THE INFORMATION REVOLUTION AND GLOBALIZATION:

SEIZING NEW OPPORTUNITIES FOR YOUTH EMPLOYMENT

NUIMUDDIN CHOWDHURY

A CENTURY FOUNDATION REPORT

THE CENTURY FOUNDATION

HEADQUARTERS: 41 East 70th Street, New York, New York 10021 • 212–535–4441
D.C.: 1775 Massachusetts Ave., N.W., Suite 400, Washington, D.C. 20036 • 202–387–0400
Visit our websites at www.tcf.org

About The Century Foundation

The Century Foundation sponsors and supervises timely analyses of economic policy, foreign affairs, and domestic political issues. Not-for-profit and nonpartisan, it was founded in 1919 and endowed by Edward A. Filene.

About the Author

Nuimuddin Chowdhury received his undergraduate training in Pakistan and his Ph.D. in economics from Cambridge University. He has worked at the Bangladesh Institute for Development Studies, the International Food Policy Research Institute, the World Bank, and on many consulting assignments for international organizations. He is currently managing director of Grameen Star Education Limited in Dhaka, working closely with Professor Muhammad Yunus, the founder of Grameen Bank, in creating affordable opportunities for information technology training.

CONTENTS

LIST OF TABLES

PREFACE

The Century Foundation is pleased to have sponsored this background paper by Dr. Nuimuddin Chowdhury on new employment opportunities created by information technology as its contribution to the Youth Employment Summit being held in Alexandria, Egypt (September 7–11, 2002).

Over the next century, as the industrialized countries become more and more preoccupied with the problems of aging populations, the developing world will continue to feel the strains of rapid population growth. The great challenges this creates—for education, training, and creation of productive livelihoods for the young—require a global response. As developments in the North suggest, "industrialization" inadequately describes the transformation of the economy with economic development. Increasingly, services, and among these, IT-intermediated services, are dominating the globalization of productive activities, in a manner nobody dreamed would be possible even a few years ago.

We believe that the vision of the Youth Employment Summit will benefit from the information Dr. Chowdhury presents and analyses in his paper about the rapid growth of these emerging employment opportunities.

—Bernard Wasow, Senior Fellow
The Century Foundation
June 2002

ACKNOWLEDGMENTS

I want to thank Bernard Wasow of The Century Foundation for many hours of discussions and for extensive comments on earlier drafts, and to thank The Century Foundation for its support. All errors in this draft are mine alone.

EXECUTIVE SUMMARY

In spite of the collapse of the "dot com bubble," information and communications technology (IT), especially the Internet, continues to bring rapid change to the organization of both work and the workplace throughout the world. Change is fastest in the industrialized countries, but developing countries are struggling to catch up. This paper is about how to harness IT to foster youth employment or livelihood opportunities in developing countries.

IT is changing economic organization profoundly. It is leading to:

- a drastic decline in the cost, scope, and convenience of processing and exchanging information within a firm, even over large distances;
- a collapse in the cost of conducting commerce at great distances;
- increasing pressure on firms to establish global brands and marketing strategies;
- increasingly intense competition, often taking the form of direct foreign investment;
- rapid growth in the importance of international capital flows relative to the world's gross domestic product;
- the increasing importance of up-to-date knowledge for workers in the newly emerging international division of labor in services and, hence, an increasing role for young people in these sectors.

DIFFUSION OF INFORMATION TECHNOLOGIES:
A HUB AND SPOKES MODEL

Throughout all these changes, the U.S. economy has performed the role of the "hub," generating innovations that are picked up through the "spokes" in the rapidly developing countries in Asia. Technological know-how, venture capital, market contacts, American managerial methods, and capital market institutions (such as stock options) all have been transmitted down the spokes from the hub. Information technology has accelerated the growth of foreign investment and international movement of goods, capital, and knowledge, the hallmarks of globalization. Marking this spread of technology and trade, three-quarters of all imports by the U.S. computer and telecommunications industries between 1992 and 1999 were from Asia.

In the United States, computerization in business absorbed between 40 and 50 percent of all business investment in 1999, rising from a tenth in early 1990s. A cluster of innovations, virtually all led by American research labs, stimulated this investment. These innovations included powerful microprocessors for desktop computers, the adoption of the windows graphical user interface, computer networking protocol (mainly transmission control protocol/Internet protocol), local area networking, wide area networking, smart networks and browsers, the World Wide Web and the Internet, and object-oriented programming. If any star in this galaxy of technological breakthroughs outshines the rest, it is the Internet. Software expertise has become central to mastering these marvelous new tools of informational hardware and software. At the end of the twentieth century, the U.S. market for IT products was the largest in the world at about $500 billion, roughly 5 percent of a $10 trillion economy.

INFORMATION TECHNOLOGY AND THE STRUCTURE OF EMPLOYMENT IN THE UNITED STATES

New information technologies have especially affected the service sector, where most workers in developed countries are employed. Here, they have tended to replace people with computers in tasks requiring low orders of cognitive skills. For example, in the 1980s (between 1982 and 1989) U.S. banks and insurance companies increased the ratio of IT spending to revenue from 3 percent to about 18 percent. Computerization was accompanied by an increase in the proportion of professional service positions from 10 percent in 1975 to 18 percent in 1995. As IT penetrated the economy, the composition of the workforce changed.

Modern economies generate a tremendous amount of information to process, store, and move, and many new jobs involve the care and feeding of databases. Transcriptionists have to computerize medical records. Court reporters have to enter verbatim reports. Many financial documents need to be imaged and then stored digitally. All of these positions are vulnerable as computer decisionmaking is substituted for human labor, but jobs for the semiskilled in IT have nevertheless been growing. It is this sort of job that might be especially suited to masses of educated but underemployed young people in developing countries.

The most populous categories of low-skill, white-collar "data" workers in the U.S. economy include, in decreasing order, call center workers, data entry key operators ("keyers"), medical transcriptionists, pre-press workers, and legal transcriptionists. Industry sources estimate that there are between 3 and 4 million call center workers in the United States. That is slightly more than 3 per cent of the economy's nonfarm workforce. Close to a million workers are employed as data key operators. A typical call center worker in the United States earns three-quarters as much as the median production worker; a typical data keyer, about 78 percent; a medical transcriptionist, about 80 percent. The massive investment in computer-related capital in the U.S. economy also has generated rapid growth in job descriptions such as computer engineer, network technician, and professional computer specialist.

TECHNOLOGICAL CHANGE, SEARCH for CORE COMPETENCY, AND DISCOVERY OF OUTSOURCING

As information technology has spread, firms increasingly are outsourcing certain information management activities, focusing instead on their core competencies. A logical progression has led to "offshore outsourcing" to regions and countries with productive workers but low wages. A pivotal case of such outsourcing occurred a few years ago, when India's strength in software production became evident as its technicians grappled with the "year 2000" (Y2K) problem of computers unprepared for the new century. At the same time as sophisticated programming assignments migrated to India and other low-wage countries, semiskilled jobs in call centers and the like had begun to move as well. The world is on the cusp of the next frontier for globalization, this time in services, especially in software and clerical services.

The educational and skill barriers posed by the high-level (software) jobs are much harder for developing countries to negotiate. Such jobs would only be accessible to highly trained youth. The prospects for massive job creation in developing countries are better in the mainly clerical jobs that information technology has spawned. These are the jobs in call centers, transcription, "back-office work," forms processing, typesetting, document processing and editing. All can be globalized through the medium of the Internet and all present lower educational and training hurdles than hardware and software engineering.

A PASSAGE TO INDIA

These developments have already thrust into prominence a small number of developing countries that have the right blend of information infrastructure, trained people, entrepreneurial culture, capital market institutions, public policy, and bureaucratic competence. In Asia, India and the Philippines are attractive destinations for direct foreign investment by information technology companies. McKinsey & Co. estimated , optimistically, that India will generate more than $17 billion in annual revenue from IT-enabled services by 2008, up from $250 million in 1997.

While a whole variety of IT-generated jobs have been migrating to India during the past few years, offshore outsourcing in medical transcription and more recently call centers led the way, largely owing to the attractive price of Indian labor. Call centers especially are famously footloose, within the limits of the availability of workers with language and cultural skills. In India, call center weekly wages, at $16–20, are less than 10 percent of Ireland's, at $357. High-profile "passages to India" for labor have been conducted by British Airlines and General Electric, while domestic Indian companies have gotten in on the game as well: the Tata family empire, Hero Honda, and Reliance. Other large Indian firms are following suit. India is trying to become Asia's equivalent of the polyglot Netherlands in the call center arena.

Hundreds of medical transcription units have been set up in the past two years in India, with capital costs per job created ranging between $400 and $750. Demand for "bandwidth," shorthand for data-carrying capacity, has risen very rapidly. As a result, Indian and multinational companies have started a race to add to fiber-optic carrying capacity: between 2000 and 2003, as much as 120,000 kilometers of fiber-optic cables will be laid, compared with zero between the 1995 and 1999.

The information revolution has started in earnest in India, and other developing countries are trying to catch up. The question arises: what kind of policies will further the IT revolution in the interest of creating livelihoods for the young people of the developing world?

POLICIES FOR YOUTH LIVELIHOOD:
OPPORTUNITIES IN THE DEVELOPING WORLD IN THE INFORMATION AGE

The single greatest policy priority of developing countries eager to participate in the IT revolution must be to enhance the quality of their workforce and their physical and data infrastructure. Countries as diverse as India and Israel, China and Costa Rica, have successfully attracted much-sought-after Fortune 100 companies for high-tech production facilities because they have delivered on these prerequisites. Among physical capacity constraints, most developing countries face chronic shortages of basic telecommunications services, so there is a need for them to induce investment in these. Pricing, too, can be rationalized—for example, through peak-load surcharges—to help alleviate shortages. More specialized information infrastructure, such as fiber optics or satellite transponder capacity, should be provided as a matter of some priority. With proper legal and regulatory institutions in place, the private sector can be expected to respond, creating many competing Internet gateways and Internet service providers.

Policies toward foreign direct investment are critically important as well. Multinational corporations can bring to a country the research-and-development-intensive manufacturing and services activities that have been growing much faster than total world output. Multinationals control market shares, profits to plow back into investment, and key technologies. Companies are footloose, and competition for their attention is intense. Quality of the workforce, infrastructure—especially telecoms and information infrastructure—and an efficient legal system that ensures contractual integrity are critical draws for foreign direct investment.

Countries will have to choose consciously between economic nationalism and the gains from a trade-oriented global outlook. History suggests that the latter delivers more rapid economic development. To promote innovation and entrepreneurship a country needs policies to create and then maintain a competitive and transparent capital market that is resistant to speculative bubbles. This is no simple task since it can imply computerized asset, as is increasingly practiced in China, India, Singapore, and Malaysia.

SPECIFIC POLICIES TARGETING INFORMATION AND COMMUNICATIONS TECHNOLOGY

Because information technology skills are prerequisites for many good jobs or livelihood opportunities, policy must help promote effective public and private occupational training. The acquisition of computer literacy—that essential first step toward the harvesting of IT opportunities—is becoming akin to one's right to basic literacy. The governments of the world's richest countries have recently proclaimed that the right to the alleviation of "digital poverty" is every bit as worthy of protection as protection from economic poverty.

Since information has so many characteristics of a public good, markets simply will not do a decent job of generating and sharing information broadly. New policies will be needed: (a) to improve accessibility of information through the Internet, especially news about job opportunities; (b) to increase the availability of computer training programs at schools and colleges and over the Internet itself; (c) to foster competition in the markets for

Internet, satellite, and wireless access and Internet gateway businesses; (d) to make fiber optic enhancements to the Internet backbone; (e) to provide educational and training loans so that young people can develop IT skills.

