

Information and Communication Technologies and Broad-Based Development: A Partial Review of the Evidence

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Information and Communication Technologies (ICTs) are increasingly seen as integral to the development process. This paper reviews some of the evidence for the link between telecommunications and the Internet and economic growth, the likely impact of the new ICTs on income inequality and anecdotal evidence regarding the role of the Internet in improving government services and governance. It looks at methods to maximize access to the new ICTs, and improve their development impact both in promoting income generation and the provision of quality services.

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1. INTRODUCTION

In 1876, Alexander Graham Bell was touting his new invention (the telephone) around America, and gave a presentation at the White House. There, the unmemorable President Rutherford Hays turned to him and said “That’s an amazing invention, but who would ever want to use one?”

Despite Hay’s skepticism, it has long been recognized that communications might have a central role in development. John Stuart Mill, writing in 1848, noted that “it is hardly possible to overrate the value, in this present low state of human improvement, of placing human beings in contact with persons dissimilar to themselves, and with modes of thought and action unlike those with which they are familiar... Such communication has always been, and is peculiarly in the present age, one of the main sources of progress” (quoted in Hirschman, 1982).

Perhaps this is even more true today. For many observers, the global economy is entering a ‘digital age’ and information has become the primary resource for economic development (Talero and Gaudette, 1996). At the same time developing countries are increasingly alarmed at an emerging “digital divide,” in which those without access to the latest (and most expensive) tools and technologies will find themselves unable to compete in the global marketplace.

This paper discusses the role of Information and Communications Technologies (ICTs) in broad-based development, and the reasons for the level and quality of ICT service provision in developing countries, suggesting methods to improve these levels. The paper concludes with a discussion of the broader agenda needed to ensure the maximum return to ICT investments –in areas such as macro-economic and education policies.¹

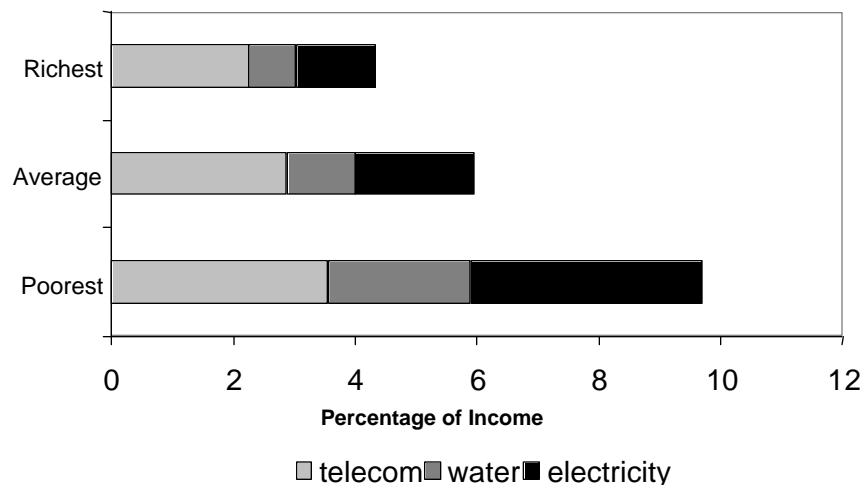
ICTs are tools that facilitate the production, transmission, and processing of information. Thus, a broad definition of ICTs ranges from traditional technologies such as the printed word, to the most modern communications and data delivery systems such as terrestrial satellites that can download digital data to a laptop computer hooked up to a cellular network. Such a broad definition risks missing trees for the forest, however. For the sake of analytical clarity, this study focuses on “new” ICTs –telecommunications and the Internet.

Perhaps the simplest way of demonstrating the importance of such ICTs in the development process is to examine the willingness of the poor to pay for service. As

¹ It should be noted that this paper will focus on the telephone and the Internet. This is not because other ICTs such as the radio and postal services are unimportant –far from it. The radio is used almost universally, making it a powerful tool for disseminating information needed by the poor. Levels of radio density in LDCs are on average about ten times higher than levels of teledensity. Postal services, offered through over 650,000 post offices worldwide, are also far from becoming obsolete. Indeed, in advanced markets, users of Internet technologies are also those that send and receive the most mail.

Figure 1 shows, the poor in Chile consider telecommunications such a basic service that they spend more of their income on telecommunications than on water. Furthermore, the *average* Chilean spends more of their income on telecommunications than on electricity and water combined.² This disproportionate expenditure is a reflection of the perceived opportunities associated with acquiring ICTs. The capacity to raise income and improve the economic growth rate alone are enticing incentives, but ICTs also offer opportunities to improve the environment, educational outcomes and health service delivery, as well as other government services.

Figure 1: Percentage of Expenditure on Utilities in Chile



Source: deMelo, 2000.

So, how do ICTs aid in the development process? The variety of technologies incorporated under the term, “ICT,” operate differently and have unique effects based on the manner in which they are used. Nevertheless, their relationship to economic and social development all stem from several basic characteristics related to improved information production and sharing. These include:

- *Sharing Knowledge*: The single-most important benefit associated with access to new ICTs is the increase in the supply of information. Reducing the cost of producing and transmitting information increases its availability and accessibility, which in turn reduces uncertainty. Reduced uncertainty will generally lead to better decision-making and allow for new forms of organizational innovation, thus reducing transaction costs and inefficiencies. The fundamental idea behind the “digital” or “new” economy is that value-added is increasingly concentrated in the application of new ideas to existing systems. Consequently, productive capacity no longer relies solely on investments in plants and labor, but on adapting new technologies and organizational forms into existing forms of economic activity.

² This expenditure on telecommunications does not cover other forms of communication tools, such as radio, televisions, and posts.

- *Increasing Productivity*: The use of ICTs benefits productivity through the creation of new models for turning inputs into products and/or services. As organizations learn and adapt to new technologies, labor can be re-deployed to more efficient tasks, discrete components of a system can be better coordinated, and raw information can be more effectively manipulated to assist decision making (Crede and Mansell, 1998). This in turn results in more innovation, leading to a “virtuous cycle,” in which the initial adoption of new technologies snowballs into increased profits at the firm level beyond.
- *Overcoming Geography*: ICTs can overcome geographic boundaries, creating a more efficient global marketplace. As buyers and sellers are increasingly able to share information on process, specifications, and delivery times, production processes can be spread across national borders, and comparative advantage can be more efficiently realized. For developing countries, this can lead to larger markets and increased access to global supply chains.
- *Openness*: Networking and information-sharing also lead to demands for greater openness and transparency. Whether this means learning the true cost of a widget in Taiwan, the decision-making process on a government agency, or the status of a central bank’s foreign exchange reserves, ICTs are a powerful tool of empowerment. Thus, ICTs might encourage the further spread and consolidation of democratic regimes.

While it is clear that knowledge and ideas play essential roles in advancing economic and social welfare, it is important to recognize that the causal relationship is complex, and ICTs are certainly no panacea. The enthusiasm with which the development community has rushed into ICT-related programs often seems to overshadow the question of precisely how ICTs contribute to national development. Exclusive emphasis on ICT projects, at the expense of careful analysis and consideration of the broader economic, social and political elements that interact to improve the lives of individuals, is likely to result in unanticipated failures and wasted resources. Unfortunately, technological change moves so quickly that it often surpasses substantive analysis, leading to an over-reliance on anecdotal evidence as justification for ICT projects. This in turn can lead to poorly designed programs and haphazard implementation schemes that do not account for local conditions, resulting in projects which fail to meet their objectives or may even harm the welfare of supposed beneficiaries (Mansell, 1999, Fuchs, 1998). Furthermore, investments in ICTs inevitably result in opportunity costs as they divert investment from other developmental needs and priorities. As Heeks notes: “...[T]here are finite amounts of money, time and attention. Investing these in ICTs means explicitly not investing them in other development areas. Yet the ICT fetishists have so far been unable to demonstrate how ICT-based information represents a more important resource than water, food, land, shelter, production, technology, money, skills or power in the development process” (Heeks, 1999, p. 16).

Nevertheless, the revolution in ICTs has profound implications for economic and social development. The key issue for both governments and donors is to ensure that ICT access reaches even the most marginalized groups, while at the same time ensuring that

ICT projects meet the needs and demands of the target population. The balance of this paper addresses the issue in more detail.

The first major section discusses the role of ICTs in economic growth, looking briefly at the theory for a relationship between the two and at greater depth at the impact of ICTs on transactions and trading as well as investment. It then turns to possible challenges posed by ICTs to LDC economic performance before looking at empirical evidence at the macro level for a relationship between ICTs and economic development.

The second major section of the paper looks at the possible equity impact of ICTs within countries. Because the majority of the poor live in rural areas, it pays special attention to the potential impact of ICTs on farm and rural non-farm income generation. It also discusses the 'digital divide' within countries –the disparity in access between rich and poor, men and women, urban and rural populations.

The third section looks at the use of ICTs in improving social services, governance and empowerment of the poor. In turn, the general effects on service provision and governance and the particular potential impact on education, health and the environment are discussed. The section then turns to risks presented by ICT use in LDC governance and service initiatives.

The final major section of the paper briefly reviews methods to maximize the provision and impact of ICTs in LDCs. It discusses the determinants of ICT provision, methods to maximize community access, policy and legal reforms to increase the potential for ICTs to support income generation and rules for the better use of ICTs in government.

2. ICTs and ECONOMIC GROWTH

Communications and Economic Growth in Theory

This century has seen an ever-widening search for the cause –or causes—of rapid development, but modern growth theories do suggest that communications might play a significant role. Madden and Savage (1998), referring to telecommunications suggest that:

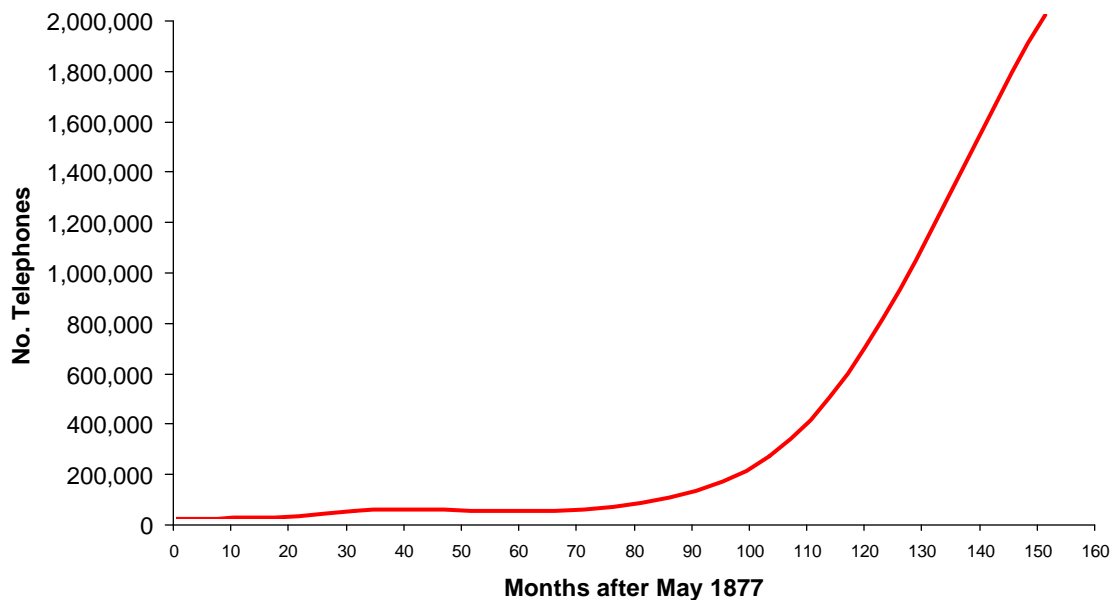
- Telecommunications services can substitute for other forms of communication (mainly postal service and personal travel) and are often more effective and more efficient than those of forms in their use of time, energy, and materials;
- A reliable telecommunications system generates new communication --partly because it interacts directly and indirectly with numerous production and distribution functions;
- Markets are critically dependent on information flows, especially the generation and productive exploitation of new information.³
- Having accessible and reliable telephone service removes some of the physical constraints on organizational communication, permitting increased productivity through better management in both the public and private sectors, making it possible to adopt different structures and locations, and aiding the evolution of increasingly complex organizations. For example, DuBoff (1980) suggests that the advent of the telegraph generated numerous internal control economies for firms and also lowered external transaction costs, thus contributing significantly to US economic growth.

Similar effects could be suggested for the Internet, and added to these effects are those working within the sector itself –in particular the impact of network externalities. Such externalities are based on the fact that value of a telephone line goes up exponentially with the number of users connected to the system. A phone system with only one phone attached is worthless. A system with two phones allows for one connection to be made. A system with three allows for three connections, four phones allow for six connections, etc. This explains the explosive growth of such networked technologies once a threshold level of users is reached. Figure 2 shows the number of telephones worldwide in the months after Bell installed his first line in May, 1877. At the start, growth was fairly stagnant –President Hay’s contention that the phone was a useless toy was borne out by the fact that there was almost no-one to call. But then a threshold was reached, and the telephone became a useful tool of business. The number of telephones connected began to shoot up –in turn making the telephone an ever more useful tool, persuading ever more

³ We have strong empirical examples of telecommunications improving the functioning of markets: Hirschman (1967) offers the evidence that a credit market for the coffee trade developed in Ethiopia after the installation of a long distance telephone network. Garbade and Silber (1978) find improved telecommunications reduce the price differentials for the same instrument in stock markets.

people to link to the network, so that the number of phones passed the 2,000,000 mark by the turn of last century. The parallels with another networked technology –the Internet—are clear.⁴

Figure 2:



Source: Standage, 1999

Sectoral Effects

Combined with this theoretical perspective, we already have a substantial body of anecdotal and empirical evidence at the sectoral level and below on the impact of ICTs. For example, at the micro level, Saunders *et al* (1994) note that telecom investments tend to generate internal rates of return of approximately 20%. Antonelli (1996) argues that Italian manufacturers who were quicker in increasing their use of telecommunications

⁴ It should be noted that there are limits to the externality effect. Those who see most value in connecting or being connected are those likely to connect first (just as in traditional markets) –this means that even while there is exponential growth in the number of possible connections with each additional user, the marginal value of the connection does fall. Taking an extreme example, adding a fourth telephone line to a house occupied by one person is likely to have not only limited value to the person, but also a fairly small marginal impact on the value of the network. The telephone appeared to have come close to the ‘personal usefulness’ saturation point in the United States in the 1980s –main line per capita growth had begun to slow. The Internet, by creating demand for a second line, may have staved off saturation, and has certainly increased demand for ‘thicker pipes’ –or faster network connections—as well as the benefit to others of those pipes being connected.

services saw significantly higher productivity gains over the 1985-88 period.⁵ The following discussion considers the relationship between ICTs and two critical macro-economic sectors in particular – trade in goods and services and the transactions costs of business, and capital accumulation and investment.

1. Trade and the Reduced Transactions Costs of Business

ICTs allow firms to spread component manufacturing across a wider array of countries, increasing the variety of service related activities that can be outsourced. This fosters efficient supply chain management and diversification and improves the logistics of moving goods and services across national borders. These factors have created new opportunities for large and small firms from developing countries to increase their sales range and tap into the global market for goods and services. The development of ICTs and the liberalization of national trading regimes could be a major factor in sustainable economic development (Hanna et al., 1996).

The opportunities offered by the e-commerce revolution are particularly exciting. In 1999, global e-commerce revenues exceeded US\$ 150 billion and are predicted to climb as high as US\$ 3 trillion by 2003 (Forrester Research, 1999). While the majority of e-commerce transactions still take place within the industrialized countries, the economic and social implications of e-commerce for the developing world might be profound. The ability to reach a global audience, obtain instant market information, and conduct electronic business transactions will increase economic efficiency and will open markets for goods and services from the developing world.

