Chapter 4

Communicating Knowledge

Revolutions in communication have often been at the center of changes in society. Movable type—the Gutenberg Bible—is widely considered to have ushered in the Renaissance, as it freed the sharing of written knowledge from the slow and laborious process of manual copying, which had for centuries sharply circumscribed access to books. Since Gutenberg, printed text has become the principal medium for sharing some types of knowledge. More recent breakthroughs in communications—the telegraph, the telephone, radio, television, the fax machine—have also wrought profound social and economic change. Today a new revolution is in full career, made possible by new technologies that can shuttle vast amounts of information almost anywhere in the world in mere seconds.

These advances in communication will enable the construction of whole new societies in cyberspace, linking individuals with common interests to share views and information. Already these technologies are enabling a new electronic commerce, which is rife with possibilities but also holds challenges. Transactions such as electronic settlement of accounts can now occur over distances previously unimaginable. The new technologies are creating a new global marketplace, where competition may be fiercer and winnow out weak firms quicker than ever before. This global marketplace opens up new opportunities for efficiency gains, as firms reap the advantages that come from a vastly expanded potential clientele.

The new information and communications technologies, from e-mail to cellular telephony to teleconferencing, let more and more people share knowledge without having to be in the same place. Sharing information through computers interlinked by telephone lines is quickly becoming commonplace in industrial countries, and increasingly so in developing countries as well.

In most developing countries, however, the use of the new technologies, although growing rapidly, is still limited. Low income, inadequate human capital, and weak competitive and regulatory environments slow their adoption. Sociocultural differences also pose a barrier, for people the world over tend to trust only what they know and feel at home with. That often means that modern knowledge must enter a traditional society through traditional channels. For example, community street theaters have proved more effective in several developing countries, such as Ethiopia and Namibia, for communicating information on AIDS prevention than have information brochures, television, or radio.

This chapter conveys two main messages:

- Although traditional channels of communication will remain important, the new information and communications technologies hold great potential for broadly disseminating knowledge at low cost, and for reducing knowledge gaps both within countries and between industrial and developing countries.
- Market competition can unleash the private sector to provide the communications infrastructure and services and expand the use of new communications technologies in developing countries. But governments have to ensure appropriate regulation to guard against private monopoly power, and supplement the market to ensure access for the poor.

Harnessing the potential of new technology

Demand for communication today is heavily driven by business relations, alliances, and exchanges that span countries. But it is also driven by personal relations—among friends and family members living in different cities, towns, or villages or traveling the globe. This heightened demand is paralleled—and perhaps boosted—by dramatic changes in information and communications technologies, which together constitute the information revolution.

Three main forces underlie this revolution: the expansion of computing power, the falling cost of transmitting information, and the convergence of computing and telecommunications:

- Computing power per dollar invested has risen by a factor of 10,000 over the past 20 years. Even as the processing speed and transistor density of microchips are increasing, production costs are being pushed down by relentless technical innovation and by economies of scale in producing microchips.
- The cost of voice transmission circuits has fallen by a factor of 10,000 over those same 20 years, mainly because of fiber optics, low-cost electronics, and wireless technology. A single optical fiber much thinner than a copper wire can carry thousands of telephone conversations, making the cost per voice circuit infinitesimal. The falling price of electronics has allowed for cheaper, more reliable telephone network exchanges. And wireless technology is offering the possibility of providing services without incurring the high fixed cost of installing lines. Together these technologies are shrinking the cost of reaching individual users.
- Digital technologies have joined together the telecommunications and computing industries and merged segments of the information industry into services that manipulate voice, text, image, video, and data. This convergence opens huge opportunities for developing countries to connect their people quickly, using innovative technologies and private sector–led investment (Box 4.1). But it also poses huge challenges for regulation.

The world information technology market—whose products include personal computers and workstations, multiuser computer systems, data communications equipment, and packaged software—grew by about 12.2 percent a year in real terms between 1985 and 1995, almost five times faster than world GDP (Table 4.1). Although the production of information technology remains highly concentrated—with more than 90 percent in OECD countries—the use of modern communications media is expanding rapidly in other countries.

However, in many countries prices have not fallen nearly as fast as costs, partly because of incumbent national monopolies, and partly because prices for international connections are still set by a cartel-like system of international agreements between these national monopolies. Still, technical change is bringing in competition, which will eventually translate into affordable access for more people in more countries. Furthermore, as outmoded monopolies lose their hold on prices, consumers will enjoy a wider choice—between fixed lines and wireless or cellular, between fax and e-mail. Moreover, the larger a given network, the greater the opportunity for users to acquire and exchange information, and therefore the greater the appeal for even more to join.

Opportunities for leapfrogging

The opportunities are great for developing countries to take advantage of the new information and communications technologies in disseminating knowledge. New wireless technologies that require less fixed investment than traditional wire-based ones can be more cost-effective in countries with sparse populations, difficult terrain, and harsh climatic conditions, because they require less maintenance. Furthermore, some developing countries perceive—indeed, a few have already seized—an opportunity to leapfrog the industrial countries by going straight from underdeveloped networks to fully digitized networks, bypassing the traditional analog technology that still forms the backbone of the system in most industrial countries. In 1993 some two dozen or more developing economies already had fully digitized networks, while the level of digitization in the OECD countries averaged just 65 percent (37 percent in Germany, for example, and 72 percent in Japan; Figure 4.1).

Consumers in developing countries can indeed benefit from the new wireless technologies. Some who find it difficult to get a fixed telephone line can get a cellular phone instead. The number of cellular phones per fixed line is already as high in some low- and middle-income economies as in some industrial countries; some developing countries with low density in both traditional telephone service and cellular phones have recently invested in cellular technology at a very fast rate (Figure 4.2). The Philippines, a country with low telephone density (only 2.5 main lines per 100 people), has a higher ratio of mobile phone subscribers to main lines than Japan, the United Kingdom, the United States, or several other industrial countries with densities of more than 50 main lines per 100 people.

Opportunities for doing new things—and doing old things differently

People in developing countries can apply the new technologies to a vast range of activities, including education

Box 4.1

From the transistor to the integrated digital network

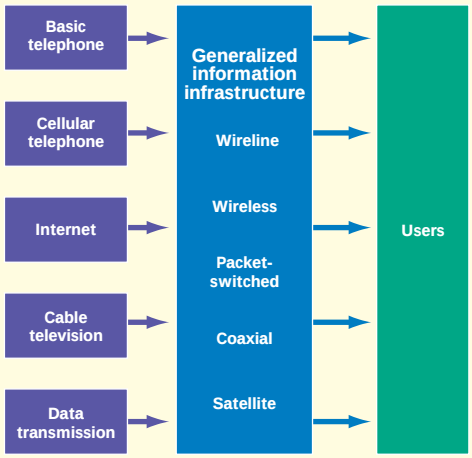
The invention of the transistor in 1947 and the complementary invention of the computer set in motion dramatic changes in the way people communicate. In 1959 came another major breakthrough: the first integrated circuits, multiple transistors connected on a single sliver of semiconductor material. In the years that followed, the cost of building and connecting these electronic components fell sharply as the number that could be squeezed on a chip rose. Successive manufacturing improvements allowed for ever smaller and cheaper yet also more powerful components to be stacked together. In 1972 the first microprocessor, the essentials of a simple computer packed onto a single chip, was introduced.

