CHAPTER

14

The Promise and Challenge of Information Technologies

Information technologies help produce, gather, distribute, consume and store information. They are more important than ever before simply because in a relatively short period of time they have become ubiquitous in daily life. This is particularly true of the Internet, access to which has increased hundreds of times over in recent years (see Figure 14.1). Terms that did not exist only a few years ago—worldwide Web, e-mail and Intranet, among countless others—are now part of people's every day vocabulary. With minimal effort, consumers can go on-line and comparison shop between hundreds of vendors around the world. They can download music, photographs and film from the Web in a matter of minutes. Complex banking and other financial transactions can be done from the home. People can listen to or watch live news from almost anywhere in the world. And all this is just the tip of the iceberg.

Is this for real? Is the Internet just a somewhat different way to communicate, a technological curiosity not so different from traditional methods of communication such as the telephone, the fax or the regular mail? Or are we entering a new era, a global economy on steroids?

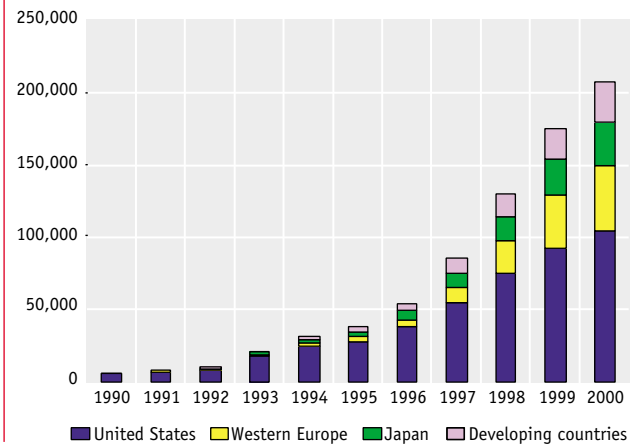
While the Internet does seem to be something more than just a fancy way to provide and receive information, the extent to which it contributes to an economy is in fact unclear. Some commentators argue that the world is posed to enter a third industrial revolution that will transform the economy in such a way that the old laws of economics will no longer apply. Sooner or later, it has been claimed, the law of supply and demand will cease to exist.

As much as information technologies "amplify brain power in the same way that the technologies of the industrial revolution amplified muscle power,"[1] the ultimate test of their benefit is their potential impact on productivity, either by creating new products or producing existing ones more efficiently. After all, faster productivity growth is the key to higher living standards, and more growth is the basis of modern growth economics. Any economy can grow by increasing its labor inputs, so long as the labor is available. Similarly, any economy can grow by increasing its use of physical capital, but investing in capital carries a cost and requires people to cut back on current consumption. If an economy can increase its productivity, real incomes will rise over time without the necessity of increased use of such inputs.

The most important new boost to growth potential and productivity, and the one so widely touted by the

Figure 14.1 Estimates of Internet Access, 1990-99

(Thousands of subscribers)



Source: ITU (2000).

[1] See *The Economist* (2000).

Box 14.1 How Latin American Businesses Can Benefit from the Internet

Researchers argue that the potential savings in transaction costs through the use of the Internet is especially high in the health care sector, since that sector is large, information-intensive, and highly dependent on paper records. Moving the processing of health claims to the Internet would require aggressive efforts to standardize claims formats, but savings could indeed be huge. In the United States, some maintain that savings amount to more than 50 percent per claim. The Internet also offers great potential in medical records management, not only for cutting costs, but also for improving the quality and effectiveness of care. Assuming that privacy concerns can be adequately addressed, patients and providers would benefit enormously from converting paper medical records into electronic forms.

The Internet can also have a major impact in the financial sector. This has been the case for the developed countries, although the experience of the banking sector in the United States shows how shifting to the Internet can pose new dilemmas. Financial services based on a provider-client relationship tied to geography and the provider's knowledge of the customer stands in stark contrast with savings offered by on-line markets for standard financial products. In the lending industry, customers may use the Internet to shop for information and compare rates. As consumers grow more comfortable with on-line transactions, it would not be surprising if loans were to start originating on-line as well. With the now legal "digital signature" law recently enacted in the United States, this may occur sooner rather than later. If so, consumers will save through lower margins plus lower costs in processing applications.