Education and training are the policy arenas that hold promise of the greatest prospective payoff in terms of youth employment. Web-based, compact modules of information and communications technology training should be prepared in every country, to spread computer literacy through distance learning. Computers must be made widely available even in poor communities in order for distance learning to be fairly disseminated.

The United Nations Development Program has mounted an interesting program to teach IT skills in Malaysia. Buses have been fitted out as fully fledged IT laboratories. Even wireless Internet connections are available on these “cyber-buses.” Poor localities have been selected, and children from poor families have been singled out for training. Once every week, children take a stab at building a web page or undertake another project on the bus. This project may deserve replication elsewhere in the developing world.

1. INTRODUCTION

The technological developments of recent years have been dazzling, producing perhaps the most concentrated cluster of innovations ever in information technology,[1] communications,[2] and transactions processing. The IT revolution grew out of five major classes of discoveries: the design of ever faster and cheaper microprocessors; the arrival of the Internet and the browser; dramatic improvement in satellite and fiber optic communications technologies; rapid advances of wireless technologies; and the development of "object-oriented" software. Three essential characteristics of these technologies are that

1. information and communications technologies, by decoupling information from a physical repository, have declared the death of distance;[3]
2. they have ushered in a period of significant change in production technology and distribution, especially of services;
3. they have unleashed forces of corporate competition and consolidation globally, including cross-border mergers and acquisitions.[4]

This paper is about the implications for youth employment, especially in developing countries, of this "information revolution." It also is about the expansion of networks of multinational corporations and of entrepreneurs, in the United States and abroad, that have acted to take advantage of emerging opportunities in IT.

Before proceeding any further, consider the big picture. Recent improvements in information and communications technologies have elevated IT to prominence in corporate strategy as firms seek competitive advantage. These changes have had the apparent effect of compressing not only time but also space as the speed of information transmission has accelerated and the cost collapsed. Services, which are employing more and more of the labor force,[5] have been introducing computer technologies even faster and earlier than manufacturing industries,[6] though this has yielded decelerating total factor productivity growth.[7] The shrinkage of the cost of communications and remote transactions among businesses separated by vast distances has spurred globalization and "outsourcing," in services as well as manufacturing.[8] Globalization of service production is likely to create immense opportunities for young people in cheap-labor countries, but it is reliant on enabling policies and incentives from the governments in those countries.

This paper presents evidence that there is something even for small firms and poor countries in the information revolution, provided the policy environment is supportive and the culture produces entrepreneurs. This relatively optimistic assessment also applies to the problem of generating working opportunities for young people in the developing countries.

2. The Problem of Youth Unemployment

Before we consider in more depth how information and communication technologies hold promise for youth employment globally, it is important to know is meant by "youth employment." Four distinct indexes can be used to assess youth employment and unemployment within the larger labor market picture. Each represents a different aspect of the problem:

- the youth unemployment rate (youth unemployment as a percentage of the youth labor force);
- the ratio of the youth unemployment rate to the adult unemployment rate;
- youth unemployment as a proportion of total unemployment; and
- youth unemployment as a proportion of the youth population.

Definitions and Sources

Young people in labor market analysis typically are defined as persons aged between fifteen and twenty-four. (Adults are aged twenty-five and above.) However, countries vary in their operational definitions. In particular, the lower age limit for young people is usually determined by the minimum age for leaving school, where this exists. Differences in operational definitions make cross-comparisons tricky. The Thirteenth International Conference of Labor Statisticians (ICLS) resolves some of these issues with its definitions of the economically active population, employment, unemployment, and underemployment. The ICLS defines the unemployed as comprising all persons above a specified age who, during the reference period, were without work, currently available for work, and actively seeking work. The unemployment rate is defined as the number of unemployed in an age group divided by the size of the labor force for that group. The labor force is the sum of the unemployed plus the employed; those outside the labor force are not included, although they affect unemployment as a share of the population.

Data for unemployment are obtained from one of four sources: household surveys of the labor force (the most common source), employment administrative records, population censuses and "official estimates."

One striking characteristic emerging from the data for developed countries, where the relevant data exist, is that, with the exception of Germany, Austria, and Switzerland in Europe, youth unemployment rates are higher than adult unemployment rates. Indeed, youth unemployment rates are typically at least twice as high as adult rates and are sometimes much higher. Germany operates a dual apprenticeship system offering a protected entry point into employment, and the ratio of youth to adult rates is typically right at 1.0. Ratios are also relatively low (though above 1.0) in Austria and Switzerland, as both countries have systems similar to Germany's. In France, since 1983,
the rate of unemployment among young people has rarely fallen below the 20 percent mark; at the end of 1996, the figure was 26 percent.[9] The French experience, however, is by no means unique in Europe: in Italy in 1996 one young person out of three was unemployed and in Spain, two out of five.

There is an observable trend over time in most developed countries for both the youth labor force and the number of unemployed youth to be declining. Also, the number of young people who are unemployed has gradually fallen as a percentage of the total number of the unemployed. This is particularly evident in countries for which data are available at least as far back as 1980. There has been a tendency for young people's participation in full-time education in developed countries to increase over time, which, in turn, can be explained by the marked rises in returns to higher education since about 1979. This represents the silver lining in what is a dark political cloud for most governments.

Developing countries do not have the requisite data to measure the scale of youth unemployment quantitatively because employment surveys are minimal or nonexistent. We know, however, that these countries have had bulging increases in the relative size of their youth cohorts, a consequence of rapid population growth in the second half of the twentieth century. There are a billion people between fifteen and twenty-four years old in the world today, with 90 percent of them in developing countries. As many as half of the latter live in just two large countries, China and India. In India, about a half of young people lack full-time work. Young men and women are often marginalized in societies, resulting in limited access to resources like kinship networks, education, land, technology, and chances to interact with formal institutions. Young women are particularly vulnerable because of their cultural and social isolation and lack of skills and knowledge. A large proportion of families are priced out of postsecondary and even secondary education for their children, even though tuition is highly subsidized. Every year, millions of young people drift into the "informal sector"—the ubiquitous underclass characteristic of the "shoeshine boys."[10] Since work experience is cumulative and career ladders critical, early participation is vital for economic advancement. Youth unemployment is a difficult problem for virtually all developing countries.

3. The Information and Communications Technology Revolution: An Overview

Having sketched the highlights of the technical changes that led to the information technology revolution, it is now time to consider them in greater detail. The story begins around 1970. The technologies that are developed in the advanced economies, notably the United States, spread rapidly throughout the world, changing patterns of production and communication everywhere. Change in the developing world, from the spread of cellular telephones and personal computers to the growth of call centers and Internet commerce, is closely tied to change in the industrialized world, though with some lag. Developments in the United States directly affect, and in some ways preview, change in the developing world.

The microprocessor was invented at the Intel Corporation in Silicon Valley in 1971. Its development since then has been astonishing. Between 1987 and 2000, for example, it has been estimated that the number of transistors needed to execute 20 million transactions per second (MPS) declined by a factor of some five thousand, and current estimates have it that, between 2000 and 2007, the same number will decline by another five thousand times. Because microprocessors are the heart of computers, the price of computers has fallen more than a factor of fifty in twenty-five years, while the price of semiconductors has fallen even faster.

In 1975, microprocessors were first packaged into a personal computer, according to a Silicon Valley legend, in a garage by Steve Jobs and Steve Wozniak. The U.S. Department of Commerce's Bureau of Economic Analysis reports that real investments in computers grew by 33.7 percent per year between 1967 and 1997. Dale Jorgenson and Kevin Stiroh argue that computers' contribution to economic growth comes mainly from the massive substitution effects of integrating computers into the workplace made possible by their steep cost decline (at an annual rate of 16 percent).[11] While the effects of substitution are undoubtedly large, some economists believe that other forces hold sway. Elhanan Helpman suggests that the computer engineering is one of the general-purpose technologies, like electricity and the internal combustion engine, that can be characterized as a "drastic innovation" and as having "a potential for pervasive use in a wide range of sectors."[12] The pervasive use of a general-purpose technology in other sectors can stimulate "innovational complementarities."[13]

The rapid and sustained price decline in computing is substantially greater than that experienced by any other general-purpose technologies.[14] These combined economic forces of substitution and complementary innovation appear to have been associated with higher output and productivity growth by adopting firms,[15] a development that may have been foreseen by the stock market as early as 1973.[16]

The last four decades of the twentieth century produced startling innovations. At the end of the 1950s, when computers had largely replaced electromechanical calculators, the roughly two thousand installed computers in the world could process perhaps ten thousand instructions per second. Today, there are approximately 200 million active computers in the world with processing power that averages approximately 100 million instructions per second. This is a billion-fold increase in forty years, a 68 percent per year increase in information processing power. Earlier waves of technological change proceeded far more slowly. Consider, for example, the replacement of the steam engine by the electric motor. In 1869 steam engines delivered 1.2 million horsepower to America's manufacturing firms. By 1939 electric motors supplied 45 million horsepower for the country's factories. This represents roughly a forty-fold increase in mechanical power in seventy years, or 5 percent per year.

The spread of computers was caused not only by their number-crunching capacities and the growing affordability of the hardware but by the process that made computers "user friendly." A key innovation was the adoption of the graphical user interface. For the vast majority of new users (the blind excepted) the graphical user interface is much simpler than anything before it. Sight is very efficient: it can take in a lot of information at once, allowing the viewer to focus on what is important and to filter out what is not.

With large-scale adoption of personal computers by businesses, demand arose for a way to enable geographically scattered machines to communicate with each other and exchange information. Around 1988, the public Internet emerged as a network, pioneered by

U.S. Defense Department and academicians and funded by the National Science Foundation. The Internet would enable computers to communicate using the Transmission Control Protocol/Internet Protocol.[17] A major push for use of the Internet came initially from resource-sharing applications, such as file transfer and remote log-in. Subsequently, electronic mail, which provided a revolutionary new mode of communication, has probably had the most significant impact of the innovations dating from the period of the Internet's popularization.

The next major departure in information technology, around 1991, was the development of computer networks. The first local area network (LAN) was established to connect personal computers at MIT to a central, more powerful server computer. Local area networks enabled users to share indivisible infrastructure, hardware, and software, thus streamlining management of technology resources.[18] Wide area networks (WANs), using routers and bridges, were a powerful extension of this idea into much larger geographical domains, permitting even greater sharing of resources that were in (relatively) fixed supply.

Wide area networks coupled with the Internet first signaled the "death of distance." The spread of LAN and WAN technologies may well have had a broad labor market impact, as Timothy Bresnahan suggests.[19] These technologies permitted offices to be run more centrally, with monitoring and cost control partially automated. Office workers, spread among many locations, could share software, data, and peripheral equipment at relatively low cost.[20] In many companies, distributed (decentralized) computer systems and client/server networks have replaced mainframe and minicomputer systems.

The debut of the World Wide Web, in 1993, was the perhaps the most significant milestone in the evolution of the Internet. The development of the first web browser by Mark Andreessen, then a Ph.D. student at University of Illinois, and the almost simultaneous formulation of Transmission Control Protocol/Internet Protocol revolutionized computing. In 1989, Sun Microsystems chief executive officer Scott McNealy had said, "The network is the computer." By giving a new meaning to that aphorism, the browser ensured that computing would from then on indeed be networked, not just locally but globally. In four short years, Internet penetration reached the 50 million household mark, an unprecedented feat in telecommunications.[21] Internet-based commerce has grown apace, driven by rapidly changing economics: the cost of sending one megabyte of digital data per second over a given distance has fallen by a factor of 100 over the past twenty years, with much of the impact of that decline concentrated in the five most recent years.[22]

Following the introduction of networked computing, the next technical advance was "object oriented programming." "Objects" are modules of programming code that can be combined into new programs. No matter where in the world each "object" may be stored, when time comes for programmers to use it, they can put it into their program with a single instruction, as if it were in their own computer's memory.