E-commerce is expected to benefit economic development in several ways: through allowing local businesses access to global markets; by providing new opportunities to export a wider range of goods and services; and to improve the internal efficiency of LDC firms. First, e-commerce allows businesses to reach a global audience. In Africa, for example, the tourism and handicrafts industries are realizing their ability to deliver their product information directly to consumers. Tourist lodges, hotels, and governments across the continent now maintain sophisticated web-sites advertising their unique features, handling booking orders, and promoting specials to interested consumers (African Business, 10/99).

Similarly, small manufacturers of traditional handicrafts are discovering how ICTs can assist the marketing and distribution of their wares. In Kenya, for example, the Naushad Trading Company (<http://www.ntclimited.com>), which sells local wood-carvings, pottery, and baskets, has seen revenue growth from US\$ 10,000 to over US\$ 2 million in the two years since it went on-line (Africa Business, 10/99). Consumers and shopkeepers can constantly access updated color pictures of NTLimited's product line, place orders, and

⁵ At the same time it should be noted that Capello (1994) reported on the European Commission's STAR programme in Southern Italy and stated that "Although this programme has achieved the aim of stimulating a local demand for advanced telecommunications networks and services, it has hardly generated any significant regional performance. Firms located in the south do not show an improvement in their business performance related to the adoption of new telecommunications technologies".

make inquiries of other types of handicrafts. On a global level, many businesses have benefited from the introduction of electronic boutiques. PeopLINK, (<http://www.peoplink.org>), for example, is a not-for-profit organization that provides developing country artisans and handicraft manufacturers with digital cameras and displays their products on its web site. PeopLINK also handles orders at its central headquarters, which provides artisans with an international customer base, eliminates middlemen, and results in increased sales and profits to the manufacturer.

A second opportunity created by e-commerce and its predecessor technologies is that ICTs can create digital marketplaces to manage supply-chains and automate transactions, increasing efficiency and opening previously closed markets to firms in developing countries. Because of this, global production processes are increasingly fragmented, with separate stages of manufacturing and value added taking place across national borders. Nowhere is this more apparent than in the information technology sector itself. The rapid obsolescence of new technologies has caused many IT firms to emphasize the development and marketing of new products, outsourcing physical production to more cost effective environments. This has created a comparative advantage for SMEs in developing countries, where lower costs for facility construction and quicker retooling create a more competitive manufacturing environment.

In Mexico, for example, the state of Guadalajara is experiencing a boom in indigenously owned and operated subcontractors that build components for major technology firms such as Compaq, Cisco Systems, and IBM. Since 1994, electronics exports from Guadalajara have increased to over US\$ 5 billion per year and the industry now employs over 60,000 workers, up from 5,000 in 1995 (Wall Street Journal, 3/2/00 p.A1). In this case, a combination of low labor costs, flexible sub-contractors, and geographic proximity to the U.S. market has caused a boom in contract manufacturing with positive trade and developmental benefits. Similarly, in 1998, Intel announced a plan to construct a US\$ 300 million plant in Costa Rica to build next-generation semi-conductors for sale in the United States. Costa Rica presented an attractive environment for Intel due to its stable economic and political conditions, well-educated and technologically savvy workforce, reasonable cost structures for labor and other inputs, and a receptive investment environment – including favorable customs procedures and capital repatriation laws (Spar, 1998).

ICTs not only open up more trade in physical goods, they also present new opportunities for LDCs to benefit from trade in services.⁶ As new ICTs reduce the cost of information transfer, it is increasingly easy and cost effective to outsource information-intensive administrative and technical functions. Trade in services can be broken into two distinct categories: data entry and software development, in which firms parse the labor intensive aspects of information management and program development to low cost environments; and back-office support such as inventory management, legal advice, accounting, marketing, distribution, and research and development. Both areas have witnessed rapid growth in recent years, as improved communications networks make it easier and cheaper to outsource these activities.

⁶ The following discussion draws heavily on Braga, 1996.

The development of an indigenous Indian software industry is a good example of the developmental benefits that can result from expanding trade in services. Beginning as a low cost environment for the labor-intensive aspects of writing software code, the country has been able to parlay that experience into the emergence of one of the most dynamic IT environments in the developing world. India now exports US\$ 5.7 billion in software products per year, and the sector may account for almost 25% of the country's economic growth (Business Week, 3/6/00).

A third benefit of e-commerce to LDCs is that it promises to revolutionize efficiency and the culture of business. While empirical data measuring efficiency and productivity related to e-commerce is scarce, anecdotal evidence suggests that b2b linkages have a number of discrete effects on global business practices. These include:

- Better intra-firm communications – E-commerce applications make it possible for businesses to better coordinate different departments and systems. The open protocol standards of Internet applications makes it possible to connect processes such as logistics, manufacturing, and human resources that previously operated within closed environments. Thus, business productivity and efficiency are increasing rapidly, leading to expanded profits and better market access for new and innovative companies.
- Cost savings – Electronic markets allow a more efficient mechanism for buyers and sellers to find each other and agree on price. General Electric, for example, operates the “Trade Process Network,” which links its suppliers and allows them to place electronic bids for component contracts. The system catalogs and displays standards for all aspects of GE's parts requirements and allows suppliers to bid for contracts and receive payments electronically. The system has cut procurement cycles in half, processing costs by a third and the cost of goods purchased by 5-50% (Economist 6/26/99).
- Reducing inventory costs – Electronic interchanges can help firms better manage their inventories. This is particularly relevant in the age of “just-in-time” approaches to inventory management. Improving links between firms allows for better demand forecasting and control over the arrival of supplies, thus reducing inventory costs and lowering turn-around time. Dell Computers has led the way in this process through a system linking its suppliers directly to its daily orders. As a result, parts arrive and are used on the same day in its manufacturing centers.

Because of this, many firms (particularly in Asia) are rushing to create regional b2b e-commerce hubs. In Singapore, for example, Advanced Manufacturing Online operates a web exchange in which companies such as Matsushita, Motorola, and Taiwan Semiconductor Manufacturing are linked with some 600 regional SMEs through a system that allows firms to make orders, share delivery forecasts and solicit quotes (Business Week, 10/25/99). Similarly, Asian Sources in the Philippines has signed on 63,000 members to a system linking Asian manufacturers with buyers from the industrialized world.

2. Capital accumulation

Capital accumulation – whether FDI, portfolio flows, or domestic savings mobilization – is fundamental to economic growth and opportunity. ICTs are the backbone of capital accumulation and management. In very few countries do banking systems still operate primarily through paperwork and person to person interaction. Rather, finance networks have become digital. And ICTs have allowed the expansion of banking services in developing countries to previously underserved groups. In South Africa, for example, “AutoBank E” has developed a fully automated savings system aimed at the poorest depositors. Customers can open an account with a deposit equivalent to only US\$ 8 and benefit from a wide range of electronic banking services. All transactions are completed through ATMs, which keeps paperwork and transaction costs to a minimum. In addition, the bank has used the data collected on depositors to analyze credit-worthiness, resulting in much better credit access for the country’s poorest citizens. The system is very popular, with 2.6 million depositors and 50,000 more being added each month (Economist, 3/25/00, p.81).

ICTs not only improve the ability of the poor to access financial services, but are also central in attracting investment to economies. ICTs attract FDI in particular in three distinct ways. First, the availability of advanced infrastructure, including modern communications networks, is a primary consideration in business calculations of where to invest. As communications costs continue to fall, geography and distance are increasingly less important factors in production site selection. Multinationals place a premium on environments that emphasize flexibility, responsiveness, and adaptation to changing global markets. A recent survey of international firms in Hong Kong, Singapore and Taiwan, for example, found that the presence of advanced infrastructure was the *most important* consideration in the placement of regional headquarters, services and sourcing operations. It was the second most important factor in determining production siting (Mody, 1997).

Second, ICTs attract high-tech industries seeking to service new and rapidly growing markets in the developing world and these invest significant resources. Multinationals are moving quickly to position themselves for a predicted boom in consumer demand for computing and telecommunications machinery in LDCs. Info-economy players such as Intel, IBM and Motorola have moved briskly in Asia to establish e-commerce facilities, leading to plant investments throughout the region. Dell Computer established a manufacturing plant in Malaysia in 1996 (see Nain and Anvar, 1996), and opened the first foreign-owned PC manufacturing plant on mainland China in August of 1999. In Brazil, PC sales are growing at a rate of 30% per year, which has attracted investments from companies ranging from ISP providers like America Online, software and networking solutions like Oracle and CommerceOne, and hardware providers such as Dell and Compaq.

Third, the process of privatizing state owned telecom companies and liberalization of the regulatory and tax environments in which they operate has also increased FDI into developing countries. Governments are increasingly seeking foreign partners to help modernize telecom infrastructure and bring desperately needed finance to moribund state-owned firms. Eastern Europe, for example, is witnessing an FDI boom in its cellular, landline, and data-transmission sectors. Western European firms have taken multi-billion dollar stakes in Hungary, Poland, Croatia and the Czech Republic, and are eagerly seeking access to the less developed markets in Serbia, Albania, and Romania (Euromoney, 12/99). In Morocco, a consortium of firms from Spain and Portugal recently acquired a US\$ 1.1 billion license to build a new cellular network.

The lesson that an efficient ICT sector can attract investment is one that many developing countries have taken to heart. Countries such as Singapore, Malaysia, South Africa, and India have moved aggressively to improve ICT infrastructure and are becoming regional leaders in attracting FDI. Projects include Malaysia's US\$ 20 billion Multimedia Super-corridor, to India's liberalization of trade regime for the high-tech sector in hopes of making it a cornerstone of future economic development, to South Africa's "Info.Com 2025," a program that brings together a diverse array of information and communications actors, to promote ICT development in addition to attracting foreign investment.⁷

Singapore is an archetypal example of how activist government policies in the electronics and telecommunications sectors, combined with an emphasis on attracting FDI, can become a central component of a country's economic development strategy. Beginning in the early 1970s, Singapore actively pursued a development strategy that focused on technological development. Combining a wholesale liberalization and major investments in the telecommunications sector with liberal trade policies focused on attracting foreign investment, the island quickly became a regional hub for the high-tech manufacturing industry in Asia. Over 4,000 multinationals have operations in Singapore, which has resulted in technology diffusion as well as a booming market for SMEs that provide outsourcing services and a flourishing domestic electronics production sector (Hanna et al., 1996). By 1989, the Electronics industry in Singapore recorded output of over US\$ 12 billion per year and employed 39% of the manufacturing workforce (Hanna, 1996).

Recent cross-country empirical research has attempted to estimate the importance of ICTs to decisions on FDI location. It was found that when countries have one more phone per 100 people than the average number of telephones expected at their given income level, they receive 0.3 cents per \$100 of GDP more foreign investment than countries with an average number of telephones. A second main finding in the study was that telecommunications sector privatization can have a dramatic impact on FDI flows. Countries that have private involvement in telephone provision not only have 1.2 more phones per 100 people than those without private providers, they also attract 0.34 cents more foreign direct investment each year per \$100 of GDP (Reynolds et. al. 2001)

⁷ See <http://www.ecomm-debate.co.z/docs/discuss07.html> and Department of Communications, Republic of South Africa, 1999, for more information.

ICTs can also play an important role in attracting private portfolio and venture capital to developing countries in three ways. First, the basis of market efficiency is access to information. Modern financial systems rely on computerized information processing and settlement mechanisms to move money through global electronic networks. As a result, the world's financial markets have been integrated to an unprecedented degree. Broadly stated, ICTs have contributed to this trend by ensuring wider dispersion of market information to investors,⁸ reducing transaction costs in order-routing and execution systems, and increasing confidence in the supervision and regulation of emerging markets. For developing countries, the integration of ICTs into equity and capital markets has resulted in improved access to a global pool of investment capital for industrial development as fund managers seek higher gains and reduced risk through portfolio diversification.⁹

Second, a flourishing indigenous ICT sector attracts venture capital in much the same way it attracts FDI. Investors believe that the developing world will witness a boom in IT spending and are seeking to export US style venture capitalism to emerging economies. Aggressive venture capitalists have been the major force in the US IT sector, bringing finance, business-plans and know-how to high technology firms. While most developing country venture capital markets are in a state of infancy, many countries are seeking to strengthen the sector in order to increase the pool of available funds for entrepreneurs. India, for example, is seeking portfolio and venture capital in the hopes of replicating the Silicon Valley experience. Analysts expect India to attract upwards of US\$ 3 billion per year in venture capital from global investors including Softbank, Chase-Manhattan, and GE Capital. In addition, India's wealthy expatriate community, particularly those that have succeeded in Silicon Valley, are increasingly seeking to bring both their expertise and accumulated wealth back to India (Red Herring, 2/22/00).

Finally, ICTs also benefit a developing country's access to venture finance by improving risk management techniques. This process can benefit financial flows in the developing world in several important ways. First, the use derivatives and forward contracts can protect investors against exchange rate fluctuations. Multinationals with global supply chains can use these tools to reduce revenue volatility and allow better forecasting and planning. This in turn leads to investment decisions based upon the unique comparative advantage of a given location and parses out the risk of exchange rate movements to other investors.¹⁰ Second, businesses can use computer-modeled derivatives, as well as

⁸ The information needs of investors include immediate access to market conditions and prices, evaluations of political and social conditions, and the credit-worthiness of firms, intermediaries and suppliers (i.e. credit risk).

⁹ Private sector capital flows to the developing world had exceeded US\$ 300 billion per year by 1997, dwarfing official development assistance (Economist, 01/30/99). However, ICTs have also contributed to increased volatility and risks of contagion. The period immediately prior to the Asian crash of 1997/98 had been characterized by record capital inflows to emerging markets. Yet these flows just as quickly vanished as money managers realized that inadequate supervision had resulted in massive problems in the banking sector; countries quickly learned that ICTs can move money out of a country just as fast as they can move it in.

¹⁰ In the past few years, markets in China, Singapore and Hong Kong have all begun offering hedging instruments denominated in local currencies. Daily trading volume in the Taiwanese, Korean, Philippines,

forward contracts and options to protect themselves against commodity price fluctuations. Farmers in the industrialized countries rely on well-developed markets in commodity futures and options to better ensure steady future profit flows. The spread of ICTs into the developing world will likely enable a more efficient functioning of agricultural markets and boost profits in that sector. Third, firms, particularly banks, are increasingly able to manage differing national regulatory and capital requirements through instant portfolio re-balancing, as well as software programs that automate risk profiles. This in turn increases efficiency and allows finance to flow into regional areas and sectors which may otherwise present an unattractive investment profile (Economist, 12/11/99).¹¹

Challenges

It should be pointed out that the increasing role of ICTs in global trade and investment does present challenges to developing countries that, at least theoretically, might see their growth prospects diminished. First, while countries with a strong ICT sector might find it easier to attract capital and exploit opportunities for trade, those without a strong sector might well be left behind. One recent estimate suggested that as much as one-half of the difference between Africa's manufactured exports as a share of GDP and East Asia's share could be accounted for by the weak state of communications networks in Africa, for example (Elbadawi, 1999).¹² As we will see, the level of ICT provision in a country is highly correlated with income per capita. If there are threshold effects at work, and a certain minimum level of ICT provision is required to benefit from the global opportunities offered by the Internet, then some developing countries might fall into a poverty trap of not being able to provide such a level of services.

The development of telecommunications and the Internet rides on the back of a range of network and scale economies. For example, a larger online community makes the development of Internet content a more attractive commercial and social proposition whilst the development of more attractive Internet content encourages the growth of a larger Internet community. But while scale economies suggest the opportunity for explosive growth, they also threaten the risk of the poverty trap. A consistent finding of surveys of users and providers in developing countries is that the lack of local language and locally relevant content are a major barrier to increased use. Unless there is a concerted effort to overcome these constraints, Internet growth in some developing

Indian, Chinese, Thai, and Malaysian currencies averages US\$ 500 to 800 million per day and is growing. (ESCAP, 1999)

¹¹ ICT based advances in risk-management techniques are not without problems, however. Technological changes in risk management techniques are moving so quickly that national supervisors and regulatory bodies are often unable to adequately monitor financial markets and protect against systemic turbulence. Furthermore, the nature of risk has fundamentally changed as the global economy moves from national bank-based financing to global money-markets.