Source: Litan and Rivlin (2000).
[1] See Arrow (1962), Rivera-Batiz and Romer (1991), Romer (1986 and 1990) and Young (1991).

media, is the technological breakthrough spearheaded by the United States. The contribution to productivity growth from the use of information technology, including computer hardware, software and communications equipment, surged in the second half of the 1990s. The use of information technology accounts for a large share of productivity increases in the United States.

Latin America, on the other hand, has arrived late to the information technology dance. Can the region push its way to the dance floor and still benefit from this revolution? In fact, there are reasons to be optimistic about Latin America's chances of benefiting from the Internet revolution. For one, being a latecomer has its advantages. The dissemination of e-commerce and other Internet applications will likely be compressed into a shorter time frame, and the spillover benefits for efficiency improvements may be absorbed more rapidly. The pioneers have already done much of the dirty work, so a latecomer does not have to reinvent the wheel. By emulating best practices in applying the new technology, Latin America may be able to realize the stream of benefits with a shorter gestation period. Although the use of the Internet in the region lags with respect to other parts of the world, the speed with which the new technology has spread has been remarkable.

How Can Latin America Benefit from the Internet Revolution?

Information technologies such as the Internet and e-commerce appear to generate productivity gains by reducing transaction costs. The rapid dissemination of information, the substitution of digital for paper record keeping, and the networking capabilities of the Internet improve flexibility and responsiveness, encourage new and more efficient intermediaries, increase the use of outsourcing, reduce time to market by linking orders to production, and improve internal coordination.[2] Productivity gains for firms can be expected through improved procurement and inventory control, and reduced costs for intermediation and sales transactions. Consumers also can benefit through reduced search costs, thus increasing competition and reducing prices.

In fact, the most important attribute of the Internet is, perhaps, the most obvious. Internet facilitates the transmission of information quickly, conveniently and inexpensively. Routine transactions, including making payments, processing and transmitting financial information, and maintaining records can be handled less

[2] See World Bank (2000).

Box 14.2 Siderar in Argentina

In March 1996, Siderar, a steel production firm, undertook an initiative to improve communications with its business partners. The idea was to provide and receive information by electronic means. Initially, electronic mail was employed. Later, more sophisticated operations were used. Through simple e-mail requests to suppliers and order confirmations to clients, Siderar used information technology in auctions, international bidding and other aspects of its daily business operations. Even today, the firm is in the process of setting up a system called "e-procurement" for inventory control and better integration with providers.

By using information technologies, Siderar encourages its 732 suppliers to access specifically designed Web pages to exchange information and coordinate operations. In this way, suppliers are able to check on the status of payments and documents (bills, receipts) as well as day-to-day reports. The advantages are lower administrative costs for both suppliers and Siderar. The use of paper has diminished, and there is more standardization among internal departments and between Siderar and its suppliers. Additional software applications have been developed in SAP, a German control system.

Siderar's systems have advantages as well for clients, who can check on the status of an order or request at any given moment. Is it in the manufacturing stage? Has it been delivered? When is the purchase expected?

Total cost of the system to Siderar has been about $1.2 million.