EVOLUTION OF SATELLITE SERVICES

As computer capacity was developed and made more user friendly, other technologies were being developed that also have been essential to IT. Satellite communications are another breakthrough that diffused rapidly during the 1990s. Here again, American leadership was vital. Cellular telephone and Internet services, in particular, stimulated the demand for new multisatellite constellations.

Between 1990 and 1999, the number of communications satellites grew at a rate of 29 percent per year globally. Because the capacity per satellite, measured in number of transponders, also increased steadily during this period, the true rate of growth was even faster than a tally of satellites would indicate. This technology has tremendously facilitated globalization of production in the service sector.

Satellite technology's accessibility in remote areas, its insensitivity to distance and rapid deployment capability, and its falling costs have encouraged use for specialized applications. One of these, very small aperture terminals, have been used heavily in the retail and financial services industries for relay of point-of-sale credit authorization and inventory control data among multiple remote locations. When companies were grappling with the "year 2000" (Y2K) problem, secure communications links enabled work to be performed on Western computer systems by programmers in India, halfway around the planet. This debugging work created an unprecedented demand for satellite hookups. The number of very small aperture terminals globally rose from 103,000 in 1993 to about 900,000 in 1999—a growth rate of 44 percent annually. By January 2001, all but three countries had installed at least one very small aperture terminal network.[23] In India, the number of very small aperture terminals grew at about the same high rate (about 30 percent annually) during the period 1995–99 as the number of Internet connections.

The satellite industry's growth rate greatly exceeds that for the telecommunications industry as a whole, not to mention the general economy. This is a variation on the theme that economic growth in the 1990s generated a remarkably strong demand for communications services that can efficiently defy distance.[24]

4. Information and Communications Technology and U.S. Industries

The revolution in information technology has affected not only the computers and peripherals industry, software engineering, and telecommunications but has profoundly changed production and inventory practice in all manner of manufacturers and service providers, high-tech or no. Naturally enough, such departures are likely to lead to changes in employment practice, even in an old, low-tech industry. The industries that are the most important users of IT include financial services, retailing, and manufacturing. It is these industries that have seen their employment levels and skill mix affected in a most pronounced manner by new technologies. This chapter will first look at recent changes within U.S. industries that rely especially heavily on IT and then look at how IT is changing other industries as well.

Table 1 shows gross output of the United States by industry. Tables 2 and 3 display revenue and employment data for a number of telecom-information-media industries for 1995 and 1998. Before proceeding further, a couple of caveats are in order. First, the data are from the Federal Communications Commission. Revenue data are based on shipments or contracts finalized. Second, it is not easy to compare how revenues size up in a national context. Table 1 is useful here, especially the category “electronic and electrical equipment,” which includes semiconductors and computer hardware, and industries such as “telephone and telegraph” and “radio and television.” Third, while the FCC data treat software separately, national accounts data treat software production as a part of business services. The data thus do not dovetail in a manner that would permit assessment of the quantitative importance of these enterprises in the national economy. However, it is a safe generalization that, for all the rapid growth in revenue and employment in IT between 1995 and 1998, it still represents a relatively small component of national economic activity.

The following conclusions can be drawn from the revenue numbers of Table 2. (Revenues are in billions of current dollars, and growth rates are annually compounded.)

- The relatively small electronic mass media sector, which accounted in 1998 for only 16 percent of the total of the three industry groupings tabulated, returned the highest growth rate during the period, 12.7 percent.
- Information products and services returned the second-highest overall growth rate, 12.1 percent. Among these industries, professional computer services (that is, system integration, design of e-commerce and call center systems, network management, etc.) returned the highest growth rate of any industry in the table, 15.6 percent.
- Telecommunications grew the least, at 7.2 percent overall, even though new telecommunications technologies—wireless and fiber optics—each grew at about 15 percent.

The most vigorous growth performance came in the information infrastructure and amorphous services sector, which grew from 28 percent of the overall total in 1995 to about 46 percent in 1998.

In 2000, it was estimated that more than 13 million Americans held IT-related jobs, and the rate of growth was six times overall job growth.[25] In this context, Table 3, which displays the corresponding employment figures by industry, presents significant contrasts with Table 2. The information grouping returned the highest job growth rate of any in the table, 11.3 percent. Buoyant job growth is found in three of the subgroup industries, namely, professional computer services, electronic information services, and software (16.6, 17.5, and 14.1 percent respectively). Both of the other two industrial groupings (telecommunications and mass media) had much lower expansion rates, 3.9 and 3.2 percent, although job growth here, too, significantly exceeded the rate for the economy as a whole.

A comparison between Tables 2 and 3 prompts one further observation. Three of the individual segments showed job growth rates that are substantially higher than their corresponding dollar growth rates. These are professional computer services, electronic information services, and software. This may reflect investor overconfidence in the era of the dot-com bubble, when many firms were producing more jobs than revenue.

IT DIFFUSION, REORGANIZATION OF BUSINESS PROCESSES, AND MANAGERIAL RESPONSES

It has long been recognized that technological change often leads to organizational change. The classic example is how the introduction of electric motors led to alterations of the factory layout. While early applications of computers were primarily directed at labor substitution (particularly of low-skill clerical workers), modern uses of computers and flexible manufacturing technologies have both enabled and necessitated substantial organizational redesign,[26] including changes in the skill mix of employees.[27] Investment in computers and reorganization complement each other, with new information technology leading to greater demand for skilled workers, geographical dispersal of decisionmaking, and team-oriented production. Case studies suggest that these complementary investments are large.[28] Following big investments in "intangible assets"—skills, organizational structure, information, suppliers' networks—pressure builds within the enterprise to reduce costs. Such cost-cutting efforts naturally seek to use the new technologies in new ways. The result is an expansion of outsourcing, some of it to faraway companies, enabled by IT.

THE STATE OF INFORMATION TECHNOLOGY PENETRATION IN U.S. INDUSTRIES

Which U.S. industries had the fastest growth of IT spending, and how has this investment affected offshore outsourcing? In the manufacturing sector, four high-technology industries recorded higher than average growth since the 1980s, namely, aerospace, computers and office equipment, electronics and communications, and pharmaceuticals.[29] Spending on applied science and information technologies has driven this rapid growth. Boeing Corporation provides an example of a complex high-technology production process that integrates electronics, mechanics, chemicals, and metallurgy. In such an environment, computer-aided design/manufacture (CAD/CAM) tools used in simulations, modeling, and engineering are essential. Boeing also has used IT in a more limited support role, for instance, in enterprise communications. In that area, IT has helped make outsourcing and globalization of the supply chain possible.

In addition to applications of IT in manufacturing, five service industries are "knowledge-intensive" and data-intensive": business services, financial services, communications services, health services, and educational services. While employment in these and other service industries has been growing faster than manufacturing in all developed countries, there is reason to believe that IT investment actually spurs the pace of relative growth of service industries. Globally, services grew in 1992 prices from $3.4 trillion in 1980 to $7.4 trillion in 1997.[30] The United States was the leading national provider of high-technology services, accounting for about 27 percent of global revenues during the 1990–97 period.

Business services, which include computer and data processing services and research and engineering services, along with advertising and other pursuits, is the largest subsector and accounted for nearly 38 percent of total service revenues in 1997. The U.S. business service industry is the largest in the world with 34 percent of global industry revenues in 1997. Unfortunately, data on individual business services by country are not available.

Services provided by financial institutions represent the second-largest of the five service industries examined, accounting for nearly 25 percent of revenues in 1997. Again, the U.S. financial services industry is the largest with 30 percent of world revenues in 1997.

Communications services, which include telecommunications and broadcast services, constitute the third-largest subsector, with 10.9 percent of total service sector revenues in 1997. In what many consider the most technology-driving of the service industries, the U.S. industry unsurprisingly has the dominant position. In 1997, American communications firms generated 35 percent of world revenues.

According to Paul Strassman, spending by U.S. businesses on IT hardware/software around 1996 was in the range of $470 billion to $500 billion.[31] This country has led the world in information technology spending as a proportion of business investment. The share of IT in total investment has increased from 10 percent in 1990 to 50 percent in 1999.[32] One expert at MIT estimates that firms and organizations accounting for as much as 60 percent of U.S. GNP (including various levels of government) intensively use information as a production input.[33] The pressures to reduce the cost of information processing and transmittal are felt at their keenest in the U.S. economy.

Financial institutions and the insurance industry are the single largest investor in informational technologies: they account for more than one-third of all IT spending.[34] Handling of information is essential to banking. Banks have to operate in a transparent regulatory environment with tight conduct guidelines and deadlines to match, which requires them to provide a great deal of information to their owners and clients as well as to regulators. They must coordinate wealth transfers with hundreds of other financial intermediaries and must process and archive trillions of bits of information a day, all so that these are available for easy and open retrieval. On top of this, their geographically scattered branch network implies that communication technologies will remain central to the achievement of cost efficiency.

According to U.S. Department of Commerce statistics, fully 82 percent of the nation's total stock of information technology is installed in service establishments: retailers, wholesalers, telecommunications, transportation, financial services, and a wide array of others. Not by coincidence, around 85 percent of the U.S. white-collar workforce is employed in services. Thus, the U.S. productivity debate is all about the synergy, or lack thereof, between information technology and white-collar workers.[35]

Several important U.S. service industries depend heavily on providing or processing paper-based information. In other cases, federal regulations require that information be processed promptly. For example, patients are entitled to have a secure record of their medical files within a specified period following any consultation.[36]
This often leads firms to purchase information processing services from specialized providers such as the following:

- Call Centers or “phone banks”;
- Check processing, remittance processing, form processing services;
- Medical and legal transcription (computer-aided verbatim reporting) services
- Data entry and data processing services
- Document and file processing services.

Each of these activities can be examined in terms of the number of jobs, earnings, the nature of the technology, conditions of entry, potential for offshore outsourcing, and effects of changes in technology on the demand for labor. While data are drawn from the United States, their relevance is much wider, especially when considering the possibilities for international trade and outsourcing.

NEW JOBS IN THE INFORMATION ECONOMY

Information technology allows tasks to be restructured and redistributed spatially. Activities that in the past were physically tied to the seller, such as customer service, now can be performed from afar using telephone or Internet connections. Tasks that required human interpretation and transcription now can be accomplished with optical scanners or other equipment combined with new or modified labor inputs. Although all such new tasks derive from activities within existing industries, some now have been spun off into companies that act as specialized service providers selling to other service industries. For example, a call center can be part of a credit card operation, or it can be part of a catalog or Internet retailing operation, helping customers with their purchases. Alternatively, a call center can be an independent firm, selling services to retailers, banks, travel agents, or other firms that need customer service providers accessible by telephone.

CALL CENTER WORKERS

Call centers are a peculiar creation of the information economy. Incoming call centers have existed for many years in banks, utilities, mail-order catalog firms, insurance companies, software companies, airline and newspaper offices, and governmental agencies. They are at the heart of their organizations' customer service technology. But call centers have only recently been widely acknowledged for their power in capturing marketplace feedback, profiling customers, recording their expectations, and providing information that can be used to build products and services around customers' evolving needs.

"Call center" is an umbrella term that can refer to reservation centers, help desks, information lines, or customer service centers, regardless of how they are organized or what types of transactions they handle. Call centers may handle voice calls, faxes, e-mail, web-based transactions, and video calls. The growth of call centers was accelerated through the development of new IT technologies. When automatic call distribution (ACD) was developed, again in the United States, it became possible for companies not only to receive calls and distribute them anywhere in the network but also to monitor agents' performance accurately. All monitoring and distributing activities can be programmed with a microprocessor. The feasibility of call monitoring made it possible for companies to adjust compensation for performance. Call centers have grown rapidly in both America and Europe.[37]

Call center workers are classified in the *Occupational Outlook Handbook* of the U.S. Bureau of Labor Statistics as "communications equipment operators." This category contained about 297,000 jobs in 1998. However, industry sources point out that in 1998, the United States had between 60,000 and 100,000 call centers, employing between 3 million and 5 million workers, with average size per call center being about forty employees.[38]

Median hourly earnings of switchboard operators in the United States in 1998 were 68 percent of average earnings of production workers; earnings of central office operators in 1998 were 99 percent of those of production workers; earnings of directory assistance operators were 115 percent. The median hourly earnings of call center agents in 1998 ranged between 70 percent and 109 percent of average production worker earnings.[39] Most agents in this nonunionized industry are female.