The revolution in information and communications technology then gained momentum, propelled by the ever-increasing ratio of computing power to computing cost, by the growth of digital communications, and by the rapidly declining costs of transmission over diverse media.

These trends made possible the convergence of computing and telephony. At first the various technologies evolved as separate networks: conventional analog telephone services used dedicated wireline networks, cable television providers strung their own coaxial cables, and data transmission systems built their own set of cables and satellites. Today, however, the world is heading toward a system where the telephone, the Internet, television, and data share a generalized digital information infrastructure consisting of interconnected systems: wireline, wireless, packet-switched, coaxial, and satellite (see figure).

This convergence demolishes the traditional view of telecommunications as a natural monopoly: competition is now possible both between and within its different segments. Although this reduces governments' role in infrastructure provision, it also generates new challenges in designing market regulation. For example, by breaking down the division between broadcasting and telecommunications, convergence raises regulatory issues of privacy, decency, and intellectual property protection.

Convergence in the telecommunications industry



Source: Bond 1997a.

Table 4.1

Product and geographical composition of the world information technology market

(percent)

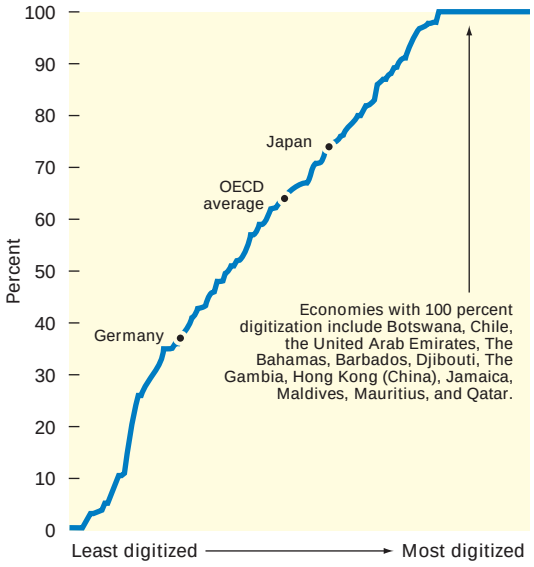
Product type or region	1985	1995	Average annual growth rate, 1985–95
By main product type			
Personal computers and workstations	20.9	30.5	17.2
Multiuser systems	29.5	13.0	4.0
Data communications equipment	3.0	4.3	17.0
Packaged software	13.5	18.4	16.3
Services	33.1	33.7	13.0
By region			
North America	59.2	43.5	9.4
Latin America	1.5	2.0	15.6
Western Europe	22.1	28.3	15.6
Eastern Europe, Middle East, and Africa	3.1	2.6	10.6
Other Asia and Pacific	14.0	23.7	18.9
World			12.2

Source: Mansell and Wehn 1998.

Figure 4.1

Economies ranked by share of the telephone network digitized

Some developing economies have leapfrogged over the richer industrial ones and installed fully digital networks.

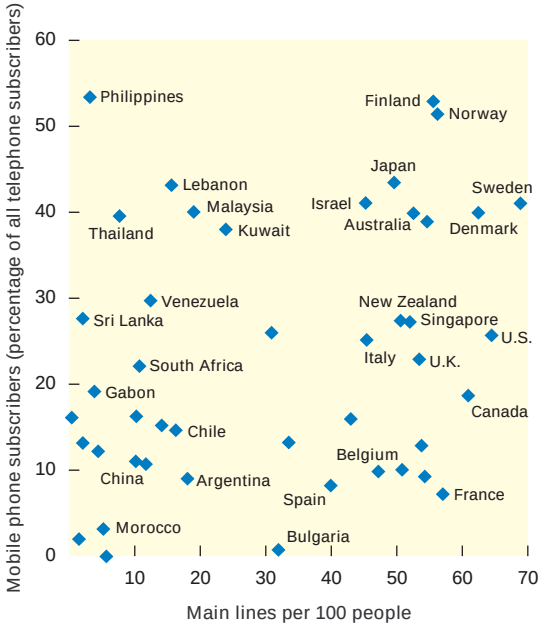


Note: Data are for 1993 for 164 economies worldwide. Source: International Telecommunication Union data.

Figure 4.2

Telephone density and mobile phone penetration

Mobile phones can complement a well-developed wire-based network—or substitute for an underdeveloped one.



Note: Data are for 1996 for 45 countries worldwide. Source: International Telecommunication Union data.

(Chapter 3), finance (Chapter 6), the environment (Chapter 7), income generation by the poor (Chapter 8), and policymaking (Chapters 9 and 10).

Supporting lifelong learning. With the growing complexity of knowledge, the speed with which it is being updated, and the sheer quantity of information to be interpreted, people today need to engage in structured and systematic learning throughout their lives. As Chapter 3 argues, lifelong learning is especially important in developing countries, where many adults did not receive basic education during their youth. With modern communications technologies they can do so at their own pace, outside of school or the workplace. Also, schools and universities can share teaching materials and resources by e-mail and over the Internet, thus relaxing some of their resource constraints.

Taking advantage of investment opportunities. Many potential investors in developing countries remain excluded from formal financial transactions for lack of information about the instruments available. In China, however, more than 100 million people—farmers and housewives, barmaids and bureaucrats—now invest in stocks traded on the country's two exchanges in Shanghai and Shenzhen. Many are active investors, frequently seeking information about companies, markets, and opportunities. The traditional newspapers that provide stock market tips are no longer enough for these information-hungry investors, so the telephone company offers more than 100 pay-per-call hotlines analyzing the market's daily performance. There is also a separate hotline for each of the nearly 800 listed stocks. Investors can use bank debit cards to place trades at storefront brokerage offices, or trade using the keypads on their mobile telephones. More than 30 Chinese cities have electronic trading terminals that link them instantly to either exchange.

Helping the poor earn more income. The new technologies can help remove constraints that keep the poor living at subsistence levels. In a small business loan program in Vietnam, e-mail keeps the lender (a relief agency) in touch with borrowers (women in a small community) and helps coordinate loan payments, encouraging the lender

to extend more loans. With the help of a nongovernmental organization (NGO) called Peoplink, women in Panama post pictures of their handicrafts on the Internet's World Wide Web, and thus gain access to a world market. And in West Africa, information technology helped eradicate river blindness, allowing millions to return to farming (Box 4.2).