Source: Bianco, Peirano and Porta (2000).

expensively with Web-based technology (see Box 14.1). Using information technologies, many firms can also reduce production costs.[3]

Latin American companies can also use the Internet to achieve the kinds of procurement and inventory savings now enjoyed only by developed country firms. Purchasing off-the-shelf electronic commerce applications is one example. There is potential for savings through reduced processing costs of procurement transactions, lower prices for inputs owing to increased competition, and improved inventory control. Keeping an electronic inventory and transferring information on replenishment needs over the Internet enables producers and retailers to reduce the time at each processing stage for components and raw materials.[4] (See Box 14.2 for an example in Argentina). Even relatively small reductions in inventory holding time in retail trade can mean substantial increases in profits, since the average cost to retailers of holding inventory for a year is at least 25 percent of the price, and margins may average only 3 to 4 percent (OECD, 1999). Improved inventory control also enables firms to become more integrated with suppliers, which saves time and allows for greater production specialization. Better integration regarding production has led to a boom in specialized manufacturing firms that produce components for better known companies.[5]

Procurement in Latin America is less efficient and more labor-intensive than in the developed countries, so the technical efficiency gains from transferring procurement systems to the Internet could be relatively large, although the region's lower labor costs could limit those economic gains. Also, the savings in working capital from reduced holding of inventories would be significant in Latin America, where the cost of capital is high and credit is often rationed or unavailable. However, the lack of reliable telecommunications networks may limit these gains.

There could be productivity gains from eliminating marketing and distribution intermediaries or improving their efficiency. By greatly expanding access to information, the Internet has eliminated retailers, wholesalers and even distributors in some sectors. More commonly, existing middlemen have been replaced by new approaches to intermediation made possible by the technology—for example, online auctions and aggregators. Eliminating or transforming middlemen functions could also enable developing country producers to access both domestic and foreign markets at lower cost.

The Internet also can generate significant cost savings in transport. As just one example, the advertising and trading of empty truck space over the Web is reduc-

[3] See Litan and Rivlin (2000).

[4] Goldman Sachs (2000) estimates that 30 percent or more of the total cost of intermediate goods typically comprises "process costs," or the costs of administering transactions and maintaining inventories.

[5] See World Bank (2000).

ing costs per ton in the U.S. trucking sector.[6] According to one estimate, total cost savings thanks to the Internet for the U.S. trucking industry could reach $15-$20 billion annually—4 to 5 percent of total industry output.[7]

The Internet also offers the potential for savings in retail transactions. OECD (1999) suggests that greater availability of information to the consumer, along with savings in providing services, could increase the productivity of sales staff in OECD countries by a factor of 10. However, the evidence on the sales of goods over the Internet so far does not show large savings. Some studies have found that goods sold on the Internet are priced the same or higher than in stores.[8] Others estimate that books and compact discs are 10 percent cheaper on the Internet.[9]

The potential savings in service transactions are more impressive. For example, the total cost (including investment) of bank transfers over the Internet is half that of existing automated systems and one-eighth that of transactions using tellers.[10] Note that one part of these savings reflects efficiency gains, while another reflects the transfer of costs from producers to consumers in the form of time spent searching the Internet. The impact of lower-cost service transactions is likely to be less significant in developing than developed countries because lower wages mean that firms have less incentive to undertake the fixed costs involved in setting up electronic systems. Also, poor distribution systems, inadequate protection against fraudulent credit card purchases, and limited Internet access combine to constrain the potential for this type of commerce in many developing countries.

Easier access to knowledge through the Internet will speed technology diffusion, which is critically important to developing countries because they tend to operate within the technological frontier. Electronic commerce can reduce the costs of communication between geographically distant partners and lower the search and compare costs involved in finding potential business partners and technologies. Also, the Internet provides a radial structure for interpersonal communication networks. Bulletin boards and news servers allow people to exchange information faster and within a wider environment than with networks based on telephone and fax.

Differences in communications and transportation infrastructure are significantly related to differences in the rate of product imitation encouraged by foreign direct investment (World Bank, 2000). Grossman and Helpman (1991) argue that international contacts enable a country to obtain foreign technologies and adapt them to domestic use, an important channel through which the productivity levels of developed countries are passed on to developing ones. Such international "networking" is greatly facilitated by the Internet. By opening markets to a wider range of potential buyers and sellers, the Internet is likely to foster a greater volume and variety of trade. On the other hand, the Internet could erode an important advantage now enjoyed by firms in developed countries; that is, proximity to wealthy customers.[11]

