners"—local nonprofit development organizations.

Each trading partner assists several local grassroots groups such as craft cooperatives and minority groups in bringing their crafts to market over the Internet. PEOPLink has set up a Web site where trading partners can display online images taken of the artisans' crafts for sale to retail and wholesale buyers in industrialized countries. Trading partners also help grassroots groups set up their own Web sites hosted by PEOPLink to show other products that are not sold on the Web. At the same time, trading partners receive training support in-person, online and by e-mail from PEOPLink to learn how to use digital cameras and computers to edit images in a compressed format suitable for Internet transmission. They also handle any e-mail correspondences with buyers about the products on behalf of the artisans.

On the wholesale side, PEOPLink acts as an escrow agent by allowing wholesale customers to pay 50 percent of the price upon order. The customer then has 10 days to inspect the product from the day it arrives and to pay the rest if satisfied with the product. Although PEOPLink will charge a 20-25 percent handling fee, the artisans still enjoy more profit than through local distribution channels. PEOPLink works with almost 100 organizations in 30 countries throughout Latin America, Asia and Africa. Its network serves more than 100,000 persons, craftsmen or technical assistants around the world. Its sales in 1998 reached $73,000, an 820 percent increase from the previous year. Sales continued to double the following year. It hopes to be self-sufficient from sales and donations during 2001.

The venture between PEOPLink and its trading partners is aimed at improving the quality of life, cultural preservation and self-sufficiency among local grassroots groups. These isolated groups earn higher income with better access to international markets and increased trade. The self-confidence of participating artisans and NGOs increases as they develop their local capabilities to promote self-sufficient income-generating activities. In one case, the Janakpur Women's Development Center in Nepal was able to take advantage of the opportunity that PEOPLink provides. The center is the first to use traditional painting for the empowerment and advancement of Maithil women. Traditionally, Maithil women paint intricate folk designs on mud walls of their homes on special occasions. The center encouraged them to transfer their skills from mud walls onto Nepali handmade paper so they could earn a living from the sales of their crafts. With the support of PEOPLink, they are able to enjoy an additional sales outlet for their crafts. However, there are no available data on the registered sales made through the PEOPLink Web site.

PEOPLink aims to replace intermediaries with reliable nonprofit-making partners to help local artisans take advantage of the virtual distributive channel and increase their sales margins. If products are actively traded over the Web, it will help alleviate poverty among remote and isolated groups. Further, the project promotes capacity building by developing training modules for its network of NGOs and artisans. Since participating NGOs are already involved in development projects with local communities and small businesses, PEOPLink is an additional service that NGOs can offer to their local partners at a relatively low marginal cost. Meanwhile, participating artisans have the opportunity to increase their earnings by tapping into new markets through PEOPLink, while still being able to utilize traditional commercial channels. Technical and managerial training from their NGO partners also promotes capacity building, empowerment and self-confidence at the grassroots level.

Last, they hope that exposure to e-commerce will "help demystify technology and allow local organizations and grassroots groups to see the benefits of connectivity and the

Internet" and attract other groups and organizations to participate. In addition, it will encourage local artisans to realize the benefits of preserving traditional crafts and capitalize on their ancestral know-how.

Source: Grant, Gail L. (1999). Case Study: PEOPLink; PEOPLink Web site.(www.peoplink.org)

Case Story 7: The Indonesian *Dikmenjur* (primary and secondary vocational education) Internet System

The case of the Indonesian *Dikmenjur* (primary and secondary vocational education) Internet-based educational information system is particularly illustrative of how a Web-based system can be developed to assist a network of institutions and educators in communicating with one another, and in promoting the learning of ICT skills.

The Indonesian technical and vocational education department is located within the Ministry of Education and Culture's Directorate of Primary and Secondary Education. It oversees 4,200 vocational institutes, of which more than 700 are public. The large numbers of private institutes include some dedicated to basic skills improvement, such as administrative and business management. These provide a practical alternative to the last three years of high school (not to be confused with vocational training offered in Indonesian polytechnic institutes, which substitute for college education with a similarly practical-focused education).