¹² Ibrahim A. Elbadawi (1999) Can Africa Export Manufactures? The Role of Endowment, Exchange Rates, and Transaction Costs World Bank Policy Research Working Paper 2120 (May 1999)

countries could be stuck in a low-use equilibrium.¹³ This is a real threat given present concerns over the emergence of a ‘digital divide’:

- Although the average OECD country has roughly 11 times the per capita income of a South Asian country, it has 40 times as many computers, 146 times as many mobile phones, and 1,036 times as many Internet hosts;
- There were only 1 million Internet subscribers on the entire African continent compared with 15 million in the UK in 1999;
- In 1998, only 23 percent of the websites in developing countries had content in their own languages;
- A recent host survey by Network Wizards shows that Africa generates only 0.4 percent of global content. Excluding South Africa, the rest of Africa generates a mere 0.02 percent (World Bank GICT Department, 2000).

Having raised this fear, there is little evidence of the low-use equilibrium developing. Hosts per capita in LDCs are at the level that would be suggested by income levels, policy factors and geographic barriers according to Wheeler (2000).

There are other threats, however. Because information and communications technologies reduce barriers to the flow of information and goods across borders, their spread is likely to have similar effects as reducing trade barriers between nations. It is usually assumed that the aggregate impact of trade on growth is positive (World Bank, 1999a). Having said that, reduced barriers to trade –whether induced by new technologies or shifts in policy-- can certainly negatively effect some regions or groups within a country. There is also some evidence to suggest that the trade-growth link is not as universally strong as frequently assumed (see Kenny and Williams, 2000), suggesting that some countries might actually suffer from greater global trade. The same may well be true of the expansion of the Internet.

By improving purchasers’ access to price information, for example, ICTs can reduce the prices that suppliers can charge for their goods. ICTs can also reduce the competitive advantage of location, allowing a foreign company to underprice a local competitor. While importers and internationally competitive companies in home markets will benefit from these changes, exporters and weaker home companies might well suffer. In countries where the broader environment is damaging to international competitiveness, the Internet might pose a significant challenge.

Broadly, however, anecdotal and some micro-evidence suggests that ICTs are connected with new business opportunities, increased trade and investment –even though there may be risks. This suggests a positive relationship between ICT development and economic growth, if one that is likely to depend on other factors in the economy. We shall see later

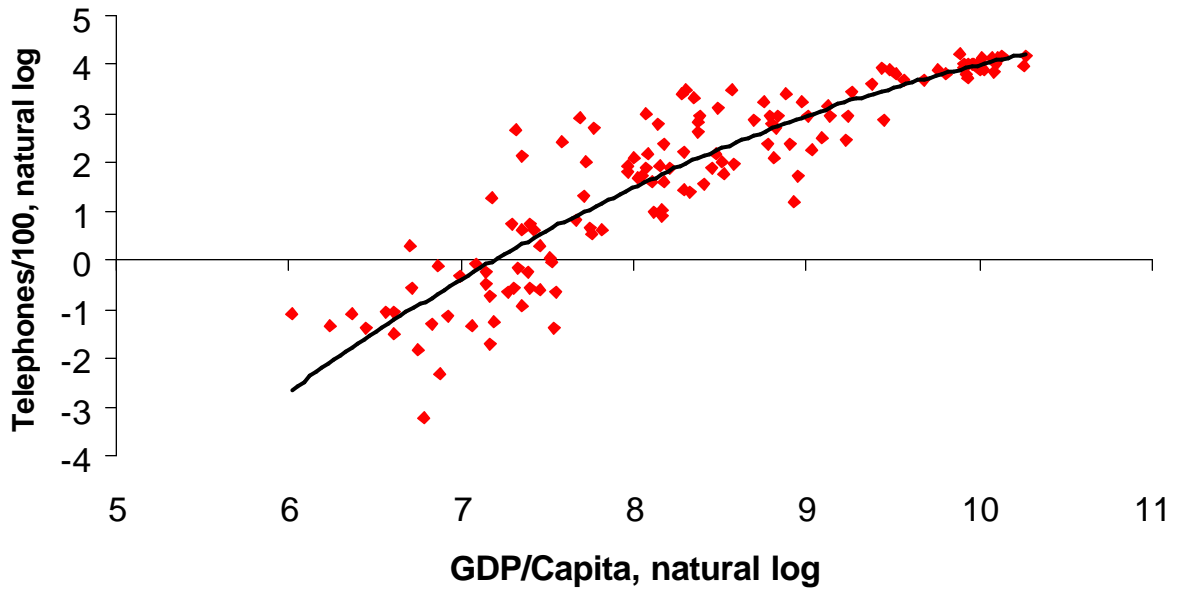
¹³ Developing countries also have the problem of finding the finance to support “lumpy” investments, such as satellites. Indeed, for two decades the only satellite services in the developing world were supplied by treaty organizations such as Intelsat. Such information and credit constraints also apply at the local level – the poor have limited access to credit, and the institutions are not always in place to assist in the aggregation of demand for lumpy investments such as a computer or the first telephone line into a village.

that ICTs appear to have an important role in a range of social services that can also be to the benefit of economic growth as well –such as health and education. This would suggest reasonably strong micro and sectoral support for the idea that ICTs promote economic growth. What does available cross-country econometric work have to tell us about the link between ICTs and economic growth, then?

A Review of the Cross-Country Data

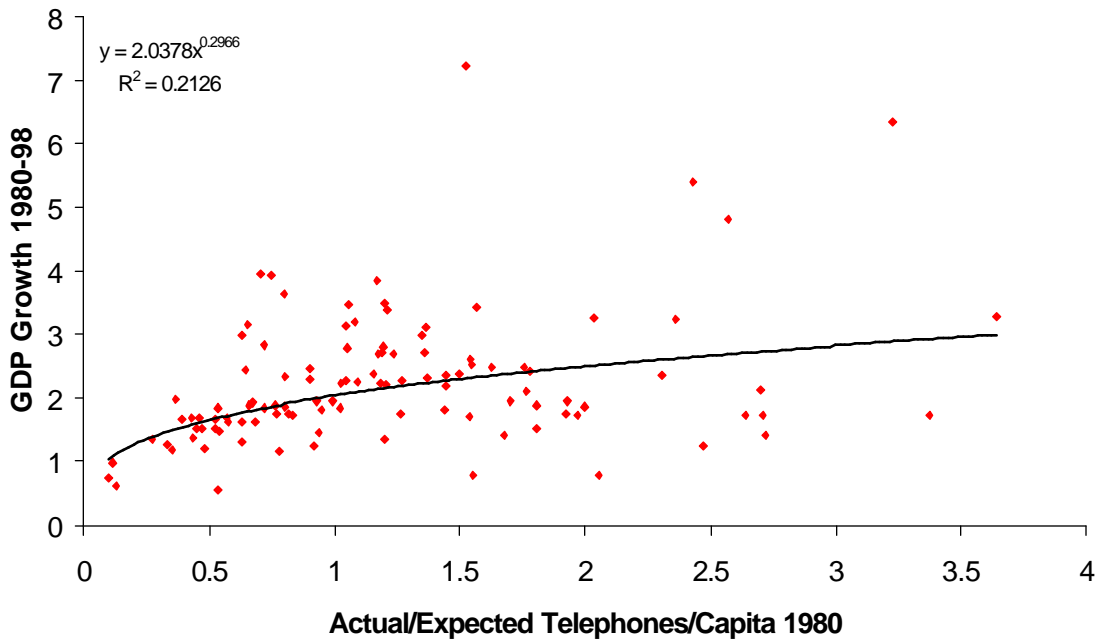
There is certainly a close link between income per capita and the number of telephones per capita –or teledensity (see figure 3)—and the same is true of Internet access. However, this is largely the result of the telephone (and Internet) acting as a consumption good (as people get rich, they want a telephone). Is there a causal relationship from telecoms to growth? A graph that looks at countries with more or fewer telephones than one would expect given their income in 1980 and GDP growth rates over the next eighteen years might suggest so (Figure 4). It is not the most impressive relationship, but it does appear that countries that had more telephones –or a higher teledensity-- than one would expect at period start saw higher growth rates. The median growth is about a doubling of income per capita over the period. Only 29 percent of countries had fewer telephones than expected and faster than median growth or more telephones than expected and slower than median growth.

Figure 3 1997 GDP per Capita against Telephones per Capita (Log Scales)



Source: World Bank, 2000b

Figure 4



Source: authors' calculation from World Bank 2000b.

A large number of recent econometric studies also suggest that the quantity of telecommunications infrastructure may be connected to growth (Hardy 1980, Norton 1992, Canning 1997a, 1997b, Canning and Fay 1993, Roller and Waverman 1995, Madden and Savage 1998, Riaz 1997, Easterly and Levine 1997, Cronin (1991), the DRI (1991), Cohen (1992), Teknibank (1993), Analysis (1992)). Others find investment in telecommunication is significantly correlated (Easterly and Rebelo, 1993).¹⁴

It should be noted that these results have been disputed, and it is empirically very difficult to estimate with any certainty the size of an ICT-growth relationship based on cross-country analysis. However, while the scale and strength of the relationship might be unclear, country specific studies again provide powerful evidence to support some sort of link. Once-developing countries such as Hong Kong, Korea, Singapore, and Taiwan used telecommunications as a key part of their overall economic strategy to build up what is now a highly competitive position in the world market for high-technology industries and services (Saunders, Warford, and Wellenius 1994). In Malaysia, a successful economic transformation has been accompanied by remarkable advancement in telecommunications

¹⁴Looking at a few of these studies in more detail, Hardy (1980) regresses GDP per capita on lagged GDP per capita, lagged telephones per capita and the number of lagged radios over 15 developed and 45 developing nations from 1960 to 1973. According to his estimated results, Hardy concludes that telephone provision does have a significant impact on GDP, whereas the spread of radio does not. Canning and Fay (1993) give estimates of the positive impact of roads, electricity generating capacity, and telephones on economic growth through running Barro (1989) style regression using initial levels of infrastructure to explain economic growth over the period 1960-1985. Norton (1992) tests the effect of the average stock of telephones in 47 countries between 1957 and 1977 on the mean annual growth rate, controlling for the stock of telephones in 1957 and a number of macroeconomic variables. He also finds that the telecommunication variable is positive and significant. Since period start telephone stock is significantly related to subsequent growth, Norton argues that the relationship "is clearly not due to reverse causality." By correcting econometric problems such as simultaneity and spurious correlation present in some earlier studies, recent works (Roller and Waverman 1995, Canning 1997b, and Madden and Savage 1998) lend further support to the argument that telecommunications infrastructure is positively related to economic growth. Roller and Waverman (1996) study the relation between telecommunications infrastructure and economic growth for 21 OECD countries and 35 other countries over the period 1970 to 1990. In order to deal with simultaneity and spurious correlation, they apply a structural setup comprised of a micro-model of supply and demand for telecommunications investments, which endogenizes telecommunications investment, and a macro-growth equation. They apply fixed effects and allow for nonlinear effects of the telecommunications infrastructure. Again, they find a positive and significant causal link between telecommunications infrastructure and aggregate output, provided that a critical mass in countries' telecommunications has been achieved. David Canning (1997a) uses physical measures of infrastructure, paved roads, electricity generating capacity, and telephones, for around 150 countries over the period 1950-1992 and finds that growth in telephones and paved roads per worker cause economic growth, while growth in electricity generating capacity does not seem to cause economic growth. Canning applies the Granger causality test and Johansen error vector correction mechanism (EVCM). Gary Madden and Scott J. Savage (1998) provide strong evidence that changes in telecommunications precede growth. Their findings also suggest (*contra* Roller and Waverman) that the greatest impact of telecommunications investment on growth has been in lower income economies (a similar result is found by Bougheas, Demetriades and Mamuneas, 2000). It should be noted that many researchers are skeptical about the validity of all cross-country econometric studies (Hénault (1996) and Analysis (1995) on telecommunications, and Kenny and Williams (2000) more generally). There are also dissenting voices on the presence of an impact at all. Munell (1992) points out that the results from many of the above studies appear to collapse once more sophisticated econometric procedures are used. By introducing state-level fixed effects, and Garcia-Mila and McGuire (1992) find that the returns of telecommunications are reduced dramatically. With different econometric corrections, Kelejian and Robinson (1994) also reach the same result.

infrastructure (Riaz 1997b). As a negative lesson, the antiquated state of the telecommunications network in the transitional economies of Central and Eastern Europe has been identified by the OECD and the ITU as a significant impediment to regional productivity, international competitiveness, and trade performance (Gary Madden, Scott J. Savage 1998).

Broadly, three lessons are suggested by the cross-country evidence. One, there probably is a link between ICTs and growth; two, econometricians will never have a clear answer as to how strong it is; third, the link is probably environment-dependent. There is a complex relationship between telecommunications rollout and economic growth, one dependent on a range of other conditions such as policy variables, the state of supporting infrastructure, the role of services in the economy. For example, Riaz (1997a) sees a complex interaction between telecoms and IT technologies, using Singapore as an illustration. Initially, the country's export dependence acted as a driver for telecommunications rollout, but subsequently this modern infrastructure enabled rapid growth in the services industry.

What about the Internet? Nicholas Negroponte of MIT Media Labs argues that the Internet is different from past technologies –and that this time the leapfrogging story could be right.¹⁵ It is too early to empirically evaluate this claim. Cross-country evidence on the impact of the Internet on economic growth is sparse to non-existent given the fact that the technology is so young. We do, however, have some studies on the impact of IT investment and growth in the US.

A recent 'survey of surveys' (Pohjola, 1998) concluded that in the 1980s and the early 1990s, the consistent finding was that there was a broadly negative correlation between IT investment and economy-wide productivity in the United States. A few studies in the late 1990s have reversed this conclusion, however. Lehr and Lihtenberg (1999) even find excess returns to investments in computers compared to other types of capital in the US, especially in the presence of skilled labor. A mixed record, perhaps, but, combined with anecdotal evidence at the sectoral level, a reason to consider the Internet an important topic for development practitioners on the grounds of its potential economic impact alone.

Theory, anecdote and available empirical evidence do suggest that ICTs have an impact on economic growth. At the same time, we should not overestimate its scale. The Internet is likely to change the world –and especially business practices—significantly, but this does not *necessarily* mean faster or different patterns of cross-country growth, even while it probably does suggest different sectoral patterns of development. New technologies are always destructive as well as being creative. The balance appears to have been positive in the case of telephony, and the limited evidence we have suggests that this might well be the case with the Internet as well. However, that is likely to depend on how governments respond to the new technology.

¹⁵ <http://www.wired.com/wired/6.01/negroponte.html>

3. EQUITY

As with the theory and evidence on cross-country growth, the overall picture concerning the equity impact of ICTs within countries is somewhat mixed. On the one hand, there is mounting anecdotal and some more formal evidence that access to ICTs amongst the poor and in rural areas increases incomes. On the other hand, there is the considerable threat of being left behind –a fate made more likely by the high relative cost of serving poor rural areas.

On the positive side, ICTs might offer some of their highest returns in rural areas, making them a potential tool in the fight to encourage equitable development. About fifty percent of the world's population (and the great majority of the world's poorest people) reside outside urban areas. For many rural dwellers, information transfer requires geographical proximity. Information on market price, credit and financing opportunities, and access to new technologies or government services is difficult to procure. For these people, access even to the most basic ICTs can make a significant difference (see Box 1).