Governments often lack the knowledge they need about the poor, their activities, and their needs. So, unfortunately, do those institutions whose mandate is to reduce poverty. The new technologies hold potential for teaching governments and institutions about the poor, for designing programs that benefit them, and for enhancing their participation and empowerment. Satellite technology, for example, can be used for computer mapping programs, to contribute to the clear titling to land that is crucial for small farmers and entrepreneurs seeking collateralized credit (Chapter 8). Care should be taken, however, to ensure that such programs are consistent with customary allocations of land rights, so that the titling is universally accepted.

Getting useful information to the poor. The information revolution offers great opportunities for informing the poor and empowering them to make decisions that affect their lives—provided political and legal impediments do not block the flow of information to the poor or weaken their ability to make their voices heard. The literate poor have greater and cheaper access to printed material and libraries than did their counterparts in today's industrial countries when they were at the same stage of development. In the Philippines, for example, a group of subsistence farmers have become pineapple specialists, using telex and fax machines to communicate directly with researchers and market representatives.

Providing information on markets and for small businesses. Small entrepreneurs and inhabitants of remote areas typically lack information about prices and market opportunities, about the successful replicable experiences of peers, or about financial systems. Information and communications technologies are a powerful instrument for remedying such information deficiencies:

Box 4.2

How information technology helped control river blindness

One of the most successful applications of information technology in developing countries has been in the Onchocerciasis Control Program (OCP), the international program to eradicate river blindness. River blindness is caused by a parasite, *Onchocerca volvulus,* that is carried from person to person by the blackfly. Because the parasite is concentrated along river beds, it had led over the years to the abandonment of large tracts of fertile land in West Africa.

The OCP was initiated in 1974 by seven West African countries: Benin, Burkina Faso, Côte d'Ivoire, Ghana, Mali, Niger, and Togo. Today 11 countries are partners in the program, which is executed by the World Health Organization. Twenty-one donor organizations (up from six originally) also participate, as well as several NGOs, community organizations, and a pharmaceutical company. The primary objectives of the program are twofold:

- To eliminate river blindness as a threat to public health and as an obstacle to socioeconomic development throughout the program area, and
- To assist in ensuring that the beneficiary countries are in a position to safeguard this achievement.

Over the past 20 years the OCP has eliminated the disease in the original seven member countries. In the 1980s the blackfly evolved resistance to the commonly used insecticide, but this was overcome by applying several insecticides in rotation. Over 30 million people are now protected from infection, and 185,000 who were already infected have been spared blindness. Fertile lands that were formerly vacant have now been resettled, and the inhabitants are thriving. A total of 25 million hectares (about 100,000 square miles) of riverine land is now available for settlement and cultivation. Under traditional technologies and agricultural practices, the reclaimed land is capable of feeding 17 million people.

The program was so successful because it pinpointed the peak times to spray, allowing systematic control of the blackfly population. Information was collected along 50,000 river kilometers, using sensors on the river bottom. Local inhabitants entered the data into computers, and the information was beamed to satellite radio transmitters and from there to a network of entomologists and laboratories, which in turn transmitted schedules to the airplane pilots responsible for spraying. Another element in the program's success was its use of epidemiological and environmental surveillance to ensure that the insecticides caused no damage to fish and invertebrate populations in the fast-flowing rivers.

Although the OCP was initially built around control of the parasite, in the last few years the discovery of the drug ivermectin has introduced a community-based dimension to the disease's control. The drug proved a real breakthrough: a single dose provides protection against the disease for a whole year. Ivermectin is provided free of cost by Merck & Company and distributed by national teams, with technical and logistical support from a committee comprising donor countries and NGOs. This combination of information technology, medical knowledge, community participation, and international support has greatly contributed to interrupting the transmission of river blindness and offers hope of eventually eliminating the disease.

- In rural Costa Rica small coffee growers use telecommunications to get marketing information from central cooperatives in the capital, which have computers linked to sources of information on national and international coffee prices.
- Farmers in Côte d'Ivoire use cellular phones to get international cocoa price quotations directly from Abidjan.
- Farmer associations in Mexico use computers to monitor the government's rural credit program; armed with that information, they can negotiate to make the program fairer and more effective.
- The introduction of telephone service to several rural towns and villages in Sri Lanka allowed small farmers to obtain current, firsthand information on wholesale and retail prices of fruits and other produce in Colombo, the capital. Before they obtained telephone service, they used to sell their crops at prices averaging 50 to 60 percent of the Colombo price. Now they regularly get 80 to 90 percent of that price.
- A small grocer in Rosario, Uruguay, who sold and delivered groceries to homes was able to expand his clientele beyond his immediate neighborhood when residential telephones became available locally and customers could order goods by telephone.
- A distributor of industrial spare parts and machinery in Nairobi saw his business expand 35 percent after additional lines were installed to his office from the local exchange. This permitted him to hire six new employees and add three light trucks to his company's fleet.

Improving governance. The new technologies can also improve governance by allowing policymaking institutions and think tanks to share knowledge. Officials of Kenya's Ministry of Agriculture brought a computer to budget meetings to show decisionmakers on the spot the consequences of adding or cutting projects as they were discussed. The result was a far better allocation of resources. In Morocco the government is using information and communications technology to enhance interministry coordination, tax administration, auditing, public investment planning and monitoring, and expenditure management. These tools have cut in half the time required to prepare the budget.

In most economies, industrial and developing, information and communications technologies are assuming a central role. In banking and international finance, tourism and travel, commodity trading, and export-oriented manufacturing, success depends on global information and efficient electronic exchange. The new technologies are also becoming a vital part of countries' economic infrastructure. At the port of Singapore, efforts to computerize port activities and customs clearance have dramatically boosted efficiency (Box 4.3).

To compete in the new global economy, developing countries must see the development and effective use of their information infrastructure as a key national objective. Indeed, a number of them have made effective use of information technologies a key thrust of their national development strategies. Malaysia, for example, has defined its information technology objectives and included them in its development strategy. The objectives include enhancing awareness of the new technologies among the population, ensuring widespread diffusion and application of information technology, expanding information technology training, and revising laws and regulations to facilitate and protect transactions that use electronic rather than paper-based modes of exchanging information. The ultimate goal is to make Malaysia into a global information hub.