The Dikmenjur system was primarily designed to focus on connecting geographically dispersed institutions via the Internet, emphasizing basic services such as information delivery and two-way communications on traditional vocational education subjects. It was initially started as a means of sharing information and connecting institutes. However, the vision became one of bringing the various institutes together as partners in the sharing of knowledge, such as sample curricula, making creative use of Web sites, etc. For instance, the six regional training centers have put their vocational training modules online and many institutions are posting their homepages on the Web with the help of students. Eventually, the system is intended to evolve to embrace more advanced applications.

The program started in August 1999 with three schools in Jakarta that entered an ASEAN homepage competition, and won. The ministry's vocational department director then decided to expand the system with federal funding, first bringing in teaching staff from Indonesia's leading technical university to train the vocational group's staff. They developed six training centers across Indonesia that taught Internet skills to the staff from the 26 provincial offices. Later, a group of 30 staff fanned out to various locations to further train the vocational teachers and teachers.

The group set out to develop the basic "firmware" (i.e., human resources) and ensure that institutions had basic connectivity, e.g., through the setting up of Internet cafes in schools. An important aspect of this was the education of local community, school administrators and teachers in broad participatory terms, to promote acceptance, use and support for the technology. This ensured that communities (parents and local businesses) and schools would support the technology through the matching of federal grants with additional computer equipment (in the case of businesses) and facilities (in the case of schools). The argument was made that businesses could also make money from these "dual use" Internet cafe facilities.

The Web system is actually hosted on a free US Web site address and many individual homepages are located at online US portals. The directorate required each participating institution to have a Web site online, which resulted in the creation of homepages and links

from many institutions (300 plus at last count). Participating institutions are spread around the islands of Indonesia, with some at the periphery being the most enthusiastic users and contributors to the system.

The system includes action plans for its improvement by each institution. Initial uses included e-mail, accessing of federally provided information (scholarship information, etc.) and other links. Now the system is gravitating to more advanced uses, such as the provision of sample curricula or sharing of curricula, notes and textbooks. Some schools have even helped local communities by designing their Web sites to advertise home stays and other tourist information.

The system has also had impacts on traditional culture, allowing students to communicate with administrators, and teachers to share information among one another. This broke some of the established hierarchy. For instance, students "at one end of the system" have sent e-mails to teachers and copied the director in charge of the government department that administers the entire system.

Through the open provision of information (e.g., freely providing information on such matters as training opportunities and award schemes), as well as the sharing of information that is promoted, the system operates in both a cooperative and competitive mode. Combined with the connectivity among the institutions on various islands—a technical achievement—this has led to a real, if not significant, transformation in the culture and operation of a part of Indonesia's educational system.

Source: Interview with the Director of *Dikmenjur*, Dr. Gatot Hari Priowirjanto, June 2000. See http://www.dikmenjur.freehosting.net.

References

Analysys (2000). *The Network Revolution and the Developing World.* Final Report for the World Bank and InfoDev. Analysys Report No. 00-216.

Arora, A., V. S. Arunachalam, J. Asundi and R. Fernandes (1999). *The Indian Software Industry*. Project Report. Carnegie Mellon University. http://www.heinz.cmu.edu/project/india

Asia Society (2000). *Micro Credit Gone Global—An ASIP Panel Discussion.* http://www.asiasociety.org/speeches/microcredit.html

Benjamin, Peter (1999). "Community Development and Democratization through Information Technology: Building the New South Africa." In *Reinventing Government in the Information Age, International Practice in IT-Enabled Public Sector Reform,* Richard Heeks (ed.). Routledge, New York. 195-210.

Bhatnagar, Subhash (2000). "Social Implications of Information and Communication Technology in Developing Countries: Lessons from Asian Success Stories." *The Electronic Journal on Information Systems in Developing Countries*. Vol. 1.

Bresnahan, Timothy, Erik Brynjolfsson and Laura Hitt (1999). "Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm-Level Evidence." NBER Working Paper No. 7136.

Brusilovsky, P., and P. Miller (2000). "Course Delivery Systems for the Virtual University." In *Access to Knowledge: New Information Technologies and the Emergence of the Virtual University*, Ted Tschang and T. Della Senta (eds.). Elsevier Science, Oxford.