Recent technology advances, such as microwave relay bases, satellite signaling and cellular telephony have significantly lowered the marginal costs associated with telecom rollout to rural areas. In Columbia, for example, a relatively inexpensive and simple microwave-radio telephone system along with community access points was installed in the remote region of Tumaco in 1994. Within three years residents of the region reported that the service had resulted in better trade and market opportunities; new business opportunities; reduced unemployment; improved health care delivery and information access; improvements in public safety and security; and an overall improvement in the level and quality of available government services (ITU, 1998a).

Box 1: Rural Radio and TV

One of the first modern communications mediums to reach rural populations was radio. Through programming content specifically addressed to the rural listener, local radio has now become the dominant force in information delivery to many remote areas. Through the radio, farmers can learn of new seed varieties and technologies, new agricultural methods, changing consumer demands in distant urban settings, as well as a wide variety of social and cultural information.

Rural radio as an information delivery mechanism has several advantages. First, both the radio unit and the programming and delivery mechanisms are among the cheapest forms of mass media. An FAO study on rural-radio in the Philippines found that the cost of delivering radio content is approximately US\$ 1.60 to 3.10 per thousand. Conversely, reaching people through television cost US\$ 32.80, through fliers cost US\$ 38.50, and local print cost US\$ 86.70 (Lucas, 1999). Second, radio signals can penetrate remote geographic regions and any individual with access to a radio set can receive information, regardless of literacy or educational level. Finally, rural radio provides region-specific information, easily incorporates local concerns and feedback, and operates in the local language.

In the Philippines, a partnership program between UNESCO, the Danish International Development Agency, and the Philippine Government, is providing local radio equipment and training to a number of remote villages. The project is designed to ensure that programming initiative and content originates within the communities. According to UNESCO, the project has not only increased local business and

agricultural productivity, but also resulted in the formation of civic organizations and more constructive dialog with local officials (Jayaweere and Tabing Courier, 1997).

Rural radio is also an example of an activity that can benefit from the presence of the Internet. In Kothmale, Sri Lanka, a joint project between UNESCO, the Ministry of Posts, Telecommunications and the Media, the Sri Lanka Broadcasting Corporation, and the Sri Lanka Telecommunication Regulatory Commission uses radio as an interface between rural people and the Internet. A daily one hour live radio program in which an announcer and a panel of resource persons browse the Internet at the requests of listeners, has proven to be capable of overcoming linguistic barriers in using the Internet by non-English speakers. In addition to the radio program, the Kothmale Community radio station is developing a rural database (<http://www.kirana.lk>), primarily by packaging public domain information often requested by listeners for off-line use. The Radio station also functions as a mini Internet Service Provider by providing Internet access points at two public libraries located within the radio's target area as well as maintaining an Internet café at the radio station.

Audio-visual media have also been successfully used in support of rural development programs. While technically more complex than rural radio, audio-visual training still offers a cost-effective means of distributing knowledge. Benefits include visual demonstration of new technologies and methods; the compression to time (i.e., an entire crop cycle can be demonstrated in one program); and the standardization of information resulting in better cost-effectiveness (Balit, 1998). A World Bank study in Bolivia, for example, found that audio-visual training activities could be produced at 1/3 to 1/5 of the cost of traditional agricultural extension activities (Valenzuela, 1994).

Case studies on the use of radio and audio/visual applications in development suggest that a participatory approach is critical if these programs are to meet their objectives. Programming content must reflect not only local information needs, but must also be sensitive to cultural factors. In Kenya, for example, a DFID project in the Mount Kenya region produced several local language soap opera programs aimed primarily at women farmers. The content included agricultural advice intertwined with drama and humor in order to attract an audience. At the same time, the producers realized that they had to appeal to male listeners as well, as husbands retained control over the radio set and would turn it off if they found the programming to be irrelevant or threatening (O'Farrell, Norrish, Scott, 1999).

The Potential to Promote Rural Incomes

As with other ICTs, the Internet provides a potentially powerful means of accessing information. For rural areas, the Internet offers a cheap and versatile mechanism connecting users with a global repository of information. Internet projects in the developing world abound. The economic and productivity benefits of rural ICT access – including access to the Internet-- can be generalized as follows: access to information and markets, access to information on techniques and environmental conditions and increased business opportunities.

1. Access to Market Information

Farmers and other rural businesses can obtain the highest possible price for their goods and bypass intermediaries through access to ICTs. In addition, supplies and other equipment can be found for the lowest possible price. A recent Asian Development Bank study found that the introduction of telephones in rural Thailand allowed farmers to regularly check prices in Bangkok, which significantly increased profits. “One village

chief . . . reported that farmers income in his village where a telephone was installed . . . doubled,” (ITU, 1998a).

In Chile, the national agricultural extension service created an Internet-based rural information service for farmers groups, rural governments, and NGOs. As the FAO reports: “It was estimated that transmitting price and market information this way cost 40% less than using traditional methods. In addition, the information was more timely, reaching farmers much faster. In the past, the publication and distribution of a printed bulletin took 45 days” (Balit, 1998 p.4).

In Argentina, private companies such as Agropol and Agrositio have taken a lead in connecting farmers. They have begun pooling farmers together through local electronic networks to purchase various inputs in bulk, which has resulted in volume discounts of approximately 5% to 15%. In addition, both firms offer services targeted to farmers such as bulletin boards where farmers can share information on plague alerts, obtain technical information, and even advertise their wares directly to other farmers and consumers. Analysts estimated that 20% of all Argentina’s farms would be connected to the Internet by the end of 2000 (Wall Street Journal, 3/2/00, A12).

2. Agricultural Productivity and Food Security

Communications are integral to knowing what, where, when, and how to plant crops. In particular, global-positioning-satellites are increasingly being used to map soil productivity in areas as small as two hectares. This data can be instantly fed through a remote computer which analyzes output and can make suggestions regarding which crops to plant and which fertilizers and pesticides might be needed. Similarly, satellite imagery and Internet communications can be used to transmit data on emerging crop infestations, track weather patterns, and monitor expected yields. A program at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), for example, has compiled a database containing 50,000 records on crops and resources of interest to farmers in semi-arid tropical areas. The database can be searched by individual farmers via the Internet or by extension agents who pass information along to farmers. In addition, the program can automatically target and deliver customized information on a variety of crops, infestation, and weather systems directly to end-users (Haravu and Rajan, 1999).

3. Increased business opportunities, efficiency and job creation

As with urban entrepreneurs, rural businesses can increase their sales range, resulting in increased production and hence employment. In Ghana, a program is underway that equips local non-traditional exporters with e-commerce type facilities in order to enhance their ability to target new export markets (Crede and Mansell, 1998). In terms of efficiency, the reduction of unnecessary journeys alone can have a major impact on the productivity of rural businesses. For example, an ITU study of factories in rural

Bangladesh found that the introduction of a telephone line reduced the amount of management travel, thus cutting associated travel costs (gasoline, salaries, etc) by a factor 13 times the cost of installing the line (ITU, 1998b). Finally, the construction of telephone centers is a means of job creation in and of itself. In the Indian State of Punjab, for example, one study found over 10,000 telecenters had sprung up by 1996 generating close to 9,000 USD in gross revenue per center.

Risks

Having said that the new ICTs present opportunities, there are also risks. Evidence from Botswana and Zimbabwe suggests that areas lacking telephone access see significantly less entrepreneurial activity than those with access, for example (Duncombe and Heeks, 1999). As with the impact across countries, it might be that the cost of being left behind is growing, creating the risk of greater income disparities. The findings in a spate of recent survey studies in both developed and developing countries suggest the potential scale of the digital divide within countries:

- *By income:* The Living Standard Measurement Survey (LSMS) at the World Bank shows that in Panama and South Africa, households in the wealthiest quintile are respectively 43 and 125 times more likely to have private telephones than those in the poorest quintile. In Nepal, 11 percent of the wealthiest households have access to a telephone, compared with 0.5 percent of the households in the previous quintile (see Table 1).
- *By education:* An Australian study shows that more than 34 percent of people with a university degree or other tertiary qualification can access the Internet from home, compared with just over 12 percent for those with secondary school as their highest educational qualification. A recent study of Capacity Building for Electronic Communication in Africa (CABECA, 1998) found that 87 percent of Zimbabwean and 98 percent of Ethiopian Internet users had a university degree.
- *By geographic region:* 10.4 percent of homes in urban Nepal had private telephone access compared with 0.11 percent in rural areas, a 100 to 1 ratio. The ratio is the same in South Africa and 6 to 1 in Panama (see Table 1). There are almost 4 times as many telephone lines per 100 in the largest city of lower middle-income countries as in their rural areas, and more than 5 times as many lines per 100 in the largest city of low-income countries as in their rural areas. These gaps are even more significant given the fact that more than 50 percent—and as many as 80 percent—of the population in poorest countries, live in rural areas.
- *By gender:* The CABECA survey of African users found that 86, 83, and 64 percent of Internet users in Ethiopia, Senegal, and Zambia, respectively, were male.

Table 1. Teledensity in Selected Countries, by Income Level and Urban/Rural Location

<i>Country</i>	<i>Poorest Quintile</i>	<i>Quintile 2</i>	<i>Quintile 3</i>	<i>Quintile 4</i>	<i>Wealthiest Quintile</i>	<i>% of urban households with telephones</i>	<i>% of rural households with telephones</i>
Nepal	0	0	0	0.5	11.0	10.38	0.11
Panama	1.7	11.0	27.5	51.5	73.8	57.45	9.27
South Africa	0.6	4.7	14.7	33.3	75.0	45.66	4.71

Source: LSMS Surveys, The World Bank.

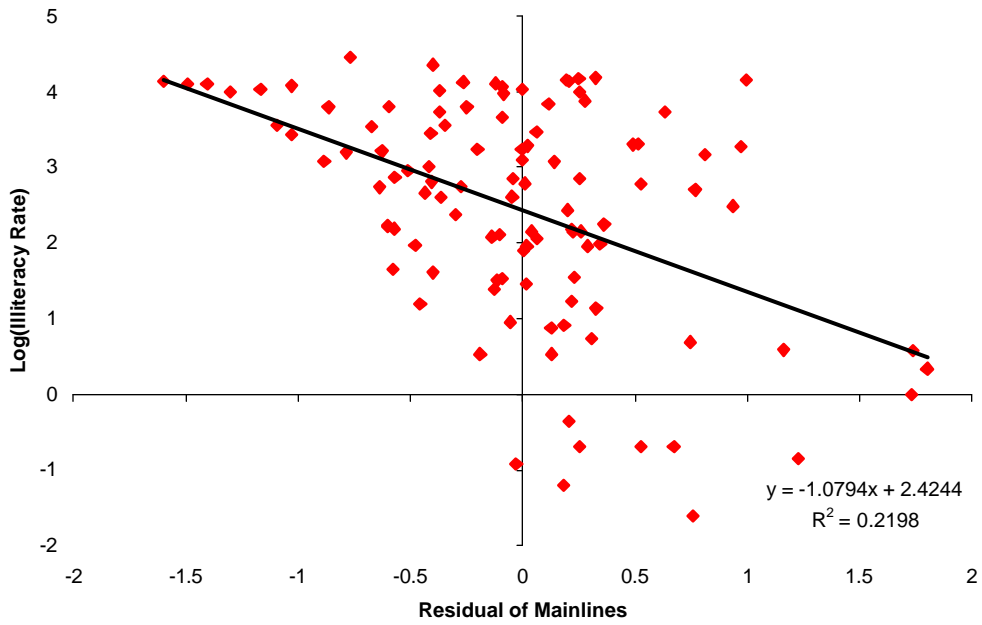
Thus, while ICTs offer great opportunities for the poor in rural areas to expand earnings potential and improve access to services, their relative scarcity amongst these same groups suggests the possibility of greater inequality (see ITU 1999a, 1999b). As much as being concerned about the gap in provision between rich and poor countries, then, governments and the development community should be concerned about the ‘digital divide’ within countries.

4. GOVERNANCE and GOVERNMENT SERVICES

That ICTs have an impact beyond income generation has already been suggested. This section will discuss that impact in greater detail, focusing largely on the new technology of the Internet. Public services (and especially education) are very reliant on information flows. Participation in governance also requires information technology –ICTs allow the voices of the poor to be heard. This section examines the mechanisms through which ICTs can lead to better governance and government services at all levels from the local to the national and identifies some of the key trends shaping the future of ICT take-up in support of improved governance and government services –especially health, education and the environment. The section concludes with a discussion of some of the risks that face government users of ICTs.

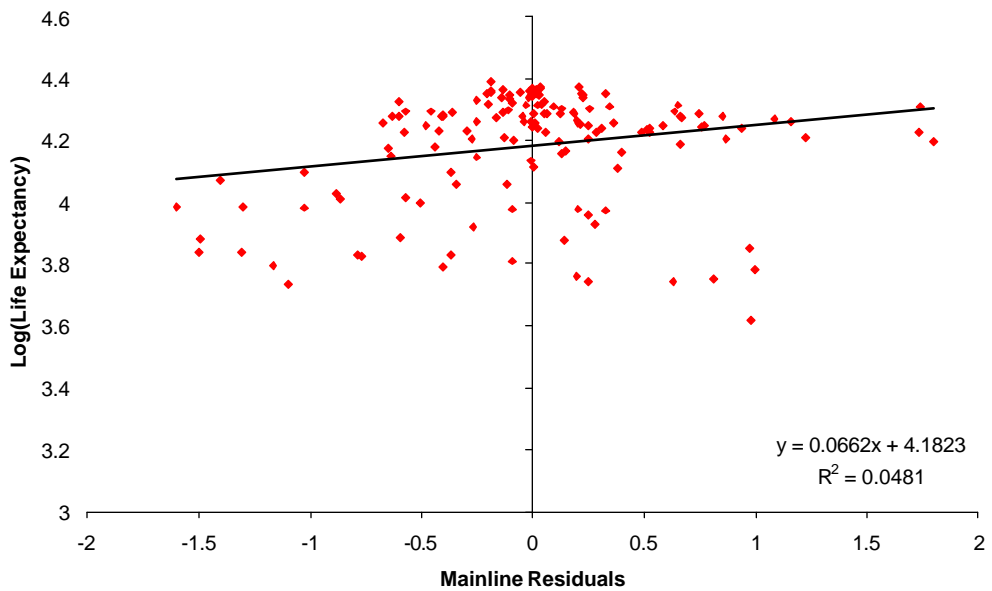
There appears to be little argument that access to telephones can significantly improve the provision of government services. The previous section discussed the case of access in Tumaco, Mexico improving rural people's ability to obtain government services. A more recent example is in the Indian city of Surat, where the outbreak of Plague in 1994 prompted a complete overhaul of municipal governance practices, particularly in the delivery of health and sanitation services. One element of the program included mechanisms to facilitate evaluation and communications between field employees and the municipal government through wireless and cellular telephones. As a result, labor and machinery can now be used far more efficiently with less idle-time and the various health and sanitation departments have been able to better coordinate their activities (Ghosh, 1998). Some cross-country support for a link between quality of life measures affected by the quality of government services is presented in the two graphs below. These take the variation of telecommunications rollout from the level expected at a given level of income, and compare it to rates of illiteracy (which are lower in countries with higher telephone provision than expected) and life expectancy (which is higher in countries with higher telephone provision than expected).

Figure Five: Variation from Expected Telecoms Provision and Illiteracy



Source: Author's calculations from World Bank data.

Figure Six: Variation from Expected Telecoms Provision and Life Expectancy



Source: Author's calculations from World Bank data.

Given the comparatively uncontroversial nature of the telecoms-services link, this section will primarily focus on examples of networked computers and the Internet providing the poor with improved access to government services and greater voice in decision making.

The Impact of the Internet on Governance

Broadly stated, ICTs can improve governance in three distinct yet overlapping ways. First they assist decision-makers in the acquisition, management, and transmission of complex policy information and data, thus creating efficiency benefits; second, they improve the delivery of government services; third, they empower civil society by raising access to government information and facilitating dialog and public feedback on government projects and performance. The combination of these three factors results in specific, quantifiable benefits in sectors such as education, health-care, and environmental preservation, discussed in detail in the sections that follow.