Because ACD has the capacity to route a call directly to anywhere in the network, call centers have tended to gravitate to locales with cheap labor, favorable tax regimes, and strong infrastructure. After NAFTA unified the markets of the three North American countries, a number of companies set up the call centers to handle all their customer support inquiries in New Brunswick, Canada. The government of New Brunswick has been providing hefty employment subsidies to companies that set up shop.[40]

DATA ENTRY WORKERS, WORD PROCESSORS, AND TYPISTS

The U.S. forms processing industry in 1998 had revenue of about $12 billion. Of this, the Health Care Financing Administration (HCFA)—one of the cash cows for the forms processing industry—accounts for $3–4 billion of these revenues. Data processing involves extracting information from a form, fax, catalog, book, electronic medium, or on-line entry system. Forms processing consists of six major steps: scan, preprocess the image to prepare it for recognition, recognize the form and its elements, validate the data, repair by keyboard any data that were not recognized or incorrectly recognized, and verify any data that require 100 percent accuracy. At present, forms processing is used successfully in automating the capture of data from such diverse sources as order entry, surveys, tickets, tax returns, licenses, credit and loan applications, and medical claims. The most labor-intensive type of data processing is one where paper documents, almost invariably with handwritten entries in boxes or other designated fields, are manually keyed and verified through repeat keying.

With technology changing rapidly, progress in the data entry industry in the United States has become a race between two competing methods. One contestant is traditional keyboard entry, which tries to compete by seeking ever cheaper labor. This has usually meant offshore outsourcing. The second contestant uses automatic character recognition technologies. Data entry principally employs three types of workers: word processors, typists, and data entry keyers.[41] Data entry keyers increasingly work with nonkeyboard forms of data entry such as scanners and electronically transmitted files. When using new character recognition systems, these workers often enter only those data that cannot be recognized by machines. As of 1998, the category of data entry workers employed about 898,000 workers in the United States overall.[42]

The U.S. Labor Department projects a decline in employment for word processors and typists between 1998 and 2008. Jobs for data entry keyers are projected to grow slowly. Job prospects will be most favorable for those with the best technical skills, in particular, expertise in appropriate computer software applications. The imperative to upgrade skills continuously is paramount for each of these occupations. Employment of word processors and typists is expected to decline because of the proliferation of personal computers, which allow other workers to perform duties formerly assigned to them. Employment growth of data entry keyers will be dampened by productivity gains, as various data-capturing technologies, such as bar code scanners, voice recognition systems, and sophisticated character recognition readers, become more prevalent. These technologies can be applied to a variety of business transactions: inventory tracking, invoicing, and order placement. Moreover, as telecommunications technology improves, many organizations will increasingly take advantage of computer networks that allow data to be transmitted electronically, thereby avoiding the laborious reentry of data.

The Internet will increase the incentives for outsourcing all kinds of word processing, keying, transcription, abstracting, customer service, and tracking jobs to cheaper locations, as soon as these prove dependable. Many organizations already have reduced or eliminated permanent in-house staff in favor of temporary help and staffing services firms.[43]

Median annual earnings of data entry keyers in 1998 were 78 percent of those for the median production worker. In the federal government, clerk-typists and data entry keyers without work experience started at about 64 percent of the median for production workers in 1999. Beginning salaries were slightly higher in areas where the prevailing local pay level was higher. The average annual salary for all federal clerk-typists was about 90 percent of the median production earnings in 1999.

MEDICAL AND LEGAL TRANSCRIPTION AND VERBATIM RECORD PROCESSING

There are three main kinds of transcriptionists in the United States. Medical transcriptionists translate and edit recorded dictation by physicians and other health care providers regarding patient assessment and treatment by listening through headsets and typing on transcribing machines. After reviewing and editing for grammar and clarity, the medical transcriptionist returns the dictated reports in either printed or electronic form to the person who dictated them for review and signature or correction. These reports eventually become a part of a permanent file. Court reporters, also called legal transcriptionists, document statements using a stenotype machine, which allows them to press multiple keys at a time to record combinations of letters representing sounds, words, or phrases. Under existing standards, legal transcriptionists in federal jobs must be able to capture 204 words per minute on these machines. These symbols are recorded on computer disks or CD-ROMs, which are then translated and displayed as text in a process called computer-aided transcription. The court reporter then proofreads the transcript. A hard-copy transcript is printed, and the disk produced is provided to the client. Stenotype machines used for real-time captioning are linked directly to a computer. As the reporter keys in the symbols, they instantly appear as text on the screen. An increasing number of court reporters and medical transcriptionists work from home-based offices as subcontractors for law firms, hospitals, and transcription services.

Court reporters, medical transcriptionists, and stenographers held about 110,000 jobs in 1998. Of these, about 70,000 are medical transcriptionists. The rest are equally divided between the other two occupations. More than one in four transcriptionists were self-employed.

The training for these three occupations varies significantly. Court reporters usually complete a two- or four-year training program, offered by about three hundred postsecondary vocational and technical schools and colleges. For medical transcriptionist positions, understanding medical terminology is essential. Good English grammar skills are required, as is familiarity with personal computers and word processing software. Employers prefer to hire transcriptionists who have completed postsecondary training in medical transcription. Completion of a two-year associate degree program—including coursework in anatomy, medical terminology, medical-legal issues, and English grammar and punctuation—is highly recommended. However, relatively few people go through college in order to acquire training as a medical transcriptionist. Most people attend one of the nationally known vocational schools that offer training for fees ranging between $2,500 and $3,000. These courses take between three and four months to complete. The basic requirements for landing an entry-level job as a medical transcriptionist are adequate command of the English language, good listening skills, and a capacity to touch-type speedily.

Court reporters, medical transcriptionists, and stenographers had median annual earnings of 104 percent of the national median in 1998. According to a National Court Reporters Association survey of its members, average annual earnings were about 211 percent of corresponding median earnings for production workers in 1999. According to a 1999 Hay Group survey of the medical transcription industry, about three-quarters of health care institutions paid their medical transcriptionists strictly according to time worked, with average salaries ranging from 78 percent to 117 percent of national median earnings in 1999.

About a fifth of survey respondents used a combination of payment methods (time worked plus incentives for production).

PREPRESS WORKERS

Prepress workers, who prepare text and other information for printing, held about 135,000 jobs in 1998, according to the Bureau of Labor Statistics (BLS). Advances in computer software and printing technology mean that, instead of receiving simple typed text from customers, prepress workers get the material on a computer disk. Other technologies, which tend to reduce prepress jobs, are being used more frequently, notably "digital imaging"—in which customers' materials received on computer disks are converted directly into printing plates—as well as digital color page makeup systems and electronic page layout systems. Today, composition work is done with computers and "cold type" technology. Newer cold type methods, which automate the photography or make printing plates directly from electronic files, are being implemented.

Desktop publishing specialists, who select the typesetting details—size and style of font, column width, spacing, color—and then use computers to display and arrange content on a television-like screen for production are replacing more traditional printing professionals. An entire newspaper, catalog, or book page, complete with artwork and graphics, can be made up on the screen exactly as it will appear in print. Operators transmit the pages for production either into film and then into plates or directly into plates. New technologies now allow customers to do more of their own typesetting. "Image setters" read text from computer memory and then "beam" it directly onto film, paper, or plates, bypassing the slower, traditional photographic process. Users may load exposed film into machines that automatically develop and fix the image. A growing number of printing plants use lasers to convert electronic data directly into plates without any use of film. Entering, storing, and retrieving information from computer-aided equipment requires technical skills. In addition to operating and maintaining the equipment, lithographic plate-makers must make sure that plates meet quality standards.

Although computers perform a wider variety of tasks, printing still involves text composition, page layout, and plate making, so the industry will still require prepress workers. As computer skills become increasingly important, these workers will need to demonstrate a desire and ability to benefit from the frequent retraining required by rapidly changing technology.

Increased use of computers in desktop publishing should eliminate many prepress jobs. However, the proportion of page layout and design that will be performed using computers is forecast to increase sharply, thus making the demand for desktop publishing specialists likely to grow much faster than the average for all occupations. In contrast, a decline in prepress machine operators is expected as manual tasks become increasingly automated. Many companies are turning to in-house typesetting or desktop publishing as personal computers with elaborate graphic capabilities become common. Computerized equipment allowing reporters and editors to specify type and style and to format pages at a desktop terminal has already eliminated many typesetting and composition jobs. As a result of the growing independence of publishing from physical tasks of prepress layout, jobs in publishing are migrating, to India especially.

The range of median hourly earnings of workers in various prepress occupations for 1998 were estimated at 101 percent of national median earnings for desktop publishing specialists and 87 percent for typesetters and prepress workers.

THE GROWTH OF PROFESSIONAL COMPUTER SERVICES

Professional computer services have enjoyed the highest growth rate of all individual segments of the service economy. This has been fueled by enterprises, both large and small, rushing to embrace the networked firm and the networked economy. Between 1992 and 1998, IT spending of large enterprises grew at a rate of 25 percent annually, while for medium and small US enterprises the comparable figure was about 20 percent. Changes in technology have been so fast and the required pace of adoption of complex technologies has been so demanding that businesses, metaphorically, were like a herd of deer startled by the noise of hunters. In the resulting frenzy, firms have sought security in purchases of IT services from the best-known high-tech firms, like IBM, Hewlett Packard, Microsoft, and Computer Associates. These services may involve designing local or wide area networks or running help desks and providing training for vendor-specific products. More recently, a new breed called application services providers offers IT services (for example, leasing, installing, and maintaining agreed software services) mainly over the Internet for a fixed monthly amount. All of this has spawned significant changes in the structure of jobs within the U.S. economy as well as the world at large.

COMPUTERIZATION IN U.S. FINANCIAL SERVICES INDUSTRIES

The banking and insurance industries provide excellent case studies of IT-driven office automation. Computerization in banks has involved check processing and automated teller machines (ATMs), use of automated information systems to help market or undertake consumer, mortgage, and small-business loans, and the rapid spread of phone centers for refinancing and second-mortgage loans.[44] Automated check processing and teller machines have led to downsizing among low-skilled white-collar workers. The introduction of automated information systems has caused job losses among loan officers, who are moderately skilled. The focus here will be mainly on checks/remittance processing.

COMPUTER-AIDED AUTOMATION IN BANKS. Banks were on the front line of change when, in the 1950s, computer-aided automation started in the United States. The earliest use of computers by banks was to sort checks according to the banks on which they were drawn, information that was encoded in magnetic ink at the bottom of the check.[45] During the mid-1980s, large banks initiated pilot programs to apply imaging technology (mounting cameras on high-speed reader sorters, a kind of computer) to process deposits. Banks realized significant cost savings from this underlying technology.

During the 1980s, banks quickly invested in information technology: between 1982 and 1989, IT investment by the banking industry rose from 2.8 percent of gross output to 19.3 percent in 1982 prices.[46] It appears almost certain that much of this investment was motivated to reduce the army of clerical workers, and much of it was concentrated within large banks.