Cohen, Stephen, Bradford DeLong and John Zysman (2000). "Tool for Thought: What Is New and Important about the "E-economy. http://www.j-bradford-delong.net/OpEd/virtual/technet/An_E-conomy

Dale Jorgenson and Kevin Stiroh, "Raising the Speed Limit: US Economic Growth in the Information Age," Brookings Papers on Economic Activity (Washington, DC, 2000)

David, Paul (1999). *Digital Technology and the Productivity Paradox: After Ten Years, What Has Been Learned?* MIT Press, Cambridge, Mass.

Economic Planning Agency (2000). "The Effects of Information Technology on Productivity: In Search of Japan's New Economy." Policy Effect Analysis Report No. 4. Research Bureau of the Economic Planning Agency, Government of Japan.

FAO (1999). *First Miles of Connectivity*. http://www.fao.org/WAICENT/FAOINFO/SUSTDEV/CDdirect/CDre0038.htm

Foundation of Occupational Development (FOOD India) Web site.
http://www.:www.xlweb.com/food/evaluate.htm

Gordon, Robert (2000). "Does the 'New Economy' Measure up to the Great Inventions of the Past?" Draft paper for the *Journal of Economic Perspectives.*
http://faculty-web.at.nwu.edu/economics/gordon/351.html

Grant, Gail L. (1999). "Case Study: PEOPLink".
http://www.peoplink.org/gen/press/990623commercenet/

Gyandoot Web site.
http://www.gyandoot.net

Hanna, Nagy, Ken Guy and Erik Arnold (1995). "The Diffusion of Information Technology: Experience of Industrial Countries and Lessons for Developing Countries." World Bank Discussion Paper No. 281.

Heeks, R. B. (1996). *India's Software Industry: State Policy, Liberalization and Industrial Development.* Sage Publications, London.

Heeks, R. B. (2000). "The Approach of Senior Public Officials to Information Technology-Related Reform: Lessons from India." *Public Administration and Development.* Vol. 20: 197-205.

Helpman, E. (1998). General Purpose Technologies and Economic Growth: Introduction. In General Purpose Technologies and Economic Growth, E. Helpman (ed.). MIT Press, Cambridge, Mass. 1-13

IMF (2000). *World Economic and Financial Surveys: World Economic Outlook.*
http://www.imf.org/external/pubs/ft/weo/2000/02/

The Indian Express (2000). "PC is their Magic Box, Mouse a Friend." 25 January 2000.

InfoDev (1999). "Rural Self-employed Women use Telephones to Improve Livelihood." ICT Stories Database. International Institute for Communication and Development and the Information for Development (*info*Dev) program of the World Bank.
http://www.iicd.org/base/show_story?id=4065

InfoDev (1999a). "Software Quenches Thirst of Indian Villages." ICT Stories Database. International Institute for Communication and Development and the Information for Development (*info*Dev) program of the World Bank.
http://www.iicd.org/base/show_story?id=3819

Infosys (2000). http://www.itlinfosys.com/corporate/comminv.htm

International Telecommunication Union (2000). *ITU Telecommunication Indicators.*
http://www.itu.int/ti/industryoverview/index.htm

Jorgenson, Dale, and Kevin Stiroh (2000). “Raising the Speed Limit: US Economic Growth in the Information Age.” *Brookings Papers on Economic Activity*. Vol. 2.

Juma, M. (2000). “The African Virtual University.” In *Access to Knowledge: New Information Technologies and the Emergence of the Virtual University,* Ted Tschang and T. Della Senta (eds.). Elsevier Scientific Press, Oxford.

Kremer, Michael (1998). “Patent Buy-outs: Mechanisms for Encouraging Innovation.” *Quarterly Journal of Economics.* 1137-1167.

Mansell, R., and U. Wehn (1998). *Knowledge Societies: Information Technology for Sustainable Development.* Oxford University Press, Oxford.

MSNBC (1999a). “Information Technology: Reaching the Unreached.” Unpublished presentation material. M. S. Swaminathan Research Foundation.

MSNBC (1999b). *1999-2000 Tenth Annual Report*. M. S. Swaminathan Research Foundation.

MSNBC (2000). “Internet Takes Root in India’s Villages: Village Cyber-cafes Save Time, Money and Red Tape.” 27 February 2000.

MSSRF (2000). http://www.mssrf.org

NASSCOM (2000) “The Indian IT Industry.” http://www.nasscom.org

NASSCOM-McKinsey (1999). “Highlights of the NASSCOM-McKinsey Study Report on the Indian Software Industry.” http://www.nasscom.org/pdf/mckinsey.pdf

Newsweek (2000). “Wiring the Villages.” Special issue July-September.