1. Enhancing Decision-making and Public Administration

Governments that successfully integrate ICTs into the state apparatus realize savings in labor and administration costs, reduce the cost of service provision, and open the workings of government to public oversight and accountability. In areas as diverse as tax administration, fiscal planning and administration, and economic reform, ICTs play an increasingly important role in helping policy-makers and administrators to better manage the provision of public goods and services.

In terms of planning and budgeting, increasingly complex fiscal priorities are prompting many countries to look to ICTs to provide better analysis and decision making support in the budgetary process. ICTs can also improve the efficiency of that process. In Colombia, for example, an on-line information system now automatically transfers payments directly to commercial banks. The system has realized significant savings by reducing no-interest liquidity that previously had been required to meet uncoordinated government obligations (World Bank, 1996).

ICTs are also increasing civil service productivity by dramatically speeding the day to day processing of information and regulatory implementation. In Singapore, for example, the government spends approximately US\$ 100 million per year on ICTs for the Civil Service. Studies have found that every dollar spent on this program has generated US\$ 2.70 in returns due to expanded productivity and reduced operational costs. As a result, over 1,500 jobs have been eliminated from the public payrolls and an additional 3,500 jobs have been reoriented towards more productive outputs (UNESCAP, 1999).

Electronic administration can make government transactions more transparent. Automated customs clearance and reduced frontier delays significantly improve tariff and

customs revenues, in part by reducing opportunities for graft.¹⁶ The Automated Systems for Customs Data (Asycuda) developed by UNCTAD, for example, is now used by over 70 developing countries to manage tariff collection and reduce frontier corruption. The system speeds up goods movement, reduces transport expenses and costs only US\$ 2 million to install (Mansell and Wehn, 1998).

2. *Improving Government Service Provision*

New ICTs can help administrators improve the provision of public goods and services. At both the national and local levels, ICTs can enhance basic infrastructure services such as water, sanitation, and electricity, speed up the approval and delivery of permits, and provide timelier and more relevant responses to information requests. This is particularly important given recent trends towards decentralization and localization of government authority. Particular examples from health, education and environmental monitoring follow later, but ICTs have a part to play in every government function –in areas as diverse as traffic management and trade facilitation:

- In Singapore, the Department of Transportation has used a wide variety of information and communication tools to manage the network of urban roads and highways. Tools include a central computer system that controls traffic signals by allocating 'green' time based on actual traffic demand and an electronic Road Pricing System that automatically deducts toll-fares through a stored-value card inserted into the vehicle. In addition, a program called "TrafficScan" has fitted 7,500 taxis with GPS equipment to monitor traffic conditions. Information concerning the location and speed of the taxis as well as the directions in which taxis are heading is transmitted via satellite to the TrafficScan control center, which identifies potential slow areas and displays this data to all drivers in real-time over the Internet.
- Many developing country industries face severe difficulties in obtaining basic information on export regulations and paperwork. This is particularly true for small and medium sized enterprises. Cumbersome paperwork requirements and difficulty in managing exports hinder national competitiveness. Many countries are experimenting with automated customs clearance and electronic filing of export documentation in order to improve system transparency and clearance times (UNESCAP, 1999). In Singapore, for example, the Customs and Excise Department reports that processing imports and exports electronically costs 70% less than paper-based systems (Commonwealth of Australia, 1999). At the international level, UNCTAD's Global Trade Point Network assists countries in implementing shared network facilities where governments provide information on export regulations, trade opportunities, and electronic paperwork processing.

3. *Bringing Government Closer to the People*

¹⁶ For the poorest countries, customs payments can account for 40 to 80 percent of total government revenues. (Mansell and Wehn, 1998)

Allowing popular access to decision-making is an important element in improving living standards. The global transition towards pluralist forms of government also relies on adequate social capacity to understand complex policy issues and communicate information. This flow of information central to these processes can be divided into three distinct networks: Citizen to citizen; citizen to government; and government to citizen. Examples of the first two networks can be drawn from the rapid growth and influence of non-governmental organizations. Examples of latter type include government initiatives aimed at making information on decision-making and operations increasingly transparent.

The dynamic growth of NGOs has been the dominant social trend of the past 30 years. Many NGOs have gained leverage and access to decision-makers through the effective use of new ICTs to educate and organize citizens. Through ICTs these groups are bringing political power to the marginalized, raising awareness of economic, social and environmental issues, and directly influencing local, national and multi-lateral decision making. To cite just a few examples:

- In Mexico City, the NGO 'Women to Women' used e-mail connections with women's groups in California to obtain information on the business practices, profit structures, and ownership information of a textile company that had announced plans to build a new plant in their community (UNDP, 1999). As a result, they were better prepared for their meetings with plant officials and management and local government.
- In Tanzania, the NGO 'EcoNews,' developed a website focused on the plight of mostly illiterate Maasai farmers who were threatened with eviction from their traditional pasture lands by a change in management planning at the local government level. By making the farmers' case on the World Wide Web and networking with international NGOs, EcoNews was able to bring international attention to the problem, which caused donor governments to raise the issue with Tanzanian officials. Eventually the plan was withdrawn (APC, 2000).
- In India, the women's rights NGO 'Sakshi' had faced difficulties in lobbying for sexual harassment legislation. With help from international women's networks, Sakshi was able to receive advice and technical assistance on legal issues surrounding sexual harassment. As a result, the group succeeded in convincing the Supreme Court to establish sexual harassment guidelines in workplaces and brought the issue within the purview of human rights violations (APC, 2000).

Governments can also take a lead using, ICTs to open decision making to wider public scrutiny. Many governments are experimenting with information provision via sites on the World Wide Web, e-mail communications, and list-serves that automatically distribute government publications and research. Accordingly, citizen participation and influence is on the rise. In South Africa, for example, the government actively sought citizen input in drafting the post-Apartheid Constitution. The Constitutional Assembly created a web-sight that made available draft texts, political party positions, and committee reports and recommendations. In addition, citizen feedback via e-mail was encouraged and a virtual community of individuals and groups was able to share ideas on

proposed drafts of the constitution (Lal, 1999). Similarly, the Indian Government Ministry of Information Technology supports the “India Image” Internet sight. Visitors can read transcripts of policy statements, parliamentary debates and draft laws; locate contact information for national, regional and local politicians and administrators; and access a wide array of information on trade opportunities and rules, national statistics, and other public information services. In addition, the sight maintains linkages to every department in the Indian bureaucracy, oftentimes with an ability to conduct government paperwork and submit requests online.

Improving Education Outcomes

Turning to particular sectors, ICTs have long been an integral part of education systems, computers, radio and TV in particular have important roles to play (see Box 2). New ICTs are also playing an important role in the learning process, offering powerful tools for expanding educational access and improving skills and knowledge. The ability to connect PCs to Local Area Networks (LANs) and the Internet makes remote information access and knowledge sharing possible. On-line databases maintained by governments, private companies, and universities contain enormous amounts of readily accessible information.¹⁷ E-mail allows students with similar interests and ideas to share knowledge and collaborate with other students around the globe. Taken together, these technologies are fundamentally transforming the nature and reach of education.

Box 2: Radio, TV and Computers in Education

The development of correspondence-courses in the early 1900s and the arrival of radio and television courses in the 1970s substantially broadened the geographic range over which learning could take place. Students who found it impossible to attend classes have been able to pursue their educational goals through the mail, television and radio, and satellite transmissions. Founded in 1969, Britain’s Open University became the model for many developing country distance education programs. Using text-based materials complemented with radio, television, and telephone access to a tutor, the program was reaching 200,000 students per year by the mid-1990s, including students throughout western and Eastern Europe. Building on this model, the University of the Philippines Open University (UPOU) offers 10 separate degree programs in topics such as public health, social work, and education to students anywhere in the archipelago.¹⁸ Students are able to access print, audio, and visual materials, and have access to local tutors who complement the learning modules (Crede and Mansell, 1998).

¹⁷ Public access online databases are too numerous to mention each individual site. A few representative examples include: NASA’s Image Exchange with thousands of photos of Earth (<http://www.nasa.gov>); the United Nations CyberSchoolBus with custom tailored teacher training modules (<http://www.un.org/pubs/CyberSchoolBus>) and MIT’s complete searchable works of William Shakespeare (<http://www.the-tech.mit.edu/Shakespeare/works.html>).

¹⁸ According to the ITU, the six largest distance learning universities are located in the developing world. These include: Anadolu Univ. in Turkey with 577,000 students; China TV Univ. System with 530,000

At the primary and secondary level, many countries have used radio and television as an increasingly important means for reaching the rural poor. In Mexico, for example, over 700,000 secondary-school students in remote villages now have access to the *Telesecundaria* program, which provides televised classes and a comprehensive curriculum through closed-circuit television, satellite transmissions, and teleconferencing between students and teachers. Studies have found that the program is only 16% more expensive per pupil served than normal urban secondary schools while students benefit from much smaller student/teacher ratios. While rural students enter the program with substantially lower mathematics and language test scores than their counter-parts at traditional urban schools, by graduation they have equaled their math scores and cut the language-score deficit in half (de Moura Castro, Wolff and Garcia, 1999)

The stand-alone PC has further transformed pedagogic methods. The essential difference between traditional and computer-based education results from the interactive nature of the technology. As UNESCO notes: "Teaching and learning are shifting from the direct instruction of established facts to student-oriented learning in which children are actively engaged in collaborative, complex, problem-solving tasks, projects and investigations that develop higher-order cognitive skills... Related to this approach, technology is used to provide students with tools that augment the problem-solving process and with connections to people and information that can support the development of a collaborative learning community." (Kozma et al., 1999, p. 12).

The PC can function as a mini reference unit in which large databases can be accessed in response to the needs and interests of the student. The information from the Encyclopedia Britannica, for example, can now be stored on 2 CD-ROMs with linkages to related information and allowing for a custom-tailored learning experience. Multimedia add-ons such as the digital camera can enhance the presentation of information. Spreadsheet and statistical programs can sort through large amounts of data and identify correlations and relationships. Additionally, computer testing and assessment of performance can fine tune the nature and order of questions presented to the test-taker and automatically focus on the weaknesses and strengths that traditional testing may not capture.

As UNESCO notes, "assessing the cost-effectiveness of ICT in education is difficult, if not impossible, for at least four reasons – lack of meaningful data, variability in the implementation of ICTs, difficulty in generalizing from specific programs, and difficulty in assessing the value of qualitative educational differences." (UNESCO, 1996). Nonetheless, the effectiveness of traditional distance education programs using interactive technologies has been demonstrated in numerous studies (Potashnik and Capper, 1998, Osin, 1998).¹⁹

The effectiveness of "Virtual Classrooms" and the benefits of Internet access on educational achievement are more difficult to measure. These programs have emerged only recently and systematic evaluations are rare. Nevertheless, some of the claims that proponents have advanced on the beneficial impact the Internet has on education include:

students; Universitas Terbuka in Indonesia with 353,000 students; Indira Ghandi National Open Univ. in India with 242,000 students; and SukHothai Thammathirat Open Univ. in Thailand with 216,000 students. (ITU, 1999, p. 9)

¹⁹ Osin, for example, found that students in Israel which used computer-assisted learning for practice and testing in mathematics improved student progress by 121%. (Osin, 1998)

- *Meeting the needs of a growing population.* In many countries, rapidly growing populations have resulted in expanded school enrollments and strained the capacity of existing facilities. Frequently, students are forced to rely on inadequate school buildings and libraries containing insufficient and outdated resources. The judicious use of ICTs can help alleviate shortages in teachers and physical materials and can be cost effective when compared to building new physical infrastructure. In Taiwan, for example, one study found that the distance-based National Open University was able to reach 30% more students than the National Taiwan University while spending less than 1/3 of the National Open University's budget (UNESCO, 1996).
- *Equalizing Access to Education.* One characteristic of developing country educational systems is a pervasive resource discrepancy between urban and rural schools. This in turn leads to lower student performance and achievement, with many rural areas facing a chronic information deficit. ICTs can alleviate these discrepancies, providing *all* students with access to modern pedagogic methods and knowledge. In Chile, The Enlaces Project (<http://www.enlaces.ufro.cl>), which is funded by the national government with assistance from the World Bank and the private sector, has linked almost all secondary schools and more than half of all primary schools to the Internet. Schools are provided with computers and technical support, as well as extensive technical training in order to make the program equipment self-sustaining. The goals of the program include: ensuring equal access to information regardless of geography; modernizing curricula and administration; development of collaborative projects across different schools; and enhanced teacher training and education (Crede and Mansell, 1998).²⁰
- *Teacher training* Teaching requires a constant re-honing of skills and the ability to adapt to new tools and ideas. While it is difficult to measure the cost-effectiveness of continued teacher-training, studies suggest that providing ICTs to schools greatly enhances a teacher's ability to fine-tune their pedagogic methods, increase collaborative initiatives, and improve their computer and technical skills. An evaluation study of the WorLD program, for example, found that as a result of access to new ICTs, 80% of participating school administrators reported that the

²⁰ At the university level, in Africa, 22 sub-Saharan countries are currently linked to the African Virtual University (<http://www.avu.org>). Through Internet connections, satellite uplinks, and audio-visual media, the program provides original courses that link students to professors in Africa, North America, and Europe. Students interact directly with faculty and have access to an online library provided by University Microfilms International in Michigan. To date, courses have been offered on computer technology, economics, language, and remedial coursework (Diagne, 2000; UNESCO, 1999). Similarly, since 1989 the Virtual University of the Technological Institute of Monterrey in Mexico has offered 15 distance-degree programs (mostly at the Masters level) in administration, education and engineering as well as a variety of technical training and skills development programs. The program uses a combination of traditional distance learning tools, but has added its own satellite network, teleconferencing system, and high speed internet connectivity to its 1,393 learning centers. By 1998, the Virtual University had an enrollment of 52,000 students across Latin America pursuing a wide variety of education and training programs (Wolff, 1999).

program had “greatly affected teachers’ computer skills, their attitudes about technology, and their attitudes about their own teaching.” (Kozma et al., 1999).

- *Individualized Interactivity.* Traditional pedagogic methods focused on a passive one-way flow of information from the teacher to student. Recent trends towards a ‘constructivist’ approach to teacher student interaction, however, suggest that the learning process can be enhanced through the use of technologies which “adapt the presentation to user needs, preferences and requests.”(Osin, 1998, p.3; Potashnik and Adkins, 1996). Due to the interactive nature of the Internet, it is well suited for a creative learning approach in which experimentation and critical thinking skills are emphasized. In Chile, for example, the Genesis program in the municipality of Nunoa has equipped 13 schools with PCs and provided staff training for faculty with an emphasis on teaching students thinking and problem-solving skills using LOGO²¹ programming language. (Potashnik and Adkins, 1996, p. 4).
- *Access to global knowledge base/Internet.* Perhaps the clearest benefit to education from ICTs comes from the ability to share knowledge and experiences with an emerging networked global community. In 1997 the World Bank initiated the World Links for Development (WorLD) Program (<http://www.worldbank.org/html/worldlinks>) with the aim of linking students and faculty from the developing world and industrialized countries. To date, the program is currently active in 15 developing countries and serves an estimated 230,000 students and 13,000 teachers. By providing computer resources and training, Internet connections, and access to a global network of schools, the program aims to improve education, enhance cultural understanding, and develop high-tech skills for its users. According to a recent evaluation report, “WorLD teachers were much more likely . . . to collaborate with other teachers and much more likely to design collaborative projects and activities for their students. Consequently, WorLD students were much more likely to collect and analyze data and use information to make predictions or draw conclusions,” (Kozma et al, 1999, p. ii). Students that participated in the WorLD program actively sought out their counterparts in other countries to develop joint research projects on a variety of topics. These included the “Wetlands Project” (<http://www.viser.net/gs21/ugdepletion.htm>), in which students from Uganda, Australia, and the United States collaborated on reports examining wetlands issues in their home countries and comparing different modes of wetland protection; and “Ciencia a Conciencia” (<http://www.enlaces.edu.py/cndelm/131198/ciculos.htm>), in which students from Mexico and Paraguay undertook collaborative research on global environmental issues and shared ideas on novel ways to overcome them. The same technology also allows students and the wider community access to both global and local cultural resources (see Box 3).