These favorable results led to other uses for the technology, such as using images rather than cancelled checks in bank statements, which provided customers with smaller statements and saved labor. What started off as an effort to replace low-end human decisionmaking with computer decisionmaking in one area soon became the basis of a better "product" and a more satisfied clientele.[47] Midsized banks began adopting statement imaging between 1993 and 1994, as lower-cost statement imaging technologies came onstream. The market began to grow strongly from the mid-1990s onward as midsized banks implemented check imaging and the technologies designed originally for large banks became ubiquitous.

It may be instructive to expand upon the nature of these technological changes. David Autor and colleagues note:

> With imaging technology, a high-speed camera makes a digital image of the front and back of each check as it passes through the reader-sorter. The image is stored on a central computer and is then accessible to bank employees working at networked personal computers. As part of this innovation, the bank also adopts Optical Character Recognition software to scan and capture the amounts on check images as the checks passed through the reader-sorter. Deposit slips are scanned in a similar way.[48]

Certain high-end and high-speed systems will allow processing of checks quickly and accurately, obviating the need for an imaging component. For instance, more than 70 million checks each month are sent to Wachovia Bank—regarded as one of America's best-practice banks—after being deposited and processed at other banks.[49] All the checks have dollar amounts typed in magnetic ink by other banks. This allows Wachovia to deal with these checks quickly and accurately using its high-speed IBM 3890/XP reader/sorters, running IBM's Check Processing Control System. These operations are almost completely automated. Magnetic ink is relatively easy to read at almost 100 percent accuracy, rendering manual intervention very rare.

Approximately 31 million checks a month from 450 operators that Wachovia processes are those for which the dollar amount has not yet been transferred into the customer's account or entered in magnetic ink.[50] These checks are processed by a system developed in 1991 by NCR, which deciphers the dollar amounts from the hand-printed numbers on the top right side of the check and then encodes in magnetic ink the dollar amount on the bottom of the check. Intelligent character recognition software automates some of the process. Each check is first prepared as a digital image and stored to disk, where the handwriting is read and validated. The data are then sent to Wachovia's check processing system for account updating.

Originally, innovations in character recognition software led to savings from eliminating the cost of typing in information on about 8 million checks each month. This yielded a 20–25 percent saving on operator labor. In 1998, improved technology increased the recognition rate from about 25 percent to 40 percent, a great improvement. As against months of tweaking to get the old character recognition software working at 25 percent efficiency, the new system could be installed in less than a day. Also, since Wachovia now archives check images electronically, it has eliminated the need to store and retrieve manually check transaction information. The bank is able to handle customer inquiries in a fraction of the time it takes with the manual process.[51]

Recently, large banks have combined with equipment vendors to establish companies that sell check processing services to smaller banks, creating a new business model. Unisys Corporation joined Barclays Bank and Lloyds TSB—two large British banks—to run their check processing operations in the United Kingdom through a new subsidiary, which will be jointly owned. The core employees of the new venture will come from the three partners' existing workforces in the United Kingdom.[52] This is yet another example of how technological changes are driving reorganization.

EMPLOYMENT IMPACT OF AUTOMATION IN CHECK PROCESSING. What has been the impact of technical change on employment in banks and other branches of finance, insurance, and real estate?[53] The employment data in Table 4 show that commercial banks and savings institutions have indeed experienced job losses during the 1990s, to the extent of some 1.6 percent of the total. However, nondepository institutions (mortgage banks, and so forth), though starting from a much smaller base, have sustained job growth of 7.4 percent annually. Another side of the financial industry, security brokers, also has employed more people over the years, a growth rate of 5.5 percent. As a result, jobs in finance overall grew at 1.4 percent during the 1990s. Slightly faster growth has been registered by the insurance industries, about 1.8 percent. Real estate has added jobs as well, at 1.5 percent per year.

Evidence on real hourly wages for U.S. finance, insurance, and real estate industries compared against those in all private industries, available in Table 6, suggests that the former grew during the 1990s at a rate of 5.5 percent annually. Whereas hourly wage rates for the private sector as a whole (including goods producing and service industries) grew at 0.7 percent a year. The relatively rapid growth of earnings in finance reflects computer-based automation and the associated shift toward jobs demanding higher skills. The proportion of workers in professional positions increased from less than 10 percent in 1975 to 18 percent in 1995,[54] and the proportion of clerical workers declined. The same transformation was happening in the American insurance industry, to which the discussion now turns.

COMPUTERIZATION IN THE INSURANCE INDUSTRY. The core business process in the insurance industry involves systems that depend on information in documents. Through business documents, insurance companies acquire and retain customers, communicate important information, issue policies and invoices, and generate cash flow. Document-intensive companies may spend as much as 15 percent of their annual revenues on business communications.[55] Increasingly, such communications are being computerized. This automation so far has mainly been done in-house.[56] However, by outsourcing the printing and mailing of insurance documents and claims processing, it is common for providers to realize overall cost savings of 20 to 25 percent. Hence, in the dissemination of documents, outsourcing is becoming more pervasive. The U.S. insurance industry has long outsourced claims processing to Ireland.[57]

FORMS PROCESSING AND DOCUMENT MANAGEMENT STRATEGIES: EARLY STEPS IN THE GLOBALIZATION OF SERVICES

These examples of technical substitution between humans and computers in financial services have their counterpart in technological change throughout a generic industry that is called "forms processing." Data entry, forms processing, and document processing are closely related terms. Because these are potentially important sources of IT jobs in developing countries, it is necessary to understand how they are affected by various new technologies, especially imaging technology.

Consider some of the steps that are included in document processing: Document management systems transform a paper form into a digitized image through use of scanning equipment and software. Forms retrieval systems allow operators to find the stored documents. Routing technologies for images and data allow remote control over sites that are geographically dispersed. These technologies permit easy outsourcing to offshore centers. Internet-based forms plus scanning technologies together allow data to be entered either on paper or electronically and to be processed either where they are entered or elsewhere.

Character recognition software is improving rapidly, and, with that, image-based data entry is becoming the predominant way to enter information from paper forms. Paper can remain at its original (scanned) physical location, while the forms-based information either can be delivered to a data entry point on magnetic media (which saves on shipping costs over paper) or can be directly transmitted. Thanks to the Internet, direct transmittal can be nearly instant and very inexpensive. Image-based data entry and lower-cost transmission are together changing the dynamics of the forms processing industry.

Image-based technology allows data key entry to be supplemented by recognition technologies. It also permits sufficient control over the data entry process so that operators whose natural language is not English can produce accurate work cost-effectively.

Lower-cost transmission removes all distance constraints. As a result, adequate satellite telecommunications links coupled with reliable electricity, low equipment import duties, eased restrictions on the import of information, and well-educated, low-cost labor are becoming more important than physical proximity to the United States in determining comparative advantage in information processing activities. Developing countries perceive image-based data entry as a desirable industry for a number of reasons: it is clean; it requires educating the work force in the usage of computer-based technologies; and it puts up-to-date telecommunications links to good use.

The Internet has been an equalizing force by permitting efficient production at a relatively small scale. By tapping into cheap labor pools, such diffusion of communications technology is making some offshore locations more attractive. The Internet has removed the attractions of local time zones by allowing keyed data to be transmitted back to the source, almost in "real time." The convergence of computing and satellite technologies has now enabled offshore and domestic facilities of considerably varying unit costs and human resources to be harnessed as though to create the commercial equivalent of a relay race.[58] In the past, dedicated leased links were required to transmit data between sites, which made this an expensive option unless the companies could guarantee sustained high volumes. The Internet reduces these transmission costs, permitting the easy sharing not just of imaged forms but of other kinds of data. As a result, there has been a significant expansion of globally distributed design, publishing, information, and software.[59] Outsourcing is gradually redefining the geography of these industries.

In breaking the link between the location of customers and the location of data analysis and management, IT has accelerated the rate of spread of work and workers throughout the world. Outsourcing of IT systems management (classified among "business services" in the national accounts data) has soared.[60] The trend toward outsourcing first gained legitimacy when Eastman Kodak hired IBM in 1994 to establish its IT infrastructure. Numerous such deals, both high profile and relatively mundane, have been struck since. Within IBM, the Global Services division is the fastest growing. A new trend is for corporate users to rent application services over the web from a vendor rather than buying shrink-wrapped software. This, too, is a form of outsourcing.[61]

GLOBALIZATION OF INTERNATIONAL CAPITAL FLOWS

In the mid 1990s, cross-border equity investment was valued at about U.S. $9 trillion.[62] Other international capital flows (short-term borrowing, supplier credits) amounted to about $15 trillion. As a measure of international portfolio diversification, in 1999 the ratio of cross-border equity capital purchases to world gross domestic product was about a third.[63] A decade previously, this ratio was just a little more than one-sixth. A similar, if more subdued, transformation in the geographical spread of investment was seen at the end of the nineteenth century, but that was much less truly global in scope.[64] This time around, international flows are not only more sustained but also geographically more evenly distributed. It is not only the case that more than 40 percent of U.S. households now hold stocks; even financially conservative German and French households have become accustomed to holding equities in their portfolios.[65]

Venture capital firms, along with equity investment, are becoming more and more common globally, with significant activity in China, Taiwan, India, Israel, and Singapore, to name five among the emerging high-tech centers in Asia. Stephen Roach explains how this diffusion of specialized expertise has come about:

> The globalization of venture-capital investing should not be so surprising. It is . . . part and parcel of the very Internet culture that venture capital funding initially spawned in the United States. The ubiquitous and transparent characteristics of the Internet provide American businessmen great opportunity to transfer US-specific business models to the rest of the world; moreover, these same characteristics—ubiquity and transparency—provide entrepreneurs outside the US the opportunity to copy American business models. The Internet, if anything, enables a borderless entrepreneurial culture to transfer its skill-set from one market to another. Signs of an increased globalization of venture-capital investing suggest that such diffusion is now starting to get under way. Equally important is the emerging globalization of Nasdaq-like equity markets around the world—especially Jasdaq (Japan), Kosdaq (Korea), and Neuer Markt (Germany); these markets provide venture capital investors with the liquidity and exit strategies needed for a flourishing start-up culture.[66]

5. GLOBALIZATION OF INFORMATIONAL JOBS IN THE LATE 1990S

As we have seen, new technologies are driving toward an increasingly globalized world economy. Many argue the merits and threats of globalization,[67] however, this paper will not treat the increasing use of outsourcing and the geographical diversification of the production process as something good or bad but simply as a major part of contemporary economic life. This chapter examines how the globalization of manufacturing production of the 1970s and 1980s, followed in the 1990s and beyond by the increasing globalization of services, will affect jobs or livelihood opportunities worldwide. It will look particularly closely at the emergence of India in the global information industry.

The globalization of business enterprises is central to our discussion. International trade in services and outsourcing of office activities can and do occur without foreign direct investment, but the expansion of multinational firms hastens both the spread of new technology and the demand for new services from providers overseas. Thus, any analysis of the burgeoning new trade in services must tie in closely with inquiries into what motivates the expansion of foreign investment.