Addressing the year 2000 problem. The information revolution and the technological progress that has accompanied it are bringing immense benefits to the world. But that same technology has generated one problem of its own that might affect today's technology-driven world quite dramatically. The year 2000 (Y2K) problem arises from the common practice in older computer programs of designating years by the last two digits only. This was done to economize on computer memory, which was then quite expensive. Computers so programmed will register the year 2000 as "00," which they then may interpret as "1900." A related problem is that computer programs with incorrect leap-year calculations will assume that the year 2000 has only 365 days instead of 366. Unless corrected, these programming flaws will cause devices containing embedded computer chips and related systems worldwide to fail or to behave in unpredictable ways.

The "millennium bug," as it is also called, is expected to affect systems in many different sectors, including communications, banking, public utilities, health care, and defense. It has the potential to seriously disrupt public and private sector operations at all levels. The precise dimensions of the Y2K problem are not known, but the global cost of fixing it is often estimated in the hundreds of billions of dollars.

Apart from the technological challenges, in many developing countries the problem is compounded by a lack of awareness. Whereas some countries have launched national programs to deal with the issue, others have yet to begin to address the problem. World Bank surveys as of August 1, 1998, indicated that only 29 out of 137 developing countries had put in place a national Y2K program. The lack of awareness and understanding means that solutions may not be implented in time, and failures may occur, causing serious disruptions.

Although Y2K is fundamentally a technical problem, choosing how to solve it is a business and regulatory issue. Accordingly, a special initiative has been launched by the

Box 4.3

How Singapore became the world's most efficient port

Singapore Network Services (SNS) manages and operates Tradenet, a networked information system that allows traders to declare imports and exports for customs directly from their office computers. Tradenet evolved from a five-person National Computer Board research project, begun in December 1986 with the aim of boosting Singapore's competitiveness in world markets. Fifty companies participated in a pilot launched in January 1988. The participants included traders, customs agents, and the Trade Development Board, which handles much of the documentation and licensing done in other countries by customs agencies.

With Tradenet, a trader's declaration is transmitted electronically to the Trade Development Board, which issues the necessary approvals within 15 minutes, after routing details to various government departments. Depending on the type of goods, as many as 20 agencies may be involved. On receiving approval, the trader prints and signs the document to obtain release of the cargo. Tradenet user software developed by SNS is offered through several approved Singaporean software houses. Software developed by others may be used instead but requires certification to ensure quality and compatibility.

Thanks to Tradenet, traders no longer have to leave their offices to obtain customs approvals. And because special trips to rectify errors or resolve disputes now hardly ever occur, traders have been able to trim their labor costs. With storage for goods awaiting clearance no longer necessary, goods can now go straight from the ship to the consignee—a particularly important consideration in Singapore, where space is at a premium.

Meanwhile a new port, container, and real-time vessel management system operated by the Port of Singapore Authority has further expedited the flow of goods. The result has been ship turnarounds of less than 10 hours, leading to huge improvements in the use of port and harbor facilities. This electronic preclearance has helped make Singapore's port the most efficient in the world. The Singapore government has valued these efficiencies at more than 1 percent of GDP.

Software from SNS is now also used for e-mail, information services, and bulletin boards, as well as a range of new services for health, legal systems, electronics, manufacturing, retail, and distribution. And the group is installing versions of its service in Canada, China, India, Malaysia, Mauritius, the Philippines, and Vietnam. Many of these installations are joint ventures with government departments (as in the case of Mauritius Network Services) or local commercial enterprises (as with Ayala in the Philippines). But how replicable the SNS experience is for countries with less human capital remains unclear.

World Bank's Information for Development program, in partnership with other multilateral development banks, some bilateral development agencies, and some private corporations. The program disseminates information to key stakeholders in developing countries on how to deal with the Y2K problem. It also provides limited financial support (in the form of grants) and technical assistance for remediation and for drawing up national Y2K plans, which will identify those aspects of the problem that merit the highest priority from an economic and a social perspective, and for providing targeted solutions. World Bank loans and credits are also available to address this problem. The use of new information technologies such as teleconferencing may also be effective in spreading awareness by promoting a broader dialogue on the issue (Box 4.4).

Although the first and necessary step in addressing the Y2K problem is to be aware of it, its solution will require resources, financial as well as human and technical. Many developing countries that have managed to develop awareness still face difficulties in mobilizing the resources necessary to begin modifying and converting their information systems.

Some caveats

Despite the great promise of the information revolution, some caveats are in order. As with the industrial revolution, gains will be fully realized only when ways of doing business have adapted more fully to the changed technology. For instance, videoconferencing may increasingly replace travel, saving large amounts of money and time. But even in industrial countries where individuals, firms, and other organizations have made large investments in new information and communications technologies, skeptics remain unconvinced about their eventual impact on economic growth. Skepticism is even more widespread in developing countries, where use of the new technologies is still sparse. The skeptics point out the dangers, and the costs, of information overload, including the huge costs involved in absorbing and sorting through vastly increased flows of information.

Another concern is that those who have access to the new technology may forge ahead, leaving those without access behind and widening gaps in well-being both between and within countries. Some worry that the wider marketplace of the global economy opens up opportunities for increased concentration of market power, and that the industrial, not the developing countries, will reap a disproportionate share of the profits.

In some countries and communities, language differences may inhibit the use of new information and communications technologies. For example, although the Internet is increasingly offering original material and on-line

Box 4.4

Teleconferencing to raise awareness of the year 2000 problem

To help raise developing countries' awareness about the Y2K problem, the World Bank is holding a series of interactive videoconferences on the topic. The first of these were produced for some countries in Africa. Originating from Bank headquarters in Washington, the conference consisted of briefings from a panel of experts from the Bank's Y2K group as well as from outside organizations. Policymakers and other decisionmakers, as well as representatives from ministries and the public and the private sector, took part. By June 1998 nine African countries—including both English- and French-speaking ones—had taken part.

These videoconferences have increased the level of awareness of the Y2K problem considerably. They have helped trigger action plans that could save these countries millions of dollars. Cameroon, Côte d'Ivoire, and Senegal have now set up national committees to examine the issue and define action plans. An ongoing dialogue is under way among organizations at the national level, as well as between the countries and the Bank. Through this dialogue, the Bank's Information for Development Program and its Information Solutions Group provide advice on how and where to find relevant information.

translations in a range of languages, English remains the dominant language on the World Wide Web. People who cannot read English therefore face much greater obstacles than others in accessing this growing store of knowledge.

Even if the ultimate impact of the information revolution turns out to be something less than the current excitement suggests, it is likely to have profound positive effects on the economy and on society. Developing countries are already reaping huge benefits in areas where lack of modern communications represented a real impediment. But reaping the full benefits of these new technologies will take longer, because they will take time to fully penetrate these economies.