²¹ LOGO has been widely used in schools since the early 1980s. The basic idea is that “children can learn to use computers in a masterful way and that learning to use computers can change the way they learn everything else.” (Potashnik and Adkins, 1996, p.5)

- *Acquiring the skills needed to succeed in the digital age.* Finally, the emergence of the digital age requires a technologically competent work force. Educational systems that ignore ICTs will fail to produce a technically literate population and hinder a country's ability to compete in the global economy. Evidence from East Asia suggests that large investments in education, particularly technology training, were a major factor in the rapid economic growth in these economies from the 1970s to the mid 1990s (Hanna et al., 1996; World Bank, 1998). Countries are realizing that teaching students the skills associated with acquiring, managing, and communicating information is a basic prerequisite for both innovative thinking and competing in a global information society. Access to ICTs from the earliest grade levels can enhance these skills, and ensure that populations are able to adapt to new technologies and remain competitive.

Box 3: Cultural Resources on the Internet

Bringing diverse cultural traditions to a global audience through ICTs can act to raise awareness of national traditions that would otherwise remain inaccessible (although the risks presented to indigenous cultures by the Internet are discussed later). Many museums and galleries are beginning to put their holdings online. The Egyptian Ministry of Tourism, for example, hosts the Egyptian Antiquities Information sight (<http://www.touregypt.net/antiq.htm>). Visitors can access pictures of archeological artifacts, read articles on Egyptian history and mythology, and access information ranging from how the pyramids were constructed to the complete contents of the "Book of the Dead" in several languages.

ICTs have also played an important role in the preservation and identification of threatened or marginalized cultural artifacts and traditions. Visitors to <http://maori.culture.co.nz> can read histories of the Maori people, view images of cultural artifacts and the unique tattoo patterns common among Maori men, obtain Maori recipes, and order cultural products from an online shop. Similarly, a UNESCO project in collaboration with an international electronic network of libraries has undertaken a global search for copies of books and manuscripts lost when shelling destroyed the National Library of Bosnia. 90% of the library's 1,500,000 volumes were destroyed during the war, including 5,200 bound manuscripts in Arabic, Persian, Turkish, and Hebrew, plus more than 200,000 Ottoman-era documents. As of 1998, over 30,000 volumes from academic presses and libraries and private donors have been contributed to the project. (<http://www.applicom.com/manu/ingather.htm>).

The Internet has also been a useful tool for local artists to bring their work to a wider audience. In Malaysia, for example, Artasia.com (<http://www.artasia.com.my>) displays the works of hundreds of Asian artists from an Internet sight in Kuala Lumpur. Customers can view digital images of works, obtain information on the artist, and place orders online. The sight has sold paintings across Asia and has attracted customers from Australia and New Zealand as well (Far Eastern Economic Review, 08/20/98). Similarly, Chinese Internet sights such as atrscechina.com and newchineseart.com are bringing global recognition to Chinese artists. Artists featured on these sights claim that rather than allowing Western pop culture to dominate traditional Chinese arts, the Internet is actually revitalizing Chinese culture and allowing it to compete on a world stage (Christian Science Monitor, 2/9/2000).

It should be noted that it is, as of yet, hard to move beyond anecdotal evidence on the impact of the Internet on education in LDCs. While many pilot projects involving the Internet in education typically incorporate some form of review and feedback, frequently these are limited to questionnaires asking project beneficiaries to describe their experience with the new technologies. For example, in the case of the WorLD program monitoring and evaluation report 1999, the authors note that their measurements are

based on subjective interpretations of the impact of the program derived from questionnaires distributed directly to teachers, students, and administrators (Kuzma et al., 1999). While obtaining first-hand feedback is critical to ensuring that projects meet local needs, non-subjective criteria are also needed to measure the degree to which perceptions adequately capture real improvements in learning.

To date most of this type of research has been concentrated in the industrialized countries. In the United States, for example, a study by the Center for Applied Special Technology (CAST) used a double blind trial to measure the impacts of Internet access on performance among elementary school students. Based in large urban school districts, the study divided 28 schools into two control groups, one with Internet access as a major component of learning, and one without. Each group carried out a common learning module based on the schools curriculum and student performance was measured through a blind evaluation of student journals, written reports, and tests. The study found that “overall, students with access to . . . the Internet produced better projects than students without online access. They received higher marks in all nine learning measures. The higher scores were statistically significant for 5 out of 9 measures.” (CAST, 1997, p.4). Studies of this type should be undertaken for all donor-finance pilot projects using ICTs in developing countries in order to establish baseline measurements with which to evaluate the relationship between investments in ICTs and better learning.²²

Improving Health Outcomes

A healthy population is a basic component of sustainable development. Unfortunately, the availability and quality of health care varies dramatically throughout the developing world. Access to medical equipment and supplies, pharmaceuticals, and trained professionals are lacking, and practitioners find it difficult to obtain information on diagnostic and treatment advancements. ICTs can play an increasingly important role in improving health care delivery to the world’s poor. According to the WHO, 40% of medical systems costs are taken up by the process of exchanging information and these costs can be significantly reduced with the use of ICTs (Panos, 1998). The information sharing and management functions of ICTs can benefit the health-care sector in several important ways:

- *Storage and transmission of data* – Generally referred to as “Telemedicine,” this process uses ICTs to transmit medical images, records, and diagnoses to remote locations in order to overcome shortages in regional health-care providers. Technologies include Internet related applications (E-mail, satellite transmissions, etc.), audio-visual conferencing, and standard as well as VHF and other forms of radio-telephony. In Gambia, nurses on a remote island river use a digital camera and a laptop to photograph visible symptoms that they cannot recognize and/or treat. The

²² The WorLD program could take a strong lead here. As the Monitoring and Evaluation Report suggests: “It is recommended that [direct assessment measurements] . . . be used in one or more WorLD countries to directly assess the impact on student learning . . . Positive results on these direct measures would increase the confidence that the program is indeed having the intended impact. (Kozma, 1999)

images are transferred to a physician in Banjul who either prescribes a treatment or forwards the images via e-mail to a company in the UK which can access specialists around the world and report back findings (ITU, 1999b).²³

- *Surveillance and Monitoring* – Global Information Systems,²⁴ Internet, and telecommunications can be a powerful force for coordinating health-care delivery in areas where disease is rampant and communications are poor. In a group of sub-Saharan countries referred to as the “meningitis belt,” the WHO has implemented an electronic system by which daily reports of the diseases outbreak are relayed to health professionals who collate the data and use findings to target mass vaccination programs. MARA – Mapping Malaria Risk (<http://www.mara.org.za>), a partnership project between a number of international donors and the Government of South Africa, collects data on malaria risk and resistance patterns from five regional centers and produces outputs that allow healthcare practitioners and researchers to better treat and study the disease. The data and maps produced by the initiative can be used to: 1) allow regional transmission patterns and severity to be defined and targeted for control measures; 2) allow geographic targeting of control resources (human, financial and technical) to critical areas; 3) spatially define regions of similar disease type and encourage regional application of appropriate control strategies; and 5) serve as a model for the study and control of other diseases (see GK-AIMS, 1998, ISU, 1999).
- *Publication and dissemination of medical findings* – E-mail and medical list-serves can automatically deliver recent medical findings to a wide audience at minimal cost. HealthNet and Satellife (<http://www.healthnet.org>), using a diverse array of ICT technologies (including radio and telephone based computer networks and low-earth orbit satellites), serve healthcare workers in 30 developing countries. Practitioners can use the service to access medical research, exchange data on emerging epidemics, and obtain information on the use of drugs and treatments. A particularly innovative feature is the diverse array of moderated electronic discussion groups that cover topics ranging from emerging trends in infectious diseases to regional coordination of research efforts containing a specific geographic component. HealthNet and Satellife are separate programs but operate together with funding from donor countries in both the developing and industrialized countries (Panos, 1998; Crede and Mansell, 1998).

Governments, donors, NGOs and private sector health-care providers are experimenting with a wide variety of other ICT applications in support of improved health delivery. Projects range from linking rural providers to the Internet, using satellites to transmit

²³ For a comprehensive overview of telemedicine applications in 34 countries around the globe, see Wright, 1997.

²⁴ GIS systems in environmental management generally refer to three distinct technologies used in combination. Global Positioning Systems (GPS) is a satellite based navigation system that can identify longitudinal and latitudinal coordinates and altitude measurements. Remote sensing is generated by satellite or aerial advanced resolution photography and monitoring can depict ecosystem diversity, vegetation density and plant chemistry. GIS is a separate application that often incorporates the use of the previous two through computer applications and database management (Brodnig and Mayer-Schonberger, 1998). The above discussion uses GIS as a generic term incorporating some or all of these applications.

information (often between continents), automating surveillance, management and record-keeping functions in order to improve efficiency, and extending coverage and reducing costs. Nonetheless, as with education, the cost efficiency of Internet-based health interventions is yet to be rigorously examined, and best practices are largely anecdotal. There is a need for more rigorous studies to ensure that Internet-based interventions are justified.

Improving Environment Outcomes

ICTs can contribute to environmental stewardship in several important ways. Improved communication mechanisms can be used for environmental information sharing between researchers, government agencies and NGOs. It should also be noted that ICTs are inherently an energy efficient component of economic activity, and as their share of economic output increases, relative energy and raw material inputs can be expected to shrink correspondingly (see Box 4).

Box 4: Environmental Efficiency and E-Commerce

Many analysts argue that ICT applications, particularly in e-commerce²⁵ and production processes, will result in environmental benefits through the reduction in factor and resource inputs. Studies from the United States, where the use of Internet and ICT applications is the most firmly integrated into economic activity, suggest that the energy component for every dollar output in the economy has been falling rapidly during the 1990s. The Federal Energy Department, for example, has estimated that approximately one third of energy efficiency gains in the past few years is attributable to the growth of the information technology sector in overall economic output.²⁶ As one study notes, if this trend continues, U.S. energy and carbon dioxide emission projections may be over-stated, improving the chances that Kyoto Global Warming Treaty targets might be met by 2012 (Coifman, 2000, see also Tyler 1977, 1978).

Communication between governments, business, and citizens is vital if environmental remediation programs are to meet their objectives in an efficient and equitable fashion. ICTs can help to include affected parties in the decision making process, ensure that traditional forms of environmental knowledge are communicated to a broader audience, and allow citizen monitoring and enforcement of environmental threats.

In Indonesia, for example, government officials discouraged by the weak enforcement of water pollution standards developed a public access information database rating the degree of firm compliance with pollution discharges. As the World Bank notes: “Even

²⁵ The energy inherent in a book delivered from Amazon.com has been calculated at 1/16 that of a book bought by consumers driving to a local bookstore. As one study notes, “Shipping 10 pounds of packages by overnight air – the most energy-intensive delivery mode – uses 40% less fuel than driving round-trip to the mall. Ground shipping by truck uses just one-tenth the energy of driving yourself.” (Coifman, 2000)

²⁶ Proponents of this view claim that as information replaces tangible goods and production processes with lower levels of environmental pollution are developed, the energy efficiency of measurable outputs will correspondingly fall.

before the information was made public, firms hurried to improve their ratings. After publication, citizen's groups used the ratings to pressure under-performing factories to clean up. Regulators, meanwhile, could focus their limited enforcement resources on the worst offenders. In the first 15 months of the program, roughly a third of the unsatisfactory performers came into compliance with the regulations." (World Bank, 1998, p.13).

Another benefit to ICTs and citizen empowerment is the ability for scientists, activists, and national legal systems to benefit from timely information and research. E-Law (<http://www.elaw.org>) is an Internet-based NGO that facilitates the development and practice of public interest environmental law. National and local environmental advocates can use the E-LAW network to exchange legal, scientific and technical information, as well as ideas, precedents, and strategies in support of environmental preservation. In India, for example, the residents of a small town filed a lawsuit against several mining companies whose uncovered trucks left a blanket of iron oxide dust each time they past through the village. The companies pointed to a lack of scientific studies showing that iron oxide dusts are detrimental to public health. Through an electronic request to E-law, the plaintiff's lawyers were able to obtain scientific proof of the public health risk via faxed abstracts of scientific studies showing the toxicity of dust components. The court responded by authorizing local police to seize any truck driving through the village without a tarpaulin cover. Within hours, police had seized 26 trucks.

Risks

Worldwide, government agencies are the single largest consumers of information technology goods and services. We have seen that the potential impact of this consumption on the quality of government services can be immense. Yet oftentimes IT systems fail to reach their full development potential. One study estimates that up to 80% of public sector IT applications result either in partial or total failure (Heeks, 1999a, 1999b). Although this figure is debatable, it does suggest flaws in the mechanisms through which governments and donors have sought to implement ICT projects in the public sector.

Aside from the generic obstacles facing ICT rollout in the developing world, the take-up of ICT services in governance faces several unique obstacles. Chief among these are large inefficient public sectors themselves. Political patronage and the legacy of state planning have resulted in bureaucratic and administrative cultures that place a premium on information control as a source of power. Such systems are inherently biased towards secrecy. In addition, productivity increases associated with ICT applications can create redundancies, threatening an administrator's power to trade jobs for political favors. Taken together, these factors can create a bias against the introduction of ICTs in public administration.

In India, for example, a program established by the National Informatics Center to provide ICT rollout and support to local governments for the storage of land records and

monitoring of Ministry of Agriculture programs found that after 15 years the program had only marginal impacts. As one study notes, “The impact . . . on administration has been marginal because the task of changing the administrative culture is enormous. Although IT can be a tool for decentralized planning, integration across departments and reduction in workload, it cannot be the sole instrument of change” (Bhatnagar, 2000b, p.1) Similarly, the Ministry of Income and Taxes sought to computerize a major component of records keeping and storage. Yet political antagonisms between regional tax commissioners and the central tax board resulted in most of the project failing to become operational and “there was only very limited achievement of reform objectives.” (Lal, 1999, p.3).

An additional bureaucratic obstacle can also emerge when public administrators do not take an active role in learning about IT systems or promoting their use. In many instances, IT development is delegated to specialized IT departments which are responsible for a wide variety of applications across agencies. Managers thus have no incentive to contribute to the technical specifications and developments required for their particular mandates. As a result, applications fail to meet the needs of agencies and resources are wasted.

The glamour associated with large-scale ICT projects can result in centralized government projects that apply common models across differing social, cultural, and geographic regions. Many studies note that “one size fits all” programs are destined to perform poorly compared to those based on community planning and stakeholder participation (Bhatnagar, 2000a). This problem is especially prevalent in donor funded national infrastructure programs that seek to replicate models from other developing countries.

Perhaps most seriously, from the perspective of equity, ICT-based reforms backfire if those who need services are excluded by the technology. For example, Singapore and New York have begun providing government services directly to customers online. If this type of service provision became a substitute rather than a complement to more traditional methods of receiving government support, those without access to the Internet would be excluded. Again, this requires more than physical access to ICTs. The introduction of an Intranet system providing information on property to staff and clients of the Johannesburg Metropolitan Council remained unused because its introduction had been technology focused, rather than needs focused, and training was inadequate (Africa Development Forum 1999). This suggests that training and acceptance are as vital as access.