Consider some important trends:[68]

- There has been a tremendous increase in the rate of growth of foreign direct investment globally during the past two decades. According to the latest World Investment Report, global direct foreign investment flows totaled $865 billion in 1999.[69] This compares with only $58 billion in 1982.[70] Multinational corporations now number some 63,000 parent firms with around 690,000 foreign affiliates and a plethora of interfirm arrangements.[71] By far the greatest slice of FDI has been among OECD countries, but about one-third has gone into developing countries. Of this amount, as much as 75 percent went into eight large, technology-savvy or favorably endowed countries: China, South Korea, Brazil, Singapore, India, Israel, Turkey, and Argentina.
- Success in attracting FDI is associated with the following variables: per capita ownership of personal computers; per capita ownership of mobile telephones; the proportion of population living in the urban areas; number of engineers and scientists per million people; and the nature of the regime of direct taxes. Developed countries have further advantages in attracting FDI that are not picked up on the list of indicators above.[72]

- With the partial exception of China, the developing countries that receive the bulk of FDI are also those that struck down monopoly control by state-owned telecommunications companies, established (comparatively) independent regulatory bodies, and witnessed fairly vigorous private investment in both basic communications infrastructure and value-added services. China is exceptional, in that it still does not have a telecommunications regulatory authority enjoying full independence from government interference and foreign investors are not allowed to enter on the same footing as Chinese state or private domestic organizations. However, even in China, following its accession to the World Trade Organization, telecommunications markets are being liberalized.
- Gross product associated with international production and foreign affiliate sales worldwide has been rising much faster than both global gross domestic product and global exports. Sales of foreign affiliates worldwide ($14 trillion in 1999, as opposed to $3 trillion in 1980) are now nearly twice as high as global exports. The gross product associated with international production is about one-tenth of global GDP, compared with one-twentieth in 1982. The ratio of world foreign direct investment inflows to global gross domestic capital formation is now 14 percent, compared with 2 percent twenty years ago. And the number of transnational parent firms based in fifteen developed countries increased from 7,000 at the end of the 1960s to 40,000 at the end of the 1990s.[73]
- The total number of mergers and acquisitions, both cross-border and domestic, has grown at an annual rate of 42 percent between 1980 and 1999, while their value has increased as a share of world GDP from 0.3 percent in 1980 to 8 percent in 1999.[74] Cross-border mergers and acquisitions provide firms with the fastest way of securing tangible and intangible assets in various countries. Command of such a portfolio of *locational assets* has become a key source of strength in a globalized economy. Information technology now propels a very large share of foreign direct investment, including cross-border mergers and acquisitions. Out of 1999 worldwide mergers and acquisitions of some $3.3 trillion, telecom/IT/Internet firms accounted roughly for a third.

GLOBALIZATION OF ENTREPRENEURIAL CULTURE:
THE INTERNET AS A "POT OF GOLD"

Following the conclusion of the Uruguay Round of trade talks, the world community began to pay serious attention to the liberalization of trade in services, telecommunications foremost among them. The United States is naturally the largest market for telecom services. In 1996, Congress passed the Telecommunications Act, which for the first time removed competitive barriers between the providers of local and long-distance telephony domestically, thus setting the stage for competition across the globe. Many of the most significant telecom market liberalizations, for instance, those in Brazil, India, and China, date from that year.

In the mid-1990s, the World Wide Web exploded upon the global business community.[75] Its potential for sharing vital information of all kinds and for buying and selling quickly became clear.

In the second half of the 1990s, for the first time, European and Japanese business cultures, led by a new generation of young entrepreneurs, began to take on a resemblance to their U.S. counterparts.[76] One year after full liberalization of the European telecoms markets in late 1998, about one thousand new licenses had been awarded. A flurry of new operators had rushed into the marketplace. And ex-monopolies had started to modernize in the face of the new competition. The successful makeover of British Telecom, once an archetypal state monopoly, is a case in point (even though, like many of the big telecom firms, its credit was subsequently downgraded by the rating agencies because of overexposure to debt, a result of the bidding wars of 2000, when it went on an acquisitions spree).

Each of the world's economic powerhouses (North America, Europe, Japan, China, India) invested heavily in the Internet backbone in anticipation of exploding demand for Internet-based services. As projected by Gartner Group, Internet penetration across the European Union will reach nearly 100 percent of households by 2007, a dramatic change in a very short time indeed. According to a 1999 survey, 47 percent of businesses in Europe were running e-commerce applications. Perhaps even more significant, 80 percent of businesses that run Internet applications did not do so just two years earlier.

Not only Europe is pulling level with the United States in terms of its familiarity with the "new economy." In developing countries, too, the Internet is making waves. In 2000, there were 20 million Internet connections in China, a number forecast by Gartner Group to rise to 51 million by 2004. In India, Internet connections are expected to grow from 2 million in 2000 to 10 million in 2004. Japan is anticipating a jump from 17.4 million connections in 2000 to 64 million in 2004. Despite the epic collapse of the dot-coms, there is an essential hardiness among investors as they assess the long-term potential of the Internet.[77]

This explains the feverish rate for supplying "bandwidth," the capacity for carrying data. In China, bandwidth has risen from next to nothing in 1991 to 55 gigabytes per second in 2000, for instance.[78] Entrepreneurs in India, which, with only 325 megabytes per second, is woefully short of bandwidth supply, are rushing to fill the void.[79] Between 2000 and 2003, Indian and foreign companies are slated to bring on line as much as 100,000 kilometers of optical fiber capacity in India in an effort to loosen the bandwidth constraint.[80] Five years ago, the corresponding number was zero. All this capacity is meant for the IT-enabled service industries, among others, that India is counting on for future growth.

GLOBALIZATION OF INTERNET SKILLS: THE "EMPIRE STRIKES BACK"

The Internet had its origins in the United States, and Americans have subsequently maintained leadership in its further development.[81] One institutional detail of the innovation process worth emphasizing is that academic institutions, students, and corporate research labs have been important sources of new ideas. The graphical user interface, the local area network, the browser, the Ethernet, and the Unix operating systems have all been the brainchild of either American research labs (like Xerox's Palo Alto Research Center) or universities and their graduate students. American universities have therefore been a star draw for the best of young technology minds, especially from less-developed countries. Even as direct foreign investment was growing during the 1980s and 1990s, there was a concurrent "young-man-go-West" ethos in large but relatively impoverished developing countries. The number of Indian and Chinese students admitted into U.S. universities grew at a rate of 11 percent per year between 1990 and 1998, while the corresponding rate between 1974 and 1988 had been just 3 percent. In particular, India, with its familial emphasis on achievement, its elite Indian Institutes of Technology, its tradition of emphasizing math skills in the southern part of the country, and its large population of technology graduates with high degree of fluency in English, witnessed a powerful surge of "Americanization" of career planning by young people. The desire for upward mobility and for entrepreneurial careers was helped by a succession of Indian governments that made investment in education a top priority.

Owing to their phenomenal success in creating world-class technologists, the Indian Institutes of Technology have acquired legendary status within the professional community.[82] In a country where central government control of virtually all aspects of peoples' lives was still overbearing even as late as the 1970s, the Indian Institutes of Technology enjoyed a degree of academic autonomy that was remarkable. Through conscious policy, admission into these elitist institutions was made fiendishly competitive, with a success rate of one out of a thousand. The Indian Institutes of Technology also had the good fortune of having a number of electrical engineering professors with exemplary leadership and dedication to excellence. As well, some of the professors used competitive ploys that were almost gladiatorial.[83]

Academic resources (books, labs) were in short supply, yet poverty, coupled with sadistic competition, engendered brutal self-discipline among students. The result was a strict meritocracy among Indian technology students, especially in engineering. Whole classes of graduates would subsequently migrate, lock, stock, and barrel, into high-profile American engineering schools.[84] With the Indian Institutes of Technology setting the pace, the rest of the technology teaching establishment could only follow suit. The fact that English has been the medium of instruction in India at postprimary levels for the past hundred years gave Indian graduates a significant language advantage over other foreigners in America. That English subsequently became the language of choice for content development redounded to India's advantage as well.

Another Indian advantage, even though its benefits might be difficult to calculate, derived from the Indian students who studied in the former Soviet Union. During the cold war days of the 1970s and early 1980s, Moscow used to share knowledge and sensitive scientific information with the Indian government and, by implication, with top Indian universities and the Indian Institutes of Technology. Soviet technology, especially in defense industries and space research in the 1980s, was among the world's best.[85] Some of these Indian students then came to the United States for further education. They found themselves well ahead of the curve because they had already cut their teeth on Soviet equipment and software.[86]

The Indian community in the United States is currently the best-educated and prosperous among any ethnic group of immigrants. Close to 89 percent of Indians in the United States have completed high school, 65 percent have completed college, and a stunning 40 percent have completed masters or doctoral degrees. Many of them are world-class entrepreneurs or managers.[87] There are about 50,000 physicians in the United States of Indian origin, with the potential capacity to support an India-based medical transcription industry of some 30,000 transcriptionists.[88]

Silicon Valley is full of Indian high-tech workers. There are about one thousand American chief executives in the United States with Indian roots. According to Arun Netravelli, president of Bell Labs, who is of Indian origin, 30 percent of all Internet software gets written by programmers with Indian roots. Fully half of the research team of MIT's RAW (Reconfigurable Architecture Workstation) project, which aimed to develop the fastest microprocessors in history, was of Indian origin. Indians are disproportionately found at the cutting edge of optical networking and chip making for high-definition television (HDTV), two of the hottest areas of technology development, generating billions of dollars of investment in U.S. stock markets.[89]

ETHNICITY, DIASPORAS, AND THE GLOBALIZATION OF TECHNOLOGY AND BUSINESS MODELS

As in India, international migration has helped to produce a cadre of cutting-edge engineers and entrepreneurs in China, Taiwan, Singapore, and South Korea. The emergence of technological leadership in all of these countries in strategic IT industries is certainly not accidental, still less the outcome of some purely market-driven process of selection. Much depends on the emergence of diaspora-based ethnic networks.

It is one of the oddities of economic life that, in the words of Nathan Rosenberg, while science is “papyrocentric,” technology is “papyrophobic.”[90] Scientists seek to disseminate their results, but those who make specific technological breakthroughs try to keep their results out of the public domain until the “patent pending” stage. Put differently, science tends to be public and technology proprietary. Many technological breakthroughs can ultimately be reduced to one or more sharp insights springing from the mind of one person or team that first develops a prototype and gets test results. The need for industrial secrecy reinforces the kinship and ethnic networks that characterize a diaspora. Pioneers in U.S. IT industry have displayed a tendency to turn to their own diaspora network in selecting team members and apprentices. Venture capital from overseas Indians has been important in the growth of the Indian IT industry.[91] The inclination toward community networks is intensified by memories of stinging discrimination in the workplace not so long ago.

An overseas incubation period has been important in producing many technology specialists in Asia, who have benefited from intimate knowledge of the demands of the U.S. marketplace. Many start-ups in India, China, and the Philippines owe their existence to the return of members of these diaspora networks to their native countries; this phenomenon also is partly responsible for the globalization of venture capital.[92] Returning entrepreneurs and technical experts have been instrumental as well in promoting integration between the pools of skilled IT workers in the United States and India, China, and the Philippines. Integration has been furthered through worker/firm certification processes, which validate quality; offshore outsourcing; and direct foreign investment, as well as direct migration. Western companies increasingly are in the happy position of seeing the software engineering profession in North America and a few large Asian countries composing a "virtually unified" labor market.

Although globalization of information technology has been essential to the establishment of high-tech industries in a number of developing countries, it also has enabled many more mundane tasks to be undertaken far from the developed world, where both customers and the primary businesses they deal with are located. These opportunities ultimately are likely to be both far more numerous and more important to young people who are not privileged to be part of elite circles in the developing world.

EMPLOYMENT CREATION THROUGH IT-ENABLED SERVICES

At the turn of the century, the world is on the cusp of great changes in the division of labor between developed and developing countries. White-collar, clerical, and "bureaucratic" activities associated with commerce in the West, increasingly are finding their way to labor markets in Asia and elsewhere in the developing world. The outsourcing of service activities overseas is driven by a sharp reduction in the cost of communications. The annual real cost, in 1985 prices, of operating an international telephone circuit decreased from $22,000 in 1965 to $800 in 1980 to $30 in 1985.[93] The cost fell to $5 by 1995. Moreover, the transmission capacity of one satellite circuit is now 100 billion bits per second, more than enough for most data transmission uses. The cost of sending one billion bits of data from New York to Bombay fell approximately ten thousand-fold between 1976 and 1996. The combined cost of receiving audio files and sending the corresponding annual output of a team of medical transcriptionists between the United States and India has fallen by two-thirds just between 1996 and 2000. At the same time, the development of telecommunications infrastructure has made up-to-date communications services widely available in many developing countries.[94] And, as discussed above, optical character recognition software has made it feasible to move rapidly and seamlessly between electronic and paper media, permitting global distribution of many, if not most, office tasks.