Because of this, older means of communication are likely to remain important for the foreseeable future:

- Radio can reach large numbers of poor people because it is affordable and uses little electricity, which is in low supply in many countries and barely affordable for many of the poor.
- Television remains a powerful and influential medium, because it presents words and images together, reaching people regardless of their literacy.
- Newspapers cannot directly inform illiterate people, but they are one of the cheapest ways to communicate knowledge and are especially effective in reaching opinionmakers.

It may be some time, if ever, before the Internet displaces radio, television, and the print media as the dominant channel for reaching low-income households in developing countries. Policymakers thus need to pay due attention to these other media, provide the right competitive environment, encourage their free development and use, and facilitate the local provision of content.

Delays in adoption

The means for using information to be more productive in the new global economy are very unequally distributed. The average high-income economy has over 100 times more computers per capita than the average low-income economy. Similar gaps exist for telephones (Table 4.2). Hampering the potential of the new information and communications technologies in developing countries are inadequate human capital, low purchasing power, and poor competition and regulation. A lack of training in the new technologies, especially in their maintenance and repair, is a major bottleneck. A recent survey of Internet users in Africa found that low computer literacy and low

Table 4.2

Selected indicators of information and telecommunications penetration by country income level

Group	Telephone main lines per 1,000 people, 1995	Personal computers per 1,000 people, 1995	Internet users per 1,000 people, 1996
Low-income economies	25.7	1.6	0.01
Lower-middle-income economies	94.5	10.0	0.7
Upper-middle-income economies	130.1	24.2	3.5
Newly industrializing economies (NIEs)	448.4	114.8	12.9
High-income economies[a]	546.1	199.3	111.0

a. Excluding NIEs.
Source: World Bank 1998d.

skill with Internet programs correlated significantly with low use. Perpetuating this skills gap is a lack of educators knowledgeable in the new technology.

Income levels, which are often related to education, appear to influence the adoption of telecommunications. Eighty percent of cross-country differences in telephone density can be attributed to differences in income per capita (Figure 4.3). South Asia and Sub-Saharan Africa have roughly 1.5 telephone lines for every 100 people, compared with 64 per 100 in the United States. Although total annual investment in telecommunications in developing countries has doubled to $60 billion a year since the early 1990s, much remains to be done to meet growing demand.

Indeed, in most low-income economies the problem is not lack of demand but inadequate supply. Although many in developing countries cannot afford a telephone, many can. Yet too often a request for a telephone line can go unmet for months or even years. The ratio of telephones on order to telephones in service is much higher in countries with low telephone density (Figure 4.3). Almost all the 28 million people on waiting lists worldwide are in developing countries, and their average wait is roughly one year. Moreover, some people do not bother to order a telephone line because they are sure they will not get it. In developing countries more than in industrial countries, the supply of telephones and of modern information technologies appears to be restrained by poor competition and regulation policies.

Competition and public policy

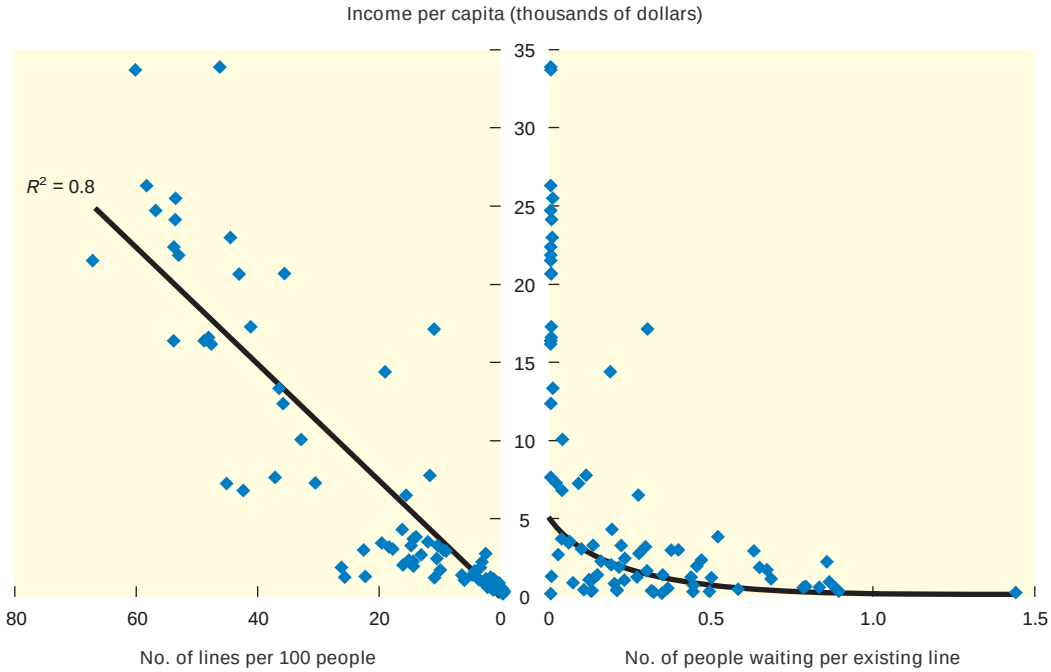
Telecommunications was long viewed as a natural monopoly. It was seen as most efficient to have one and only one producer. Because costs in this industry fall as the scale of production increases, the largest firm in the industry achieved the lowest costs and could underprice its rivals. As it did so, it would come eventually to dominate the industry. Most countries took the position that the only or at least the best way to prevent abuse of this monopoly power was for government to operate the telephone system.

Governments accordingly entered the arena. They then prevented the entry of competitors, arguing that they would wastefully duplicate existing facilities or provide

Figure 4.3

Telephone density, queuing for telephone service, and income per capita

The scarcity of telephones in developing countries reflects low income, but also unmet demand.



Note: Data are for 1993. Source: World Bank 1997g.

services only to low-cost users (typically those in urban areas, where the density of customers was high), thus inhibiting the government's ability to provide broad service at reasonable prices. Undercutting this argument, however, is the fact that capital costs of state telephone monopolies in developing countries often reach $4,000 per telephone line—three to four times the achievable cost.

Inefficiency and underinvestment by state telephone monopolies led to bad service, and little or none to the poor or to rural areas—an irony given that one of the justifications of government monopoly was that only government ownership could ensure universal service. Highly subsidized domestic calls meant low revenues and limited expansion. Low prices generated profits for businesses with access, which was unfair to those (usually small) businesses that had none. The authority to allocate scarce lines bred corruption. Thus a system designed to help the poor and to protect consumers did neither, and inefficient service inhibited economic growth.