Nua Internet Surveys (2000). http://www.nua.ie

Odedra M., M. Lawrie, M. Bennett and S. Goodman (1997). “Information Technology in Sub-Saharan Africa.” International Perspectives, CACM. http://www.sas.upenn.edu/African_Studies/Comp_Articles/Information_Technology_117.html

Oliner, Stephen, and Daniel Sichel (2000). *The Resurgence of Growth in the Late 1990s: Is Information Technology the Story?* http://www.federalreserve.gov/pubs/feds/2000/index.html

PANAsia (1999). *Success Stories of Rural ICTs in a Developing Country*. Report of the PANAsia Telecenter Learning and Evaluation Group’s Mission to India. IDRC, Ottawa.

PEOPLink (2000).
http://www.peoplink.org/scripts/web_store/web_store.cgi?page=./gen/about.htm&cart_id=7285804.16586

Pernia, E. M., and M. G. Quibria (2000). “Poverty in the Developing World.” In *Handbook of Urban and Regional Economics*, Vol. 3, E. S. Mills and R. Cheshire (eds.). North Holland Publishers, Amsterdam.

Pohjola, Matti (2000). “Information Technology and Economic Growth: A Cross-country Analysis.” UNU World Institute for Development Economics Research. Working Paper No.173. UNU/WIDER, Helsinki.

Psacharopoulos, G. (1994). “Returns to Investment in Education: A Global Update.” *World Development*, Vol. 22, Issue 9.

Richardson, D., R. Ramirez and M. Haq (2000). *Grameen Telecom’s Village Phone Programme in Rural Bangladesh: A Multi-Media Case Study.* TeleCommons Development Group report for the Canadian International Development Agency.
http://www.telecommons.com/documents.cfm?documentid=107

Schumpter, Joseph (1939*). Business Cycle: A Theoretical, Historical and Statistical Analysis of the Capitalist Process*. McGraw Hill, New York.

Sholay Special (2000). “Rural Folk Get Net Savvy in Madhya Pradesh.” 27 February 2000.

Solow, Robert (1987). “We’d Better Watch Out.” *New York Times Book Review*. 12 July 1987.

Srinivasan, T. N. (2000). “Growth and Poverty Alleviation: Lessons from Development Experience.” Revised Paper prepared for the High-level Symposium on Alternative Development Paradigms and Poverty Reduction. ADB Institute, Tokyo, 8 December 2000. [online at www.adbi.org/PDF/cf3rdann/srinivasan.pdf]

Szczypula, J., T. Tschang and O. Vikas. (2000). “Reforming the Educational Knowledge Base: Course Content and Skills in the Internet Age.” In *Access to Knowledge: New Information Technologies and the Emergence of the Virtual University*, Ted Tschang and T. Della Senta (eds.). Elsevier Science, Oxford.

Talero, E., and P. Gaudette (1995). “Harnessing Information for Development—A Proposal for a World Bank Group Strategy.” World Bank Discussion Paper No. 313. 145-188.

The Times of India (2000). “IT Section.” 10 October 2000

UNESCO (2000).
http://unescostat.unesco.org/en/stats/stats0.htm

United Nations Foundation (2000). “Online Medical Group Targets Developing Countries”.
http://www.unfoundation.org/unwire/archives/UNWIRE000622.cfm#5

Whelan, Karl. “Computers, Obsolescence, and Productivity,” Board of Governors for the Federal Reserve Working Paper 2000-6 (Washington, DC: Federal Reserve Board, May 2000)

White, H. (1980). “A Heteroscedasticity-Consistent Covariance Matrix and a Direct Test for Heteroscedasticity.” *Econometrica.* 48: 817-838.

World Bank (1998). *Knowledge for Development.* World Development Report 1998-1999

World Bank (2000a). *Poverty Trends and Voices of the Poor*. http://www.worldbank.org/org/data/trends/trends.pdf

——— (2000b). *World Development Indicators 2000*. On CD-ROM.

Wu, W., and Y. Yuan (2000). “The Digital Economy in China: A Preliminary Assessment,” mimeo, United Nations University/Institute of Advanced Studies.

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