The second driver of the globalization of back-office services is demographics. In the decade beginning in 1995, the number of people between the ages of eighteen and twenty-four in the workforce in the United States, the prime market for back-office operations, is expected to fall by 17.5 percent. American companies are already experiencing difficulty in attracting and retaining qualified back-office labor. For example, job turnover in the claims offices of U.S. insurance companies exceeds 30 percent a year. Hence, the increasing resort to outsourcing to Ireland.[95] In contrast, the population of young workers in third world countries is rising, which suggests that companies seeking employees for back offices will have an easier time locating them in developing countries other than in the United States. For example, the pool of unemployed and underemployed labor in the Caribbean is so much greater than in rural America that companies locating facilities on the islands have no problem expanding their operations after start-up.[96]

A major consideration leading companies to choose overseas locations for their back offices is that the prevailing wage differential between developing and industrialized countries continues to increase. A U.S. government study revealed that total labor costs for back offices located overseas were about 75 percent of those paid in the United. In very low-wage countries such as India or the Philippines, the difference is much greater.

All of these conditions are raising offshore transferral of white-collar work to a whole new order of magnitude from the 1980s, when Oxford University Press outsourced specialist text mark-up tasks to workers in the Hebrides. The Philippines started hosting data entry centers in the early 1980s. A decade later it was ranked first as in data processing jobs in a 1992 study funded by the World Bank, which reported that it had found 2,000 stations where workers key in data there.

Liberated from “place” by collapsing telecommunication costs, back-office work has become remarkably footloose. In 1997, while U.S. workers in clerical data entry positions were typically earning $7–$8 an hour, workers in Barbados received $2.00–$2.88, in Grenada $1.26–2.10, in St Lucia $1.10, and in Jamaica $0.80–$1.00. Caribbean rates have been rising over time, which has led to a further relocation of the industry, this time to Asia.

Mainland China, with wage costs in the 10–20 cents an hour range, has increasingly loomed as a competitive source for U.S. information processors to tap. For instance, California-based Digital Imaging has shifted much of its basic keyboard work to Beijing and away from its unit in Barbados. Because labor costs are so low in China, the same text can be input separately by two or even three workers and then automatically compared for errors, thus making it possible to use workers who speak no English. Quality control on the Chinese work is implemented from Barbados using satellite technologies.[97]

In the twilight years of the twentieth century, global data entry and back-office work began to shift rapidly to India.[98] As in the Philippines, this has much to do with large pools of cheap urban labor with good English skills.

A TAXONOMY FOR IT-ENABLED LIVELIHOOD OPPORTUNITIES

A mature economy generates enormous quantities of information to process. More than 60 percent of U.S. GDP, including governmental activities, consists of processing and manipulation of information.[99] Regulations and reporting mandates require prompt processing of information, and competitive pressures dictate that this processing come from multiple sources. In our shrinking world of instant communications, this generates business opportunities for developing countries that have the requisite human resources and IT infrastructure.[100] Firms located anywhere on the globe can provide services to customers across the planet. Customer inquiries have to be handled; accounts have to be prepared; forms, checks and remittances have to be processed; patients' records and legal documents need to be archived, sometimes verbatim and within statutory time deadlines; mail and telemarketing campaigns have to be launched.

S. Ramani classifies the opportunities in information processing as follows:[101]

- Accountancy services, financial accounting;
- Engineering design, product development;
- Human resource management;
- Correspondence (reports to be submitted to statutory authorities, for instance, the Securities and Exchange Commission, or updating/maintaining customer correspondence);
- Legal assistance (study of case materials, document search, preparation of documents to be submitted);
- Staffing call centers, customer service;
- Marketing via direct mail, e-mail campaigns;
- Publishing, editing;
- Prepress activities (such as typesetting);
- Compilation of abstracts;
- Transcriptions from dictation to a computer record;
- Producing and programming Internet content;
- Animation;
- Remote ticketing;
- Patent filing;

- Billing;
- Warehousing, packing, shipping;

With large pools of skilled English speakers, and equipped with high-speed data technology that was not available five years ago, some Asian countries now may become back offices to the world. In front of blinking computer screens 9,000 miles from the United States, workers are producing legal and medical transcriptions while Americans sleep. In Madras, Calcutta, and Manila they answer customer requests, offer assistance to computer users, process payroll accounting, and work shifts at twenty-four-hour phone help desks for credit card billing, remote ticketing, and the like. The time difference gives Asia a special advantage.

The number of Western and Indian firms collaborating to provide back-office services has been growing fast. Since 1996 the back-office sector in India has grown from $15 million to $300 million, according to the Delhi-based National Association of Software and Service Companies. To take an example, in 1996, British Airways' back-office workers all sat in costly London. Now the operation runs out of Delhi and Bombay, staffed by college-trained women in their early twenties. For them, the $282-a-month starting salary is princely—some seven thousand Indians compete for each job. So effective and cheap did British Airways find its Indian support staff that it branched out to other simple data services, opening a new 1,000-strong office in April 1999. British Airways' information processing and clerical workforce in India grew from virtually nothing to about 2,500 by 1999.

Several other global firms have already begun using India as a base for such operations. McGraw-Hill has moved much of its typesetting and prepress work into Bombay (refer to Case 5 in the Appendix). GE Capital and American Express use Indian offices to provide back-office and ticketing functions. Trade sources have forecast that these IT-enabled services will likely generate about $18.8 billion in revenue annually over the next decade, creating about 1.1 million additional jobs.[102] This has sent (virtuous) shock waves of anticipation through the country's economic planning agencies and has prompted collateral investment by the business community. Foreign investors have come calling. A number of large multinational firms have set up research, design, and development centers in India. Others, like Bechtel, have made their Indian operations the control center for some of their global operations. Bechtel has an office in New Delhi with 400 engineers who use the latest computer-based technologies, serving a global clientele. Using a dedicated wide area network, this facility collaborates with other Bechtel civil and energy engineers and managers scattered in offices throughout Asia, the United States, and Europe. India is gaining ground as a headquarters location, creating high-skill jobs for Indian young people with technical degrees.

TOWARD A GLOBAL VILLAGE: "THE CALL CENTERS ARE COMING"

Airlines and hotel chains and banking and capital market institutions around the world are actively investing in Web-enabled call centers and revolutionizing the way in which sales support, reservations, technical queries, bank account and receivables management, client services, telemarketing, and market research are conducted. The latest version of a call center is a "global intelligent network." This features a centralized database with advanced call handling facilities that enable 70–80 percent of the calls to be serviced without intervention by human agents. Calls that require intervention are spread across the globe, taking advantage of either switched data transport or the Internet Protocol.

As soon as toll-free 800 numbers debuted in India in December 1998, call centers started to migrate from the West. The first high-profile "passage to India," characteristically, was taken by British Airways in April 1999, as discussed earlier. General Electric (GE) created a large international call center in Gurgaon, near New Delhi, for customers of GE Capital Services. Other big players like iDLX have established call centers at Gurgaon. Hero Honda, the manufacturer of popular two-wheelers, intends to start a 1,300-agent call center, at a cost of about $23 million. Tata Steel has issued firm commitments to team with Sitel to set up a huge call center with 10,000 workstations. India's largest conglomerate, Reliance, has announced plans for setting up call centers, entirely catering to U.S. demand, that will eventually employ as many as 100,000 agents.[103] Many observers see India promoting itself as an Asian version of the polyglot Netherlands in the global call center industry.

Following British Airways' lead, a number of major airlines have moved their phone-based reservations systems into India, as have a number of other service companies, including the U.S.-based international real estate management firm Jones Lang LaSalle. Jobs created in these centers largely go to educated young women. A large percentage of these agents have finished university and have polished their spoken English based on watching American soap operas on satellite television.

The government of India has announced a favorable incentives package for luring IT-enabled services. The race also has been joined by Indian states seeking their slice of the market for such jobs. While the southern Bangalore-Madras-Hyderabad triangle emerged as the unchallenged destination for IT, the Delhi-Gurgaon and Bombay-Poona corridors are the preferred destination for call centers because they have available manpower. Bangalore-Madras and Bombay-Poona rank high in terms of infrastructure, according to Jones Lang LaSalle. The same firm's rankings based on English-language fluency and accent is topped by Delhi-Gurgaon, followed by Bombay-Poona, Bangalore-Mysore, Hyderabad, and Madras. Real estate costs in Bangalore and Gurgaon (U.S. 45–52 cents per square foot) and Hyderabad (34–45 cents) are low compared to other locations, such as Delhi (78–90 cents), Madras (60–70 cents), and Bombay ($1–1.07).

India has joined Ireland and Australia among the most sought-after call center locations. Manpower costs in India are approximately one-tenth those of the United States. The minimum weekly wage in India is estimated at $16.50 compared to Australia's $461.70, the United States' $375, and Ireland's $357. The technology to support call centers is readily available in India. Alcatel, Lucent, and Enhancement Technologies have established extensive client support networks in the country.

The Philippines also has been active in attracting call centers for major U.S. businesses. According to HatchAsia.com, a Manila-based incubator firm, the number of jobs in Filipino call centers rose from about one thousand in 1995 to twenty thousand in 2001, a growth rate of some 40 percent a year. The cost of setting up a call center in the Philippines is about U.S. $4,000–5,000 per agent. Help desks providing IT support and other customer service using call centers are coming as well. The emergence of web-enabled call centers in the Philippines has benefited a variety of international companies, such as Barnes and Noble and PeopleSupport, Inc., searching for cheap but professional customer service support to U.S.-based clients. PeopleSupport recently opened a 1,000-agent call center and has space for adding another 3,000 agents during the next two years.

One activity that is taking advantage of the rapidly growing capacity in Philippine call centers is that of distance tutoring of American students. For instance, Tutonic Inc., a large U.S.-based company specializing in coaching high school and college students, used the web to connect American math students with calculus instructors based in the Philippines through toll-free numbers in the continental United States.

Philippine call center agents make $200–250 a month in entry-level positions, while those who have three to five years of experience earn $300–350 a month. Real estate costs in the Philippines run generally around U.S. $100 per square meter annually. Turnover rates, especially among young workers, are high, however, at 20–30 percent per year. Call centers represent one way in which technology can help alleviate poverty.

CLERICAL JOBS

Clerical jobs, which also are migrating in droves to the Philippines and India, include medical and legal transcription, data entry, content production, document processing, and geographic information systems.

MEDICAL TRANSCRIPTION AND OTHER CLERICAL SERVICES. One of the first companies formed in the United States to tap offshore labor for medical transcription in a significant manner was formed by non-resident Indians, almost all physicians, in 1992. HealthScribe, Inc., in 1994 pioneered medical transcription in India by opening the first production center in Bangalore, with fifty transcriptionists. By July 1998 the number of transcriptionists had grown to 250, and by July 2000 employment had grown to 500.[104] HealthScribe reported U.S. revenue of some $22 million in 1999, of which about 40 percent was directly attributable to the work of the transcriptionists in Bangalore.

The National Association of Software and Services Companies (NASSCOM) in New Delhi estimates that the number of clerical jobs in that sector in India has risen from some twenty-three thousand in 1998 to forty thousand in 2000. Medical transcription has experienced the largest growth spurt among them. This is because the skill barrier is lowest for medical transcription. The typical business model of a medical transcription start-up involves training, over the first year, of two batches of students who pay their own way, while the company inserts these streams of newly trained workers into supply chains for contracts procured simultaneously from clients in the United States. In the first half of 1999, there was a veritable boom in the medical transcription business, which is now witnessing a consolidation, with a marked tapering off of the numbers of trainees in a typical batch. (See Case 1 in the Appendix.) There have been quite a few success stories. (See Cases 1 to 4.) However, there have been some disappointments, too.