The changing competitive environment in telecommunications

An equally important cause of the poor performance of many telecommunications providers has been a lack of competition combined with ineffective government regulation. Confronted with the failure of their public telecommunications monopolies, more than 70 developing countries are now shifting to private, competitive markets. Even when government retains control of the core of the telephone system, there is still enormous scope for private participation in cellular and value-added services. All too often, however, government policies restrict this participation. Partly because of these restrictions, in Sub-Saharan Africa, for instance, only 25 percent of telephone lines (outside South Africa) are privately provided. However, the World Trade Organization's recent agreements on telecommunications services offer the possibility for ever-larger gains from competition as telecommunications liberalization goes global (Box 4.5).

Since the 1980s, countries the world over have witnessed a sea change in the way information infrastructure is supplied, priced, financed, used, and regulated. The old telecommunications paradigm is crumbling fast. Recent technical advances allow for low-cost public access to a range of communications media. Although information infrastructure markets remain far from fully competitive, technology and increased demand have signed the national monopolies' death warrant. As already noted, natural monopolies occur when firms that produce more output have lower costs—they are said to achieve economies of scale. But when firms using the new technologies can have low costs even at a small scale of operation, there may be many effective competitors. Even a market as small as Sri Lanka's has shown that it can support four cellular operating companies offering globally competitive prices. That country now has some of the lowest cellular telephone tariffs in the world—and added 56,000 cellular lines between 1993 and 1996.

In many industrial countries and a handful of middle-income economies, this new trend is helping create a dynamic marketplace for new kinds of services, in which knowledge and information are rapidly tapped and disseminated over dense national and global networks. Many developing countries, too, are seizing opportunities to provide ever wider and broader access, to reduce gaps in the availability and affordability of information, and to connect their people to each other and the world through innovative technologies and private sector–led investment. But to keep from being passed by, countries have to introduce competition in their telecommunications sector. Indeed, in many segments of the telecommunications market, competition is not only feasible—it is inexorable. And governments will be able to maintain monopolies only with repressive measures.

Ongoing changes in technology, the competitive environment, and pricing are leading to a rebalancing of prices across different services: prices are falling for international calls and rising (as subsidies are removed) for domestic calls in many developing countries. Traditional pricing patterns have often given the wrong incentives to both

Box 4.5

Telecommunications liberalization receives a global push

The World Trade Organization's General Agreement on Trade and Services, part of the 1994 Uruguay Round set of agreements, brought the services sector, including telecommunications, into multilateral trade negotiations for the first time. After the Uruguay Round, the Negotiating Group on Basic Telecommunications was created to continue the progress that the round had started. By February 1997, 69 WTO members, representing more than 90 percent of the world telecommunications market, had tabled internationally binding commitments to liberalize basic telephone services.

In these talks, 31 industrial and 24 developing countries made commitments to liberalize their voice telephone services. Other services to be liberalized included long-distance international and resale voice telephony, data transmission, private leased circuits, mobile and satellite services, and trunk services. Most participants made commitments to all or part of a set of procompetitive regulatory principles. The likely benefits for signatories include greater competitiveness, increased FDI, and a better price-quality mix of consumer services.

Box 4.6

Pressure to reform accounting rates for international calls

An international call used to be a service jointly provided by a telephone company in the country originating the call and its counterpart in the country receiving the call. Under traditional "accounting rates" established bilaterally between telephone companies in different countries, the originating company compensates the company at the receiving end for each call. The settlement payment is normally half the wholesale price for international calls. This price is usually higher than the actual cost of the call.

Developing countries typically receive more international telephone traffic than they originate. The reasons for this include differences in incomes, sizes of emigrant communities, and prices for international calls. As a result, telephone operating companies in, for example, China, India, Mexico, and the Philippines routinely receive substantial settlement payments from the United States, a net originator of international traffic.

Today, telephone companies in the United States and other countries that have introduced competition in international telephone services are under pressure to lower charges to customers. This pressure, combined with increased opportunities for arbitrage in international calling, through callback and calling card services, has produced substantial revenues for operating companies in many developing countries, which they are using to finance the development of information infrastructure. But this is hardly the ideal way to finance such investments, for the following reasons:

- Accounting rate payments benefit countries unequally. Mexico received more than 17 percent of U.S. settlement payments in 1995, Sub-Saharan Africa less than 2 percent. Canada, Germany, and Japan have also received net settlement payments from the United States, whereas Albania, Afghanistan, and Somalia have been net payers.
- Settlement payments have not always financed telecommunications development, but have gone instead to general government revenues.

Finally, by keeping the floor price of international calling charges artificially high, the settlements system hampers the development of new, information-intensive exports (such as in data entry services) and of other services such as tourism.

users and suppliers. High charges for international calls have traditionally been justified on grounds that they subsidized local calls, ensuring access for all. But sometimes controversy arises over the extent of the subsidy, or even whether there is one: since domestic and international calls are, to some extent, produced jointly (much of the same equipment is used for both), allocating to each the costs of the facilities they share is tricky. By most reckonings, international callers have traditionally paid more than their share, and domestic callers less. Experience has shown that high international charges usually translate into low monthly rentals for telephones and low charges or none for local calls. This discourages telephone companies from extending the network. And overpriced long-distance and international telephone services penalize subscribers with clients, friends, and families in distant cities or abroad. Now, however, competitive service provision is putting the old pricing systems under threat—and the international tariff structure under serious challenge (Box 4.6).

Access to telecommunications is widening, but still limited in many countries. Sub-Saharan Africa has just one pay phone for every 5,300 people, compared with one for every 100 in Singapore. Many people in poor countries often travel several miles to get to the nearest pay phone—if there is one available. For example:

- A couple in rural Jamaica lives 156 kilometers from their daughter, who has to call her parents' neighbors half a mile away to reach them. Their messages are relayed up and down the hill by younger members of the community.
- A Johannesburg resident reports that his parents in the Northern province, one of the poorest parts of South Africa, have to travel 5 kilometers to the nearest shopping center to make a telephone call. His parents do not even dream of getting a telephone in their own home, he says.
- Residents of a medium-size town in Albania wait along a concrete wall for the chance to make a long-distance call. They scribble on scraps of paper the telephone numbers of friends, businesses, or government agencies they wish to reach and pass them through a small opening in the wall. Behind the wall the operators of old-fashioned manual switchboards then wait to connect to one of the only two long-distance lines in town. Long delays and failed connections are frequent before a call is completed.

Traditional cross-subsidies from international to local calling have generally failed to provide universal access, because they have been neither transparent nor well targeted. Competition is likely to increase access. Widespread evidence suggests that, once privatization and competition are introduced, service provision expands (Figure 4.4). Chile allowed competition in all market segments in the 1980s, and in less than a decade its telephone density more than tripled, to over 15 lines per 100 inhabitants. The Philippines opened its private monopoly to competition in 1993, and by the end of 1996 the number of telephone main lines had risen from 785,000 to 3.4 million. Other countries are following their lead. Uganda has li-

censed a second national telecommunications operator, and its privatization agency will soon sell the original one.