The Internet's impact on the access of Latin American firms to multinational supply chains is uncertain. More available information about developing country firms may improve their access to multinationals, which often have limited knowledge of potential suppliers. Goldman Sachs (2000) estimates that because of poor research, company purchasing managers tend to award 90 percent of their procurement contracts to about 20 percent of suppliers. On the other hand, suppliers with poor hardware, software and Internet transmission capabilities may be unable to compete with better-connected companies. There is some evidence that the new online auction systems have not resulted in the expansion of supply networks. General Electric, for example, has seen a reduction in the number of its suppliers since starting its online bidding site for procurement.[12]

As some have argued, Latin American firms may find it difficult to access online auctions because of a lack of credibility. Purchasers need to have confidence that suppliers will provide input on time and in accordance with specifications, and product quality may not be known ex ante. More than half of 35 large firms using online auction or exchange sites said that they would not do business through online Web sites with firms they did not know.[13] Interview results indicate that buyers—typically developed country firms—see the risk

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[6] See *The Economist* (2000).

[7] See *The Economist* (1999).

[8] See Goldman Sachs (2000), OECD (1999), and *The Economist* (1999).

[9] See Oliner and Sichel (2000).

[10] See UNCTAD (2000).

[11] See Harris (1998).

[12] See *The Economist* (2000).

[13] See World Bank (2000a).

Box 14.3 Patterns of Adopting New Technologies: Electricity vs. Information Products

In a widely cited study, David (1990) highlights the striking parallels of information technologies and previous technological breakthroughs. He mentions the steam engine and the combustion engine, but chooses to concentrate on how the dynamo—that is, direct electrical current—came to conquer U.S. industry around the beginning of the 20th century.

The process took almost half a century—longer than one might imagine. It took time to expand the capacity of the electric system and to tailor the technology to its potential applications in industry. And it took time for organizational systems of workplaces to adapt to the opportunities opened up by the new technology. In the case of the dynamo, that involved switching from huge steam engines to a series of smaller electrical machines, in the process making factories more flexible. Finally, the workforce needed time to come to grips with the new technology (learning by doing). In some cases, replacing cheap labor with electrically powered machinery did not produce immediate financial gains.

During the early days of electrification, the productivity gains form the electric dynamo were not particularly large, and in some cases productivity actually dropped. But once the adaptation process gained momentum and higher volumes of electrical power began to push down prices, there was explosive growth.

It should be mentioned that some analysts have pointed out differences between the respective processes of introducing electricity and information technologies. They note, in particular, the much quicker price drop in computer-related equipment, and the fact that, unlike information products, electricity managed to coexist with the technologies it replaced.

Sources: Triplett (1998), Eriksson and Adahl (2000), and Gordon (2000).

in purchasing from developing country firms as especially high. Over time, greater use may be made of certification agencies (e.g., the International Standards Organization and the International Electrotechnical Commission) to independently assess the quality of the products and services of new businesses. However, even in developed countries, relatively few small firms use the certification services these bodies provide. This is because of certification costs and concerns that certification may not fully address buyers' concerns in the markets where small firms compete.[14]

An Economy on Steroids?

The three key characteristics of information technologies are low reproduction costs, the high cost of switching and, in particular, network externalities. Taken together, these characteristics explain the S-pattern of diffusion of information technologies: slow at the beginning, then accelerating, and finally, slow again. These features are not unique to information technologies, as Box 14.3. explains in the case of the electric dynamo. Therefore, as Shapiro and Varian (1999) state, the "economy on steroids" in many fundamental respects is not a new economy.

Low reproduction costs. Information is costly to produce but cheap to reproduce. Books that cost hundreds of thousands of dollars to produce can be printed and bound for a dollar or two, and $100 million movies can be copied on videotape for a few cents. In economic terms, then, it can be said that producing information goods involves high fixed costs but low marginal costs; that is, the cost of producing the first copy may be substantial, but the cost of producing or reproducing additional copies is negligible. This cost structure leads to substantial economies of scale. The more someone produces information-related products, the lower the average cost of production. Moreover, the dominant component of the fixed costs is sunk costs, while the marginal costs of additional copies of the product do not tend to increase, as with other commodities.