Further complicating the introduction of ICTs is the issue of complementarities between government departments and services. Normally, a wide variety of computer-based systems support different government activities. However, these systems are usually implemented as components of separate projects responding to specific needs, with little appreciation of requirements in other areas, and little thought given to critical interrelationships. As a result, the information systems are often disparate and segmented with little or no capacity for sharing data. They have overlapping and sometimes

conflicting functionality and provide incomplete coverage, particularly for managerial information requirements that normally span several functional areas. Having said that, the risk of centralized, top-down government ICT projects was noted above—suggesting a complex trade-off is at work.

Finally, networking government is very expensive. A recent World Bank–supported project in one Indian state (AP), designed to computerize revenue offices, involves training 5,000 staff members and installing 4,500 computers in 1,124 sites over a quarter of a million square miles to handle a database containing over 80 million records. Multiplying this up to the national level in a country as large as India and across a wider range of functions, the scale of the process becomes clear. All of this suggests that, although a range of high-return investments is possible in low-income countries to improve government performance through ICTs, programs to use them should be carefully evaluated—an issue returned to in Section 5, and discussed in greater detail below.

Many of these problems are reflected in the education sector, where the issue of cost and sustainability can also be clearly illustrated. Even for schools in the industrialized countries the front-end costs of developing a high-tech classroom are often prohibitive. Investments in hardware, operating platforms, applications, and connections to Internet Service Providers (ISPs) must be weighed against existing infrastructure requirements such as facilities and books. Further complicating the issue is the speed with which technologies become obsolete. Educators face difficult choices in ensuring that ICT investment is both appropriate to the needs, as well as self-sustaining. As one observer notes: “Care should be taken to avoid allowing the novelty of technology to drive decisions regarding the most appropriate delivery mode. . . . If a country’s conventional education or teacher training program is not effective, using a new technology to deliver that education or training will not make it any more effective.” (Potashnik and Capper, 1998, p.45).

As noted previously, quantitative measurements of the cost-effectiveness of ICTs in education are difficult to make. This is further complicated by the fact that most pilot projects that use ICTs have been critically reliant on international donor funds and/or material contributions as well as support from the private sector. In order for these programs to become self-sustaining, analysis should concentrate on developing accurate cost-benefit techniques and measures with which policy-makers can weigh various funding priorities and options. In general, studies have found that the per-pupil costs of ICTs in education range across a spectrum in which radio is the cheapest and television the most expensive, with Internet and computer applications falling somewhere in the middle (Blurton, 1999; Potashnik and Capper, 1998; World Bank, 1998; and Osin, 1998). However, more work is needed to standardize these measures and establish baseline figures so that countries can target specific technologies and ensure that investment decisions will pay off in long-term educational improvements.

Quality and cost-effectiveness of telemedicine is a common concern as well (see Box 5 and Heeks, 1999c). Governments and donors must weigh the varying needs of national

systems in relation to available resources. Many health problems can be addressed through basic infrastructure improvements such as clean water and sanitation facilities rather than expensive technical solutions. As one study notes, “although information and education can raise people’s awareness of the problems. . . information in itself is an insufficient remedy if people lack the means to implement what they learn.” (Uimonen, 1997)

Given the cost and complexity of ICT introduction into government services, the threat of growing risks of exclusion of those who do not have access to government services, and the limited studies to date of the cost-effectiveness of the new ICTs in sectors such as health and education, ICT introduction should be planned very carefully, a subject that will be returned to later.

Box 5: Internet and Health Governance

Several issues have emerged in tandem with the growth of ICT based health-care delivery. First, the absence of effective international regulations could result in substandard levels of care in which the patient has no recourse to legal protections or compensation. The industrialized and developing countries have begun to examine these implications in both national and multilateral fora. One possible model is the Malaysian Telemedicine Act of 1997, which restrict the practice of telemedicine to either certified local practitioners or to outside practitioners who register and are granted a certificate to practice telemedicine.²⁷ The wide-scale adoption of these laws, might, however, discourage continued development of telemedicine applications.

Second, the electronic transmission of patient data leads to an increased potential for breaches in the confidentiality of doctor-patient relationships. As digital transmissions of patient information (x-rays, diagnoses, physician comments) and the electronic storage of patient files increases, mechanisms will need to be designed to ensure continued confidentiality. This is particularly problematic where information crosses national borders with differing regulatory requirements and capacities. Multilateral rules and agreements have yet to address this issue, but as the use of telemedicine grows, problems in this area can be expected to increase.

Third, as current medical technologies tend to be proprietary, they use a variety of different formats, technologies, and input languages. As telemedicine reaches across national borders, attention will need to be focused on the standardization of platforms in order to reduce medical errors and wasted resources. Several international national and initiatives aim to develop common standards to guide telemedicine providers, but the efforts are, at present, uncoordinated and do not include a global frame of reference.²⁸

²⁷ An unlicensed practitioner faces a sentence of imprisonment up to five years and a fine up to RM 500,000. Tele-medicine is defined as "the practice of medicine using audio, visual, and data communications." (Siddiqi, 1999)

²⁸ In Europe, for example, the Technical Committee for Medical Informatics (TC 251) has been established with the European Standardization Committee. The committee serves as an official source for the organization and coordination of standards in health-care informatics throughout Europe (Wright, 1997). At the multilateral level, the International Medical Informatics Association (IMIA) brings together national healthcare groups and societies from 54 countries. The organization seeks to “facilitate information exchange between standardization bodies of different continents, to ensure the broad dissemination of standards and create awareness, to ensure the involvement of end-users through members of regional and national scientific associations, to enable the analysis and the comparison of different needs and priorities in different countries, to channel feedback and comments from the scientific medical community to the standard developers.” (<http://www.ehto.be/imiawg16/index.html>).

5. MAXIMIZING THE LEVEL AND IMPACT OF ICT PROVISION

This section opens with a brief review of the cross-country literature and some new evidence on the determinants of the Internet and telephone penetration in countries, focussing on income, policy, demography and geography and financing (it will not perform a detailed analysis, nor look at individual country analyses --see Analysys, 2000 for a partial review of these). Telephones per capita or internet hosts per capita are not necessarily a good measure of *access*, however, which is likely to be the more significant determinant of the extent and equality of the development impact of ICTs. The section outlines some methods to maximize access (see Navas-Sabater et. al. (2001) for a fuller treatment). The section goes on to look at broader reform for the e-economy and briefly discuss methods to maximize the efficiency of government use.

Determinants of Provision

Income alone is correlated with about 80 percent of the variation in the number of telephone lines per capita across countries and a similar percentage of Internet users and hosts. This remains (and probably always will) by far the best predictor of the comparative level of ICT rollout across and within countries. Even with further reform and technological advance, the cost of telephone services means that the majority of the population in developing countries could not afford a telephone in their home –let alone an Internet connection.

Other sources of variation in the level and quality of service are important, however, and these can be examined with reference to a number of recent studies, including Canning (1997a) Wheeler (2000), Kubota (2000), Reynolds et. al. (2001) and Wallsten (1999):

- Privatization is considered a significant determinant of cross-country telephone rollout by Reynolds and Kubota (although Wallsten finds it negatively correlated in the absence of a strong independent regulator). Kubota also argues that privatization reduces the waiting time for a phone to be installed, although privatization had a slightly positive effect on the cost of a local call. Across countries, those that have privatized their telecommunications systems have experienced much faster growth in their telecom service revenues and employment than those that have retained a state monopoly.
- Competition and independent regulation is seen as a significant determinant of rollout by Wallsten (although Kubota finds regulation negatively correlated) –Wallsten also finds that competitive markets have more payphones and cheaper local calls.
- Urbanization is found positively correlated with phones per capita by Kubota and Canning (who also found that area when allowing for population (effectively a measure of population diffusion) is negatively correlated with rollout). The same result is found by Wheeler for mobile telephones (although these results are contradicted by Wallsten). A user in an area of low demand density because of sparse population will still tend to have proportionately higher communications costs and lower available functionality. This phenomenon is firmly rooted in the basic cost

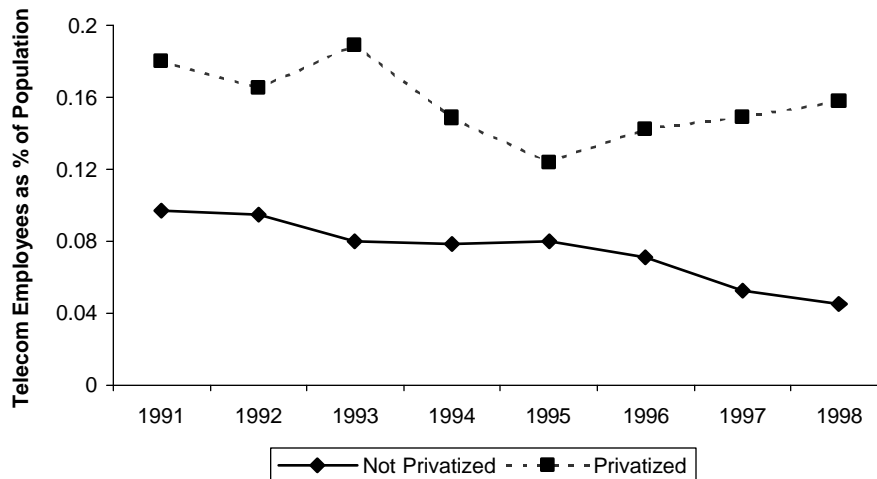
economics of networks. Telephones in rural areas, requiring smaller exchanges, cost significantly more per line not only because each connection is further from the next, but also because economies of scale in switching cannot be achieved.

- Wheeler finds a broadly pro-competitive macro policy environment is correlated with mobile rollout, a similar result is found for lower expropriation risk by Wallsten. This might be linked with the skewed distribution of foreign direct investment in ICTs – and especially the extremely limited nature of flows to the rural areas of poorer economies.

Although separate studies of the determinants of Internet penetration are rare, those that have been carried out (including Africa Internet Forum, 1998 and Wheeler, 2000) suggest that similar factors are at play in determining hosts and users per capita.

Further, data from Reynolds et. al. also suggests that fears that privatisation will reduce employment are unfounded. Countries with privatized incumbents have a higher share of employment in the telecom sector than those not yet privatised. Compared with levels at the beginning of the 1990s, the share of employment in telecom sectors with and without privatization was lower in 1998. However, since 1996, the trend has been upward in privatized markets, while it has continued to fall where the incumbent is not privatised (See Figure 7).

Figure 7. Telecom Employment



While the evidence for more rapid expansion of provision in private competitive fixed line networks over public monopoly networks might not be as strong as is sometimes suggested, certainly the evidence for the newer technology of the mobile telephone is convincing. Combined with evidence suggesting that employment is protected in privatized sectors, this suggests that the assumption in developing countries should be in favor of well regulated private competition. Having said that, the overwhelming role of income and the significant role of geography and broader institutional factors in determining rollout suggests that moving to a private competitive market alone will not be enough to guarantee access.

Public Access

In particular, poor countries will never be able to afford “one person, one phone” –let alone an Internet enabled computer per person. Of course, the solution to this problem is not complex. It is to provide public access, which allows multiple individuals to share the fixed cost of ICT provision. Basic sector reform alone is not enough to ensure access to public call centers –let alone the Internet—either, however. It must be complemented by a web of regulatory and policy initiatives if that goal is to be achieved. Regulatory mechanisms to help ensure faster rollout –such as licences requiring service rollout-- are discussed in Navas-Sabater et al. (2000). Below, we discuss a second potential tool, the telecenter.

A large body of literature has examined the explosive growth of “telecenters” or “telecottages” in rural areas. These programs can be divided into two categories: privately owned centers where local operators cater to business demand for limited services such as phone, fax, and photocopying, and multi-purpose, community-oriented initiatives that seek to provide a larger set of economic, technological, and/or educational and cultural services (discussed below). As the ITU notes, the growth of these centers may signal an important shift away from the “universal service” goal of bringing a telephone into every household to a more realistic and cost-effective goal of universal community access. In Senegal, for example, more than 6,000 privately operated telecenters have come into existence since the early 1990s.²⁹ Public access to a telephone has more than doubled – with the added advantage that the cost-effectiveness of each additional line was four times greater than that of a private home line (WTU Backgrounder, 1998). India, Peru, South Africa, and Thailand have also seen dramatic growth in privately owned and operated telecenters providing rural inhabitants with new information sources and opportunities (Ernberg, 1998) (see also Ervin, 1998, Falch, 1998, Jensen, 1999, Richardson, 1999 and Telecommons, 2000).

GrameenPhone is a good example of cost-effective methods for bringing telephone access to the rural poor. Building on its impressive track record providing micro-credit loans to the rural poor in Bangladesh, Grameen bank has provided over 1,100 telephones to mostly rural poor women through loans averaging US\$ 350 to cover equipment and start-up costs. The operators make a profit by reselling airtime to others in the village. Villagers report that the introduction of the service has allowed rural farmers to check livestock prices, and coordinate medical needs, and the service has also challenged the traditional power that wealthy landowners and intermediaries have held over rural economies and politics. In addition, the phones themselves have become an important new business sector in the villages, generating jobs and income where none previously existed.³⁰

²⁹ For more information on telecenters in Senegal, see http://www.idrc.ca/acacia/engine/eng_6.htm; <http://www.telecom-plus.sn/observatoire/Obtcp.htm>; and <http://www.sonatel.sn/c-telece.htm>.

³⁰ More of information can be found on GrameenPhone and it’s founder, Muhammed Yunus. See <http://newciv.org/GIB/crespec/CS-162.html>;

Many donors, governments and NGOs are experimenting with community-based multipurpose community telecenters (MCTs) that incorporate Internet access, e-mail and other computer applications to existing community access telephone centers.³¹ For the most part, these programs rely on donor resources rather than the private sector. Nevertheless, examples abound of the positive net effects that access to electronic communications brings to rural areas, and the donor community is increasingly interested in supporting MCT projects. Examples include:

- In South Africa, the Universal Service Agency (a government body charged with achieving universal access to communications) is test-piloting a project to bring approximately 80 MCTs online within the next few years. With funding from the Government of South Africa, the ITU, UNESCO, and IDRC, the program has already established several MCTs and initial evaluations suggest that strong demand exists for their services. The program relies on local input and management to ensure that services rendered are appropriate to community needs.
- In India, the All India Society for Electronics and Computer Technology (funded by the Government of India) has established more than 600 community based computer and Internet centers. The centers offer applications ranging from basic telecommunications to advanced desktop publishing, Internet and E-mail facilities, access to agricultural and GIS systems, and even local government services such as employment bulletins. Each MCT costs approximately US\$ 5,000 to set up with recurring costs around US\$ 3,000 per year to maintain. The emphasis is primarily on the Village and Panchayat level, and the Society hopes to bring the concept to all 5,000 blocks in the country. (Chouby 2000)
- In Estonia, the Association of Tele-cottages operates over 50 tele-cottages throughout the country. Services offered include a commodities and farmers' exchange, municipal information, tourism advertising, and the development of tele-commuting possibilities for the rural unemployed.

Some observers argue that the current wave of interest in MCT projects may leave insufficient room for adequate project appraisal. One study of a pilot program of the Ministry of Environment, Natural Resources, and Fisheries in Mexico, for example, found that of 23 tele-centers set up in rural areas around the country, only 5 remained functional after two years. Problems encountered included insufficient maintenance funding, inadequate political interest and will, and cultural constraints which hampered community interest in the projects (Robinson, 2000).

Realizing the potential benefits as well as problems facing rural access to ICTs, the World Telecommunication Development Conference of 1994 issued the Buenos Aires

http://infoasis.com/people/stevetwt/heroes/muhammed_Yunnus.html; and <http://www.rdc.com.au/grameen/impact.html>.

³¹ A few multi- and bi-lateral donors with active programs related to MCT development include: USAID's Leland Initiative (<http://www.info.usaid.gov/regions/afr/leland>); IDRC's Acacia Initiative (<http://www.idrc.ca/acacia/index.html>); The International Telecommunications Union (<http://www.itu.int/ITU-D/index.html>); UNESCO (<http://www.unesco.org/webworld/iip/#funding>); and The World Bank (http://www.worldbank.org/html/fpd/telecoms/subtelecom/selected_projects.htm).