Competition has also reduced costs to subscribers. In Ghana a second cellular operator brought 30 to 50 percent reductions in both connection charges and tariffs, besides inspiring a rapid expansion in the first operator's service provision plans. Soon thereafter, entry of a third operator induced the first two to improve service.

Ensuring competition in liberalized markets

In telecommunications, as in all industries, private ownership and competition are the two essentials, but neither is easy to achieve. The sequence in which privatization, competition, and regulation are introduced can affect the outcome. When a state monopoly is privatized without appropriate regulation, a private monopoly can emerge. And private monopolies, more often than not, seek to stifle further attempts to introduce competition. Economic rents may then be transferred from the public sector to the private, with no gain in efficiency, no lower prices, and no broader service. Experience also shows that allowing private companies to compete can put pressure on a state monopoly to become more efficient, and this may eventually facilitate its privatization (Box 4.7).

This suggests three principles. First, privatization should follow the establishment of a regulatory structure, to ensure that competition is maintained and that the terms of licenses are respected. Regulations need to ensure that any monopoly power after privatization does not restrict entry, and to guarantee that new service providers have access to the incumbent's infrastructure. But the need for regulatory reform should not be an excuse for undue delay in opening the telecommunications sector to private participation—privatization should not await the ideal regulatory system. Chile, Ghana, and New Zealand privatized before fine tuning their regulatory systems.

Second, wherever possible, privatization should follow the introduction of greater competition. This might be achieved by extending licenses to new private companies or by breaking up the telecommunications monopoly.

Third, it may be easier to introduce competition by privatizing only part of the system. Especially promising are moves in some Sub-Saharan African countries to lower costs by exploiting competition among international telephone providers. This they have accomplished through soliciting competitive bids for purchase of their systems' more commodity-like aspects, such as local lines.

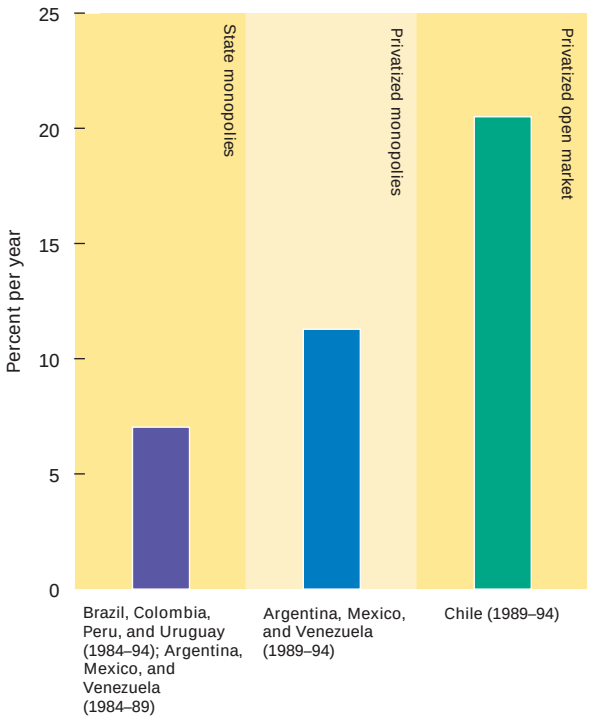
Telecommunications companies in the industrial countries, often prime candidates to purchase publicly owned services in developing countries, are continually innovating and offering new services. And increasing competition in these companies' home markets makes it all the more likely that developing countries will enjoy more of the fruits of these innovations. But to realize these benefits, developing countries must ensure effective competition among international companies in their domestic markets as well. Each company has an incentive to persuade countries to give them the inside track, and some companies have tried, in a variety of ways.

In Poland the benefits of liberalization have been thwarted by poor regulation. About 200 new telecommunications licenses have been awarded since 1990, but only 12 were in use in 1996. Among the main impediments cited by licensees are unfavorable terms for revenue sharing with the dominant state operator, limited access to its network, and prohibitions against setting up their own transmission facilities. This suggests that an important new role for regulation is to ensure that the dominant operator does not engage in anticompetitive practices—for example, by withholding essential technical and commercial information needed to price interconnections. And even when

Figure 4.4

Growth in telephone main lines under differing market conditions in Latin America

Telephone networks have expanded faster in open, privatized markets.



Note: Data for monopolies are averages for the countries included.
Source: Wellenius 1997b.

Box 4.7

Competition before privatization in Ghana's telecommunications services

In less than four years Ghana has implemented one of the world's most ambitious telecommunications reform programs. In 1993 the industry was the exclusive domain of Ghana Posts and Telecommunications Corporation, then entirely state owned and losing money. Telephone density was extremely low, with only one main line for every 400 people. The average wait for a telephone line exceeded 10 years. Service was limited in range and poor in quality.

In 1997 Ghana became the first developing country to introduce privatization and competition in all areas of service, in all parts of the country. To raise financing, the government tapped international investors. It sold a 30 percent stake in Ghana Telecom Ltd., the company formed in 1995 by splitting telecommunications from the postal service, to a consortium of Telekom Malaysia and local investors. It granted a second national license to a consortium of two U.S. firms and the Ghana National Petroleum Corporation.

Ghana also issued national licenses to five cellular operating companies, to contain any monopoly power the consortia might attempt to wield. Three were operating at the end of 1997, providing 30 percent of the country's telephone lines. Ghana now has several privately owned Internet service providers, one with an aggressive program to provide access in rural areas through collaboration with the post office.

In 1997 alone the number of connected fixed lines increased from 90,000 to 120,000, while Ghana Telecom's revenue increased from around $55 million to $75 million. The company is now earning substantial profits for the first time in its history, and the government's remaining 70 percent holding is worth several times the value of the entire company before privatization. The company plans to meet its rollout obligation of 225,000 lines in three years, rather than the five allowed in the license.

Regulatory capacity was not strengthened before introducing competition, however, and there are worrying indications of poor performance by the regulator. Developing regulatory capacity is now Ghana's priority. Despite these problems, however, Ghana's model of competition with or before privatization is now being adopted by Madagascar, Nigeria, and Uganda.

these barriers are swept away, regulation is still necessary to ensure competition. For example, the United States, despite having one of the most competitive telecommunications industries in the world, does not yet have sufficient competition so that regulation can be put aside.

Although competition is increasing in telecommunications, it is still far from perfect. Of particular concern is that, typically, in certain vital parts of the industry there is still virtually no competition. This is especially true of the final wired connection to the local user (what is often called "the last mile"). Although cellular connections provide a partial substitute for these hard-wired connections, they remain an imperfect one. Regulators need to be concerned that the firm that controls the last mile does not abuse its market power by raising prices too high, or by restricting access. Access to existing networks is vital for any newcomer into the industry. A cellular phone company that could only connect its customers with each other would have a hard time garnering market share. Regulators have to ensure that the charges imposed for such interconnections are fair and that the quality of connection offered is good.