High switching costs. Sometimes new technologies are linked with what are called "lock-in" effects. Once the new technology is chosen, the costs of switching become extremely difficult. In fact, lock-in effects are not absolute, since new technologies do displace old ones. But their existence can affect a firm's ability to compete, as well as its strategy and options. The extreme historical example of a lock-in problem is the layout of a computer keyboard, the so-called *QWERTY* arrangement. Why is this slower arrangement still in

[14] See World Bank (2000a).

use, even when others, such as the Dvorak system, appear to be more efficient?[15] The problem is that it is difficult for any one user to change from this system because the return to each person depends on what everybody else is doing. One simply cannot ask the question "*QWERTY* or Dvorak?" in a vacuum.

Network externalities. A third feature of many information-related products is that they tend to exhibit network externalities. Communications technologies such as telephones, electronic mail, Internet access, fax machines and modems are prime examples. Technologies subject to strong network effects have long lead times followed by explosive growth. This pattern is a result of positive feedback: as the installed base of users grows, more and more users find adoption worthwhile. The key challenge is to obtain a critical mass so that the market can build itself. The fax machine is an example. The basic technology was patented in 1843, and AT&T introduced it in the United States in 1925. However, faxes remained a niche product until the mid-1980s. During a five-year period, the demand for and supply of machines exploded. Before 1982, almost no one had a fax machine; after 1987, most businesses had one or more. The Internet shows the same pattern. The first e-mail message was sent in 1969, but up until the mid-1980s e-mail was used only by technical specialists. When Internet traffic did finally start growing, it did so in a big way, doubling every year from 1989 to 1995. After the Internet was privatized in April 1995, it started growing even faster.[16]

Largely as a result of network externalities, but reinforced by low reproduction costs and high switching costs, the use and impact of new technologies follows an S-shaped path. This kind of expansion resembles the way an infectious epidemic spreads among a population. In the first stage, there is a slow rate of contagion and a small, relatively stable number of infected individuals. Once a critical number of people are infected, the rate of subsequent infection accelerates rapidly. In the third stage, there are so many victims that the number of cases tends to stabilize. Similarly, new technologies require an incubation period before they can build a user base. There often is little growth or output for some time. The spark might involve any combination of factors, including additional training of the workforce, reorganization of the production process or company structure, or replacement of obsolete machinery. After this period, which can be very long, productivity and growth can skyrocket. Not only is the direct impact of the technology swift and widespread, but there are often indirect spillovers into other industries as well. In the final stage, the technology is exploited to capacity, so growth again slows.[17]

How Large Can Productivity Gains Be?

Economic growth has three basic sources. The first is increased labor input, which involves more hours worked, more workers, or better quality workers. The second is increased capital input, that is, more physical machinery. These first two sources both involve increased inputs of the two basic factors of production. The third source of growth comes from improving the efficiency in using these inputs. Economists refer to this as "total factor productivity" or TFP. Higher TFP growth is the holy grail of modern growth economics. Any economy can grow by increasing its labor inputs, but the labor has to be available. Similarly, any economy can grow by increasing its use of physical capital. But investing in capital carries a cost and requires people to cut back on current consumption. If an economy can achieve higher TFP growth, however, real incomes can increase over time without the necessity of increased use of such inputs.

Total factor productivity increases when existing capital and labor are combined to produce more output, that is, when productive efficiency increases. Factory redesign, organizational efficiency and better production methods all contribute to this. The use of the Internet (in addition to the purchase of the equipment, which enters as physical capital) is part of this, too. Thus, as much as information technologies might strengthen intellectual capacity, the ultimate test of their benefit is their potential impact on productivity, either by creating new products or by making existing ones more efficiently. After all, faster productivity growth is the key to higher living standards.