Action Plan with the aim of developing best-practice models of MCT development in rural and remote areas.³² With funding from ITU, MCT projects are proposed by national governments with an eye towards experimenting with new technologies, mechanisms, and partnership arrangements in order to establish baseline strategies for ICT rollout. In addition, the program seeks to evaluate the social, economic, and cultural impacts of ICT access (Ernberg, 1998). The IDRC's ACACIA Initiative (<http://www.idrc.ca/acacia/index.html>) has also implemented a pilot-project MCT program in Africa that contains a strong evaluation component (See Graham, 2000).

A common theme running through the literature is the importance of learning from these initiatives (see Gomez and Lamoureux, 1999). Whether tendering bids for a private cellular network or funding a MCT in a remote area, successful programs tend to have the following characteristics:

- Demand-led approaches which allow market forces to operate;
- Stakeholder participation in program design and maintenance;
- Transparency of national policies and regulations
- Focus on appropriate technologies rather than the most recent and impressive; and
- Multi-sectoral interventions targeting both the end user and national policy-frameworks.

It is not difficult to measure costs and benefits in this sector. Future work should aim to disseminate best practice findings and develop national strategies that identify the best mixture of technology and policy for differing rural environments. In addition, capacity training is vital to ensure that systems can be maintained once programs become self-sustaining.

Legal Reform

Beyond access, citizens in LDCs face a number of challenges in harnessing the benefits of ICTs for development. This is especially true in the new area of e-commerce. Given limited technical capacity and resources available for e-commerce development, policy frameworks must be driven by a clear vision of desired ends and sequenced interventions in order to maximize benefits and minimize project redundancy and failure. A broad array of technical, legal, and international governance considerations need to be addressed if e-commerce is to succeed in raising incomes and trade flows in the developing world. In addition, multilateral issues of governance need to better incorporate developing country concerns in the emerging e-commerce trade regime. Thus, developing countries need to focus their efforts in two areas beyond access: capacity, and international governance.

1. Building Capacity

³² See ([Http://www.itu.int/universalaccess.htm](http://www.itu.int/universalaccess.htm))

Aside from communications infrastructure, successful e-commerce relies on a variety of other public sector inputs. Legal systems must adapt to a new range of contract and liability issues, educational systems must produce a technically competent work force, and banks must be able to accept electronic payments. These factors are a critical – yet often overlooked – component in successful e-commerce development.

E-commerce requires a supportive legal framework in the banking and industrial sectors, as well as legal and juridical changes in response to challenges that have emerged in tandem with the new technologies. These include standards and protection of digital signatures, the liability of value-added networks, regulation of certification authority, protection of intellectual property, and computer crime and data protection. The complexity of these issues is a major obstacle for countries that lack the technical capacity to design and implement needed reforms. In response, the United Nations Commission on International Trade Law (UNCITRAL) has developed a standardized e-commerce “model law” designed to be easily integrated into most country’s legal systems. The law is based on the developing equivalencies for paper-based concepts such as ‘writing,’ ‘signature,’ and ‘original.’ In addition, the model law provides specific guidance for the design of regulations covering legal coverage of electronic communication and the transmission of goods and services via the Internet.³³ Regional institutions have also sought to assist countries in the design and implementation of legal and regulatory frameworks for governing e-commerce (UNESCAP, 1999, Mansell and Wehn, 1998).

A second major capacity issue involves human resource development and specialized technical skills. E-commerce is computer and network intensive, requiring skilled programmers and applications-development personnel. Furthermore, as the majority of Internet content and programming languages are English-based, intensive language training is necessary. Educational systems that cannot provide sufficient technical training will hinder a country’s ability to adapt to e-commerce. In addition, for B2C e-commerce and government services online to succeed, consumers also require both basic literacy and computer skills.

Finally, the financial systems in many countries require significant upgrading and regulatory changes in order to meet the demands of e-commerce. Business and consumer trust in electronic forms of payment need to be enhanced through effective supervision and technical capacity. In particular, national banking systems will need to upgrade their infrastructure to accommodate electronic payments and settlements. In addition, due to cultural constraints, inadequate financial infrastructure, and low incomes, most countries lack a critical mass of credit-card equipped consumers who can buy goods over the Internet. As electronic forms of payment are critical for B2C e-commerce, improvements

³³ The various issues covered by the model law include legal recognition of data messages, digital signatures, originality, admissibility and evidential weight of data messages, the formation and validity of contracts, recognition by parties of data messages, attribution of data messages, acknowledgement of receipt, and time and place of dispatch and receipt of data messages. See <http://www.uncitral.org/en-index.htm> for the complete text.

in either credit-card penetration or other forms of on-line cash will need to be developed (see Box 8).

Box * E-commerce and Financial Reforms

As opposed to the majority of other sectors covered in this report, the use of ICTs in finance and trade has been almost entirely market driven. As a result, donor interventions have been minimal and the private sector has adopted ICTs regardless of domestic or international policy initiative (or lack thereof). Several worrisome trends in finance and trade flows, however, point to areas where market failures might justify donor interventions. These include helping governments build better supervision and regulatory systems, and technical assistance to the poorest countries, which lag far behind in ICT capabilities and, as a result, have largely missed the benefits of growing global trade and financial flows.

The digitization and integration of financial flows makes it difficult for regulators to understand the true nature of risk exposure that banks and investors face. Because private financial practices change quickly, supervisory and regulatory frameworks might be unable to keep up. This suggests a larger role for multilaterals and donors to strengthen the governance and supervision capabilities of domestic regulators. At a minimum, basic training in ICT applications for regulators in the finance sector could be supported on a regional basis.

Second, where markets have failed to keep pace with ICT developments, donors must catalyze the process. sub-Saharan Africa (except for South Africa), for example, lags far behind most of the countries discussed in this report. Access to ICTs for financial and trade sectors are patchy at best and non-existent at worst. One positive example is UNCTAD's work with automated trade facilitation systems.

2. International Issues

The cross-border effects of e-commerce require international coordination in order to avoid unilateral actions that could stifle trade and lead to uncompetitive practices (UNCTAD, 2000). Unfortunately, a serious disconnect has emerged in the dialogue between the industrialized and developing countries over the international governance of e-commerce. Industrialized countries have the most experience with e-commerce and have driven the negotiating agenda, while developing countries have only recently begun to systematically raise their concerns in the WTO and UNCTAD. Part of the problem centers on the speed with which e-commerce has turned into a major trade issue. Many LDCs have been ill equipped to understand the technical components and trade implications of continued e-commerce growth. As a result, negotiations have not kept pace with the speed of change and serious issues are only beginning to be systematically explored and discussed.

First, the digital transmission of goods and services will render traditional customs procedures and domestic taxation systems archaic and/or obsolete. Through work in the OECD, the United States and Europe have adopted the position that cross border e-commerce flows should be entirely market-driven and have proposed a moratorium on e-commerce taxes. Ignoring for the moment the issue of how to collect taxes on digital goods and services (i.e. whether authorities are even aware that the transaction is taking place), countries must consider the revenue implications of tax-free transactions if e-commerce reaches the order of magnitude that many analysts predict.

Second, e-commerce makes it increasingly difficult for countries to distinguish between goods and services. WTO rules approach trade in goods and services differently; Goods are generally subject to tariffs while trade in services is limited by restrictions on national treatment and/or quantitative controls regarding market-access (Singh, 1999). As a result, several important WTO rules, particularly the General Agreement on Trade in Services, which emerged from the Uruguay Round, may already be in need of reconsideration and negotiation.

Third, the digitization of information, combined with ability to make it available to a mass audience at small marginal cost, has raised concerns that global trade rules do not protect information producer's rights to own and profit from their work. As a result, many countries are seeking to discuss the impact of electronic commerce on the areas of copyright and related rights, trademarks, patents, domain names and unfair competition within the framework of the WTO's Trade in Intellectual Property (TRIPs) agreement. Differences have emerged, however, over balancing the needs of information and content providers with ensuring equal access to new technologies and methods. Stronger rules on TRIPs could potentially reduce developing country access to new tools and technologies.

Developing countries, with the support of donor agencies, will need to respond to these threats through greater participation in international fora abroad and reform and technical training at home. Further, as has been mentioned, it is likely that the networking revolution will create losers as well as winners, this greatly increases the importance of safety nets for individual workers and programs supporting structural change and re-engineering at the company and sector level. Governments must also take account of the cultural pressures created by a medium with the power of the Internet (see Box 9).

Box 9 –Culture and ICTs

ICTs can play both a constructive and destructive role in cultural production and preservation. On one hand, electronic transmission of cultural products can enhance understanding and appreciation of diverse cultural traditions and forms of expression. On the other, the dominance of industrialized country products, particularly films, television, and music, gives rise to complaints that indigenous cultural forms are unable to compete with multi-billion dollar cultural industries from the industrialized countries.³⁴

³⁴ As one observer notes, "Pop culture is America's hottest export item . . . US movies, music, TV programming and home video now create an US\$ 8 billion trade surplus in this sector. Top sellers are Mickey Mouse, Madonna, Michael Jackson, McDonald's burgers, Levi's jeans and Coca Cola. In the past five years the overseas revenues of Hollywood studios have doubled. The US\$ 20 billion music industry earns approximately 70 per cent of its revenues outside the United States." (Hamelink, 1997)

For many developing country artisans and policy-makers, the prospect that Western (particularly American) content producers will be able to use ICTs to broaden their marketing and transmission reach raises fears of cultural preservation in the face of a relentless onslaught of market-driven entertainment and artistic products. New technologies such as MP-3 players for music delivery, digital streaming and satellite delivery of audio and visual materials, and the expansion of television's reach and penetration reduce the transaction costs of delivering content and can expand the allure of western cultural products. Critics decry this trend as a threat to cultural and linguistic diversity. As UNESCO notes, "The expansion and concentration of television, radio, and film production in a relatively small number of countries and enterprises tends to favor conformity and standardization at the expense of specificity, adding to the concern about the loss of native culture. There is a fear that many native elements including language, folklore, oral histories, traditions and foods may be lost in the process." (UNESCO, 1996)

A related problem is ease with which ICTs can move unsavory or illegal content across national borders. Pornography and gambling are emerging as the largest industries on the World Wide Web and attempts to control it nationally have proved futile as providers can safely operate in offshore locations anywhere in the world. While applications have been developed that can block access to pornographic sights, it remains technically impossible to block certain types of content completely. Countries thus face an all or nothing choice. Restricting access to ICTs because of perceived threats to cultural values will have negative spill-over effects on other ICT reliant sectors. On the other hand, developing country concerns regarding cultural preservation face increasing challenges in the face of the powerful reach of cultural content providers. When combined with the problem of scale economies in web page construction, this suggests at the least a significant role for government support for locally relevant, local language and culturally specific Internet content.

Efforts aimed at preserving local cultural production have moved into international fora. During the final negotiations at the Uruguay Round in 1993, for example, France successfully argued that "cultural products" should not be treated the same as other industrial products and should be allowed to continue to receive subsidies and other forms of state support. A problem is emerging, however, in that as the supply of commercial cultural products rises, local and non-commercial productivity tends to decrease (UNESCO, 1996). Government support can help make up the difference, but resources are limited for these types of public expenditures and the future of cultural subsidies under international trade rules is still in doubt.

Maximizing the Impact of ICTs on Government Service Provision

As we have seen, governments can use ICTs to improve the quality and efficiency of public services, to strengthen government information flows internally, to promote accountability and transparency, to procure goods and services fairly and efficiently, and to raise quality standards for information technology suppliers. At the same time, there are significant risks: institutional failure, expense, poor design, and low levels of consumer access. A number of lessons should be kept in mind:

- *Incorporating ICTs must be seen as secondary* to a broader reform agenda considered on its own merits. Broadly, this suggests a four-stage process in introducing ICTs (Heeks 1998): (i) acceptance by key stakeholders of the need to reform (ii) identification of the agenda for reform (iii) identification of the information systems requirements of the reform (iv) identification of the role of ICTs, if any, in meeting these requirements.

- *Evolutionary approaches* should be preferred over revolutionary reforms. Introduction is complex and expensive—training and support costs, such as operations and maintenance, for computers can add up to as much as five or ten times the cost of equipment, and this does not allow for the wider institutional reforms that are a necessary part of computer introduction. Demands on scarce technical capacity are also high. This suggests that the costs of failure are very high—and the risk and cost of failure grow with the increasingly radical nature of reform.
- *Prioritization is vital*, given the difficulty, cost, and time taken to introduce new systems. Priority should be given to the government sectors where better information processing has the highest return, and the risks of exclusion are lowest. This is likely to be in back office functions such as the processing of tax and land records rather than use in direct contact with service consumers, who might not yet have access or the knowledge to use that access.
- *Widespread consultation and participation* of users and stakeholders is necessary during the design process. While a senior champion is undoubtedly vital to the process as well, if the everyday system users and supporters are not involved in reform efforts and ICT rollout, they are far less likely to accept the new methods of service provision.
- *Access should precede service rollout*, especially as governments begin to move toward directly providing services to citizens online. This suggests an ambitious program of MCT rollout. It also suggests implementing the technologically most simple and robust systems that will not become immediately obsolete. Microdesign issues become important here—using Word 2.0 rather than Word 2000, and avoiding large graphics in Web sites.

Egypt might be looked to as a best practice model, here.³⁵ The government established the Information and Decision Support Center (IDSC) in 1985. The organization is mandated to assist policy-makers at the national, ministerial, and regional levels with developing information and decision support systems and encouraging informatics projects in support of managerial and economic development. A number of organizational innovations within IDSC ensure that the program maximizes the effectiveness of outputs and minimizes the likelihood of project failure. Various departments have been tasked with prioritizing information needs, matching user needs with appropriate systems, ensuring human resources development, controlling project costs and expenditures, and remaining up to date on international IT developments that might be integrated into the program. A particularly innovative feature is a dual phased approach to project implementation and institutionalization. In the first phase, user needs are assessed and projects are formulated. In the second phase, solutions are institutionalized within the host organization through a process that focuses on ensuring that programs fit within the existing institutional culture, maximizing administrative and human resource capabilities for sustainability, tracking and monitoring ongoing use, and evaluating the ongoing value-added of the program. Since its inception, the organization

³⁵ This discussion draws heavily on the work of Kamel, 1998. See also El-Nawawy and Ismail, 1999.

has grown from 3 employees to over 800 by 1997 and now manages over 500 projects for national and regional government agencies. (Kamel, 1998).

CONCLUSION

The role of knowledge in growth is no longer disputed. This suggests an important place for information and communications in development, which cross country evidence on the positive impact of access to ICTs on poverty also supports. There is growing anecdotal evidence on the impact of the power of the Internet in improving opportunities for income generation, service delivery and voice amongst the poor –although it should be noted that there is a serious deficiency of strong empirical support for this position as of yet.

Despite this broadly positive outlook for the role of the Internet in LDCs, there are a number of concerns:

- There are reasons to believe that the Internet might act as a technology of divergence. Certainly, the spread of modern ICTs will create losers as well as winners.
- The growing digital divide suggests that the rural poor are especially vulnerable, and might be left behind in the race to build an ‘Internet economy.’
- Implementing reform of the ICT sector, and using ICTs as part of a reform program in other sectors, is very complex and prone to failure.

Given these issues, the Internet should be seen as a potentially helpful tool, rather than a cure-all. Further, in our present state of near-ignorance, pilot projects and research to uncover best practices and lessons of experience should be of the highest priority. In particular, it is vital that the equity impact of moving to Internet-enabled service provision is foremost in the minds of policy makers and implementers.

If the challenges offered by the Internet are recognized along side the opportunities created, the new ICTs will take their place beside more traditional communications technologies as a potential force for income generation and empowerment.

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