There is some controversy about what constitute "fair" access prices. In industrial countries with pro-competitive policies in information infrastructure—such as Australia, the United Kingdom, and the United States—regulators have used various approaches to estimate a "reasonable" price of access to the facilities of the dominant operator, to help prevent abuse of its market power.

Regulation will take different forms in countries at different stages of development and with different needs, but there is much to learn from the successes and failures in Chile, Ghana, Poland, New Zealand, and the United States. The task of the regulatory authority—independent of operators—is mainly to help competing operators reach a reasonable agreement when they cannot do so themselves. For instance, Guatemala requires the regulator to choose among the parties' final offers for connectivity charges. If one of the parties refuses to relinquish an unreasonable position, the regulator is likely to choose the other's price. (If regulatory skills are scarce, this task can be outsourced.) State-owned operators must also be deprived of the sovereign immunity that protects them from legal action, and new entrants should have recourse to the courts or to approved professional arbitrators to settle disputes.

Bringing access to the poor

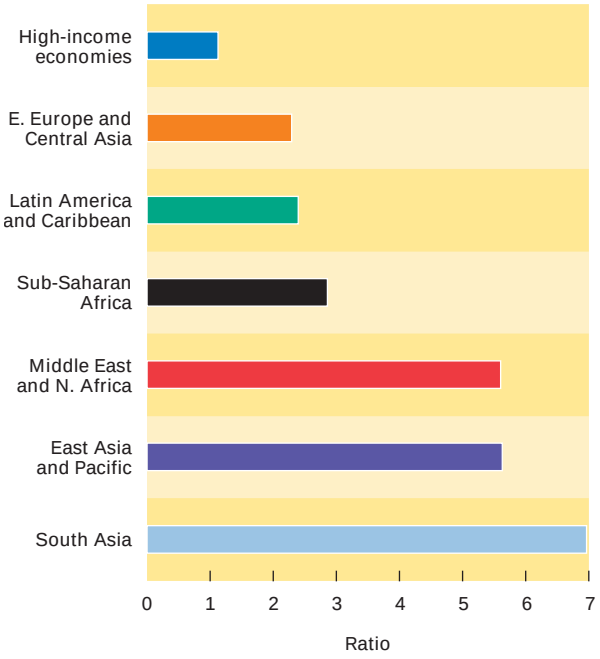
The towns, small cities, and rural areas of many developing countries are underserved by telecommunications: in parts of Asia and Africa rural telephone density is a fifth that in the largest cities (Figure 4.5). But in some developing countries entrepreneurs have proved themselves capable of bringing telephones even to the poorest. Senegal in 1995 had more than 2,000 privately owned "telecenters," each with a pay phone and a fax machine; this was four times the number just two years before. But providing access to the rural poor often requires government support.

Governments can support such community facilities directly, thus leveraging poor people's willingness to pay,

Figure 4.5

Ratios of urban to rural telephone density, by region

Telephones in the developing world are concentrated in the largest cities.



Note: The ratio is the number of main lines per 100 people in the largest cities divided by the number per 100 people outside the largest cities. Source: International Telecommunication Union data.

as in South Africa's multipurpose community information centers. The country's Universal Service Agency, established in 1996, provides each center two years' worth of startup costs, plus field workers to offer technical support. A 1997 survey of these centers found that 67 percent had a telephone, 31 percent a computer, and 8 percent Internet access.

Government can also work with the private sector to support services to low-income areas—markets, after all, have proved far more successful than traditional state monopolies in rolling out service. Even those who cannot afford the full cost are often willing to pay something to obtain access.

The proposition that market-supporting initiatives are likely to be more successful than direct subsidies is supported by Chile's competitive bidding for rural pay telephone subsidies. In 1994 a special fund, set to expire in 1998, began awarding subsidies competitively to projects providing telephone service to small and remote locales. By 1996 the fund had achieved 90 percent of its objectives while using only about half of its $4.3 million budget, largely because it received bids to provide service with no subsidy at all for projects accounting for half the locales and 59 percent of the targeted population. With successful completion of the bids, more than 97 percent of Chileans will likely have access to basic telecommunications by the end of 1998.

Chile's experiment suggests that private competition can greatly accelerate rural telecommunications development. By using market mechanisms, the government learned at low cost which projects required subsidies and how much. The experiment also shows that market mechanisms can give small subsidies tremendous leverage: with only half the designated budget, or roughly $2 million in public funds, the government triggered private investment equal to about $40 million. The average cost of installing a rural pay telephone dropped by 90 percent of the cost of direct public provision.

Monopoly power is a concern not only in telephone service but in the mass media as well. Again, different media are typically imperfect substitutes; each reaches a different audience. Some countries are increasingly concerned about concentration of ownership of television stations, or of print and broadcast media more broadly. Where there is such concentration, citizens may not get the diversity of viewpoints that is essential for a vibrant society. Media concentrated in the hands of a few may also fail to serve as an effective check on corruption, particularly if the owners are closely connected with the government. Worse still, such media may try to steer elections by distorting the positions of one or the other candidate. Monopoly power thus has more than strictly economic effects: it can thwart the flow of accurate information, or of at least the airing of competing views. The same concerns also arise when the media are state controlled, for there the government may use its control of information to maintain itself in power. Several countries are placing tighter restrictions on concentration in the media than in other industries, because the concern goes beyond just prices to the very functioning of an open society.

Another worry is that privatizing state-controlled media may curtail diversity. Providers who compete for a mass market tend to provide similar products, leaving those with more specialized interests without adequate service. This is one of the rationales for public radio and television. Fortunately the new information and communications technologies have the potential to enhance diversity: cable and satellite television can deliver far more stations at low cost than conventional broadcasting ever could. One private company, for example, is about to

launch three satellites, one each to cover Africa, Latin America, and Asia, to beam a variety of world-class programs to low-income consumers.

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For developing countries, the new information and communications technologies hold enormous potential. The new wireless technologies will extend modern communications into areas that conventional copper wires would have taken decades to reach—if they ever did. People in remote communities the world over can have access to knowledge beyond the dreams of anyone in the industrial countries even a quarter century ago.

Using privatization, competition, regulation, and selective public action, developing countries can supplement traditional media with these new tools for communicating knowledge. Indeed, to compete in the new global economy, developing countries must make the development and effective use of information infrastructure a top national objective. They have to seize the opportunities offered by the new technologies to enhance private provision of telecommunications services and extend the reach of the new technologies throughout society. If done well, these strategies promise to enhance educational systems, improve policy formation and execution, and widen the range of new opportunities for business.