Recent developments in developed countries have fueled the conventional wisdom that information technologies do in fact affect productivity and thus, eco-

[15] See Shapiro and Varian (1999).

[16] However, having the superior technology does not guarantee success. Agreeing upon standards is also important. See Shapiro and Varian (1999).

[17] See Chong and Zanforlin (1999) and Coyle (1999).

nomic growth. This idea has been reinforced by the experience of the United States, which, at least until recently, enjoyed the most prolonged period of expansion in its history. Not only did productivity performance reach exceptionally high levels, but the rate of unemployment dropped below what was previously thought to be the natural rate of unemployment. All of this occurred amidst few signs of inflationary pressure.

However, skeptics point out that it is difficult to know the baseline or benchmark against which to measure the impact of information technologies. How can one be certain how productive firms would have been in the absence of information technologies? Triplett (1998) compares the intensity of investment in information technologies in various U.S. industries with their growth rates of total factor productivity, which measures the increase in the ratio of output to the sum of capital and labor inputs. They find essentially no correlation. Indeed, certain industries where information technologies were especially strong in relation to total output—such as education and banking—had either low or negative growth in total factor productivity. However, these researchers acknowledge possible measurement problems.[18]

Oliner and Sichel (2000) show that the contribution to productivity growth from the use of information technologies, including computer hardware and software and communications equipment, surged in the second half of the 1990s. In addition, technological advances in the production of computers appear to have contributed significantly to more rapid productivity growth. These researchers estimate that the use of information technologies and the production of computers account for about two-thirds of the one percentage point increase in productivity growth between the first and second halves of the last decade. In summary, they claim, information technology is the story behind those gains.

By using new data and a new methodology, Nordhaus (2001) estimates that productivity growth in the new economy sectors has made a significant contribution to economy-wide productivity growth. Labor productivity growth in recent years in the business sector excluding the new economy sectors was 2.2 percent annually, as compared to 3.2 percent including the new economy. Of the 1.8 percent point increase in productivity growth in recent years relative to the earlier period, 0.6 percentage points was due to the new economy sectors.[19]

While there has been a delay between investment in information technologies and productivity growth (the S-shaped curve), a latecomer enjoys the advantage of being able to simply emulate existing best practices or applications of technology, and thus reap the benefits over a shorter gestation period. In fact, it has been shown that spending on information technologies in developing economies has been growing more than twice as fast as in the developed ones over the past decade, though admittedly from a low base.[20]

Where Does Latin America Stand?

Latin America is a latecomer to the information technology revolution. Despite rapid growth in Internet access in the last few years, it is estimated that only 0.5 percent of Latin Americans had access to the Internet in 1999, compared with 30 percent of U.S. residents. Electronic commerce is also in its infancy in Latin America, representing $459 million of the region's GDP of $2 trillion in 1999.[21]

The number of Internet hosts and the use of personal computers are two effective indicators of how well new technology is being assimilated.[22] Both these indicators show an enormous gap between Latin America and the developed countries. Whereas the number of Internet hosts is 811 per 10,000 people for developed countries, the corresponding figure for Latin America is 23. Similarly, the number of personal computers per 1,000 people in developed countries is 353, compared to 44 in Latin America.

However, unlike what the conventional wisdom would lead us to believe, the numbers for the region are

[18] See Litan and Rivlin (2000).

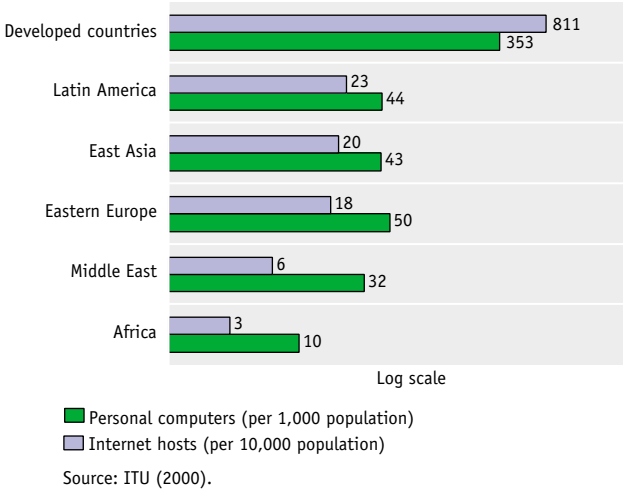
[19] A more skeptical view by Gordon (2000) argues that recent aggregate U.S. economic performance, though impressive, does not qualify as an industrial revolution. He posits that (i) investment in information technology involves redistribution of wealth rather than its creation; (ii) much of what Websites offer represents a reduction in the cost of providing an existing activity rather than the invention of a new one; (iii) the Internet has resulted in much duplication; and (iv) trading or purchasing from the office has detracted from productive work.

[20] See *The Economist* (2000) and Goldman Sachs (2000).

[21] See World Bank (2000a).

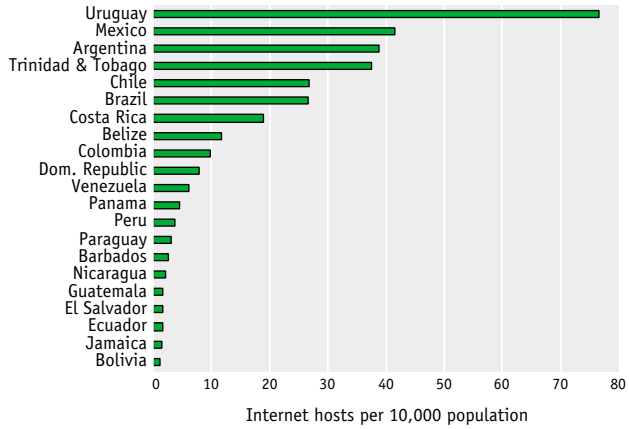
[22] Internet hosts are defined as any computer system with an Internet Protocol address connected to the network. The data do not provide a full count of users because surveys do not capture all computer systems connected to the Internet (e.g., computers behind firewalls) and thus provide an indicator of the minimum size of the Internet.

Figure 14.2 Internet Hosts and Personal Computers by Region, 1999



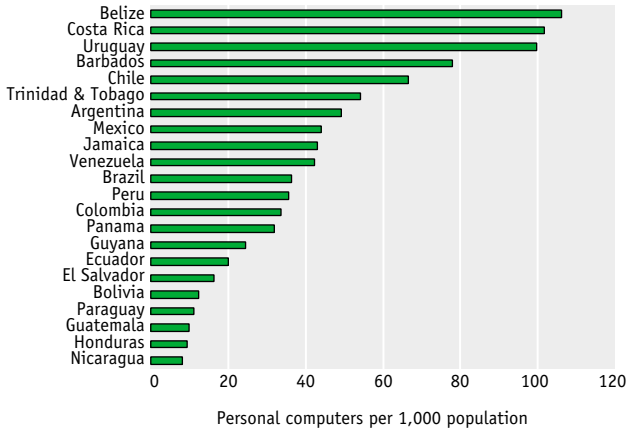
Source: ITU (2000).

Figure 14.3 Internet Hosts in Latin America, 1999



Source: ITU (2000).

Figure 14.4 Persons with Computers in Latin America, 1999



Source: ITU (2000).

in the same neighborhood as those for East Asia (20) and Eastern Europe (18) in terms of Internet hosts. Numbers of personal computers are also similar: 44 in Latin America, 43 in East Asia, and 50 in Eastern Europe (see Figure 14.2). The regions at the bottom are the Middle East (6) and Africa (3).

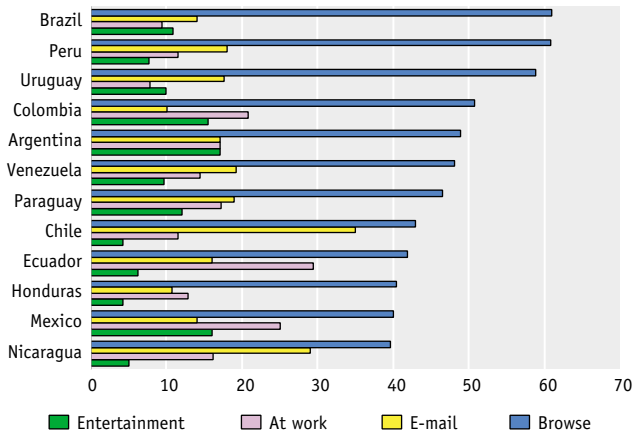
A closer look at the numbers shows that there is wide disparity among the Latin American countries themselves. Uruguay is currently the most wired economy of the region, with 77 Internet hosts per 10,000 people and 100 personal computers per 1,000. Next on the list are Argentina, Chile, Mexico and Trinidad and Tobago, where the average number of Internet hosts is roughly 34 per 10,000 and the average number of personal computers is around 54 per 1,000. Interestingly, Belize has the highest number of personal computers (106 per 1,000), but counts with only 12 Internet hosts per 10,000. At the other extreme, poor countries such as Honduras and Bolivia have at most one Internet host per 10,000 and around 11 personal computers per 1,000 (see Figures 14.3 and 14.4).

The most common use of the Internet in Latin American countries is browsing for information. More than 50 percent of people surveyed by Latinobarómetro in Brazil, Peru, Uruguay and Colombia who have Internet access surf the web primarily for information, and around 15 percent use it for sending e-mails. In Ecuador and Mexico, people browse the Internet mostly as part of their office tasks (see Figure 14.5). The Internet has also changed the time people spend at their job, watching television or reading a newspaper. In fact, more than 15 percent of those surveyed in Mexico, Chile, Brazil, Paraguay, Argentina, Venezuela and Honduras report changes in the time they spend at their office because they now have access to the Internet. And in Uruguay and Peru, around 15 percent of people say they have changed the time they spend watching television because they now have the alternative of browsing the Web (see Figure 14.6).

Given the low penetration in the region of new in-

Figure 14.5 Most Common Uses of the Internet

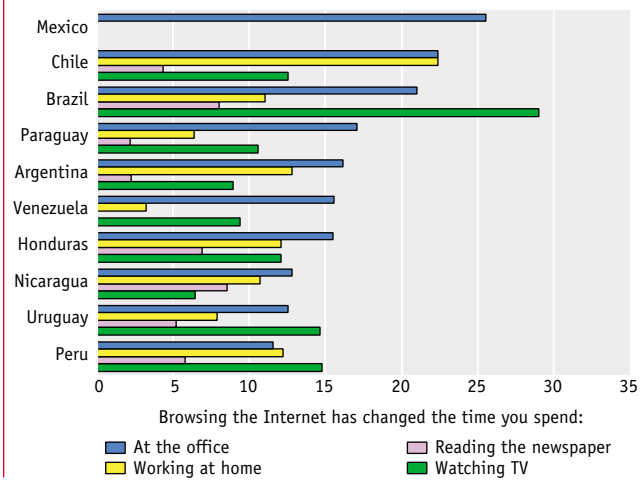
(In percent)



Source: Latinobarómetro (2001).

Figure 14.6 Changes in Other Activities Due to Browsing the Internet

(Percent of respondents)



Source: Latinobarómetro (2001).

formation technologies, their benefits to Latin America may well lie ahead.[23] Since the effect on productivity is potentially large—as the experience of the United States shows—promoting the use of computers and the Internet in Latin America would appear to be a simple and effective way of fostering growth in the region. Unfortunately, this would be a flawed conclusion. The ability of countries to productively assimilate the new technologies depends not just on the availability of computers or the number of Internet hosts, but on the presence of an environment conducive to innovation. The Holy Grail of productivity may not be in computers, but in some more fundamental factors that make computers such an attractive tool.

[23] In contrast, some have argued that most of the benefits of the Internet in the United States have already happened (see Gordon, 2000).