A number of conglomerates in India have made concerted moves into not only medical transcription but other IT-enabled call center services as well. This is true of the Max India Group, the House of Khoday, and the Tulsyan Group, to give three examples. Each of these groups had annual revenue in 1999 of at least US $100 million—quite big in the Indian context. As well as investing in HealthScribe India, Max India is investing U.S. $11 million in two American companies, AltaCast and MindCrossing, for software and web-enabled services. The Khodays have invested in U.S.-based call centers and India-based proofreading centers as well as in transcription facilities.

In the Philippines, the number of such clerical jobs is estimated to have risen from 15,000 in 1995 to 25,000 in 2000—a growth rate of about 6 percent a year.[105]

FORMS AND DATA PROCESSING. Remote data processing, which has been operating in the Philippines for the past fifteen years, has come more recently to India. Workers view images of paper documents that have been scanned overseas. Material also can be transmitted in the form of indexed documents on CD-ROM or other highly portable media. Imaging and archiving of enterprise documents—increasingly used by multinational banks in India—generates outsourcing contracts for domestic Indian companies. (See Case 5 in the Appendix.) U.S. firms that specialize in forms processing, serving insurance companies, state governments, medical and Medicare claims processing, and subscription fulfillment in addition to a variety of warranty and business applications, typically have an Indian operation.[106] Data entry costs are generally 30–40 percent less in India than in the United States.

Other document processing activities also are moving to Asia. British Airways implemented systems that connect workers in North America, Europe, and India to bring together such diverse functions as remote ticketing, issuing paperless electronic tickets, updating customer frequent-flyer credits, and back-office business processes.[107] Indian companies have moved into the document processing/forms processing arena, too. Informal establishments using largely manual methods subcontract work from the more automated (paperless environment) document processing units, especially when there are exceedingly large orders.

THE BUSINESS OF TRAINING FOR IT JOBS

Throughout most of Southeast and South Asia, training in computer and IT skills has become a thriving industry, creating hundreds (in India, thousands) of jobs for young instructors. These are decent jobs that pay about $350 a month in India and Bangladesh and $500 in the Philippines. Most of the instructors are technical graduates from universities, not necessarily in computer science, with at least one vendor certification under their belts. Microsoft offers the most popular certification track. As training institutes have boomed, they also have created jobs for young network specialists, not to mention ancillary office help. Many of these establishments have bought expensive franchises from name-brand companies with high profiles in IT training, such as National Institute For Information Training (NIIT) and Aptech in India. The master franchise (for the right to sell franchises to other training companies) offered by Indian training majors in Bangladesh costs between U.S. $750,000 and $1 million. In the Philippines, where software companies hire something like 3,500–4,000 entry-level software developers a year, no more than a half of that number is supplied by the country's universities, while the other half is supplied by private training institutes, themselves franchisees. Being an IT instructor requires a university education, admittedly a far cry for most of the millions of young men and women who seek livelihood every year in these countries. Nonetheless, employment multipliers from the booming demand for IT instructional staff creates demand for unskilled labor in a variety of jobs from office supplies to cleaning services. As is the case with export activities, the initial income and employment generation creates demand for many local products and workers.

Multilateral lending institutions have identified IT training as an essential component of job-growth strategies that can benefit the young from poor families. In November 2000 the World Bank, Citibank, and NIIT teamed up to create a lending facility in India of $100 million to provide access to IT training for students from poor families. The Asian Development Bank, too, is targeting IT training as a way of securing the biggest payoff from its own involvement in information and communications technology.

IT and Internet-based businesses have captured the imagination of not only American-trained technology specialists with roots in the region but also of local, "old-money" industrial elites. Industrial families that made their millions in diverse sectors of the economy—liquor, real estate, finance, steelmaking, electricity generation—are now taking a stab at "new economy" niches. Those that have brought in professional help and have had enough skilled management to upgrade skills in-house have succeeded. Those that lacked the managerial acumen to learn new tricks quickly failed.

Table 8 presents an idea of the employment creation and market potential in India represented by IT-enabled services. Content development in this table is forecast to grow from nearly nothing in 1999 to as much as a $5.4 billion industry by 2008, while back-office work and remote maintenance could generate $4.3 and $3.4 billion, respectively, in revenues by 2008. The table forecasts total annual revenue of $18.6 billion dollars and 1.1 million new jobs in businesses connected to IT in India between 1999 and 2008.

Creation of Jobs through Communications Services

One major source of job creation besides IT-enabled services is based on demand for telecommunications services in developing countries. Recently, a number of success stories in this service industry have garnered attention in Asian and Latin American countries. Here are two case studies in this context, selected from India and Bangladesh.

The "phone ladies" in Bangladesh. Demand for communications services is surprisingly robust even in poor countries and communities. Out of dire necessity, people are willing to pay remarkably large shares of their incomes in order to stay abreast of information critical to their occupations or to keep up with family, to name just two important reasons. With communications technology becoming ever more powerful and convenient, private businesses have sprung up to take advantage of the opportunities created by the need to stay in touch. In Bangladesh, the lessons of innovative microcredit lending schemes have now been applied to communications services. Perhaps the most successful example of this is GrameenPhones, a company that is part of the Grameen Bank Group, led by Muhammad Yunus—known as the "peoples' banker" for his pioneering efforts to make credit accessible to entrepreneurs on a very small scale. GrameenPhones has enabled thousands of very poor women to set up businesses selling communication access on cellular phones.[108] As well as creating the means to a livelihood for poor women, particularly younger ones, this has benefited small rural producers by improving their access to information, notably market conditions and prices of various crops.[109] Its success exposes as myth the notion that the rural poor in Bangladesh cannot be taught even to dial a long-distance number on a cell phone.

STD booths. In India, the Department of Telecommunications helped create 600,000 "STD booths." These telecommunications units, the size of small cubicles, house a phone and fax machine combination. Often, they are located in the living room of the owner. Each STD booth costs the equivalent of U.S. $2,500, including $1,500 put up by the owner. An STD booth creates two jobs, each worth about $500 a year in wages. Close to 1.2 million jobs, which are filled by young people who have finished high school or college, have been created as a part of this program.

Creating jobs in India using Internet kiosks. An Internet kiosk rents access to networked PCs for the equivalent of couple of dollars per hour. Capacity-sharing mechanisms, like routers housed in a hub, make it possible to share a fixed line between five to fifteen computers.

Each of these machines can surf the net and send and receive e-mail. The cost of setting up an Internet kiosk is U.S. $10,000, and the annual cost of maintaining a line is $1,000. On average, four people are employed in each kiosk. The number of kiosks is limited not by the size of market demand or the availability of capital but by general lack of skills and knowledge of English. The kiosks are taking off fast, especially in the south of the India, where the level of English fluency, knowledge of applied mathematics, and per capita incomes are all relatively high.[110]

CREATING ASSEMBLY JOBS

Sales of desktop personal computers (PCs) in India are growing at a 40 percent annual clip.[111] During the fiscal year 1999–2000, the market share of name-brand firms fell to 42 percent from 47 percent during the year before, while the market share of small local independents rose to 58 percent. The market share of multinational company brands rose slightly, from 22 percent to 23 percent, while that of Indian brands (for example, Wipro and others) fell from 25 percent to 19 percent. This crowding out of the PC brands names is attributable to the extreme price sensitivity of Indian consumers. Assembling PCs is a low-margin business, in which a large proportion of establishments are tiny, set up by young entrepreneurs. Assembling computers is a useful skill in any information economy, and it takes only a few weeks of training. Assembly workers in India probably make just U.S. $800–900 a year. But these workers are typically very young, single people who have not attended university. There is a career path clearly marked for such people, into skill tracks of becoming network technicians or help-desk support staff. Both of these kinds of positions pay well to those who have experience. Clearly, the emergence of local entrepreneurialism in the manufacture of PCs in India is an encouraging sign for young people with a bent toward technology.

SEEDS OF EXCLUSION

Amid all the enthusiasm for technology's promise, one sobering fact must be acknowledged. A large proportion of jobs in the "new economy"—even jobs like call center work, which in the developed world would go to the unskilled—in developing countries require skills and experience to which few children of the poor have access. The intensive training involved in becoming fluent in English or competent in the processing of forms is an expensive proposition even for a middle-income family. Seeds of exclusion are sown at the same time as the next crop of millionaires is being nurtured. While many jobs and careers are being created in urban areas for young people, most will go to those who already have relatively secure incomes, not to the hundreds of millions of poor families who most need such opportunities. This is the essence of the policy dilemma being thrust by the information revolution upon the leaders of the developing countries.

6. PUBLIC POLICY TO PROMOTE IT-ENABLED DEVELOPMENT

What kinds of policies are best likely to provide an economic environment in which the new crop of IT-enabled activities will have room to flourish?[112]

Reaping the full direct and indirect benefits of rapid technology growth requires, first of all, enhancing the quality of the workforce and of the physical, particularly the data-related, infrastructure of the country concerned. These twin policy goals, always important in economic development, are more so today than ever. Countries as diverse as India and Israel, China and Costa Rica, have successfully attracted much sought-after high-tech production facilities from Fortune 100 companies because they have the human resources and the infrastructure to make investment profitable.

Policies toward foreign direct investment are critically important as well. Companies are footloose, and developing countries are among the many wooing them. Besides the quality of the workforce and sound infrastructure, tax and legal systems that ensure contractual integrity and predictable are powerful draws for foreign direct investment.

Historically, inward-looking policies that cut countries and industries off from knowledge and foreign competition have generally resulted in slow growth. Countries must choose between parochialism and the gains from having outward-looking economic policies. Contemporary evidence suggests that countries should adopt trade-friendly domestic policies.

The overriding objective remains broad-based participation of the young in a development regime that makes full use of opportunities created by IT. However, the macroeconomic context also is important. Acceleration in IT-led investment will likely have large employment multiplier effects for young people throughout the economy. While those with good education may work as software engineers or Web developers, those with less schooling may find new jobs in shops or on farms, selling to those benefiting more directly from the boom. Hence, getting the overall direction of the policy package right is no less, perhaps even more, important than just providing incentives and infrastructures aimed at the narrow confines of IT.

Widespread education and training for use of information technology must be a high priority of developing countries. The global stock of productive knowledge is moving to the Internet, which has already become the world's largest library and one of its largest laboratories. The Internet is the world's greatest public good, affordable access to which can become the lifeline to marketable skills and a decent livelihood. Likewise, the right to acquiring computer literacy—that essential first step toward the cultivation of IT skills—is becoming akin to one's right to adequate food because without it, people are likely to be poorly prepared for the demands of the marketplace. The governments of the world's richest countries have recently proclaimed that the right to the alleviation of "digital poverty" is every bit as worthy of protection as that safeguarding against economic poverty.[113]

But do governments have really a role to play in this? Will markets not do a decent job of generating and sharing information with the public, investing in the appropriate infrastructure or web content, imposing standards of effective performance for schools and colleges in the interest of having a well-qualified workforce, encouraging self-policing of conduct in the interest of avoiding speculative frenzies, etc.? By a long shot, the answer is no. The markets will provide more of some kinds of services than is necessary, while they will hardly supply certain others kinds of services at all. Policies will need to be developed in the following areas: (a) improving accessibility of information through the Internet, especially news about job opportunities for young people and students; (b) increasing the availability of computer hardware and training programs at schools and colleges and over the Internet itself; (c) fostering competition in the markets for Internet, satellite, and wireless access and Internet gateway businesses and removing all vestiges of statism; (d) using tax breaks encourage investments to make fiber optic enhancements to the Internet backbone; (e) providing educational and training loans so that young people can develop IT skills.

Having said that, this is not the place to go into detail about what kind of educational or information infrastructure policies developing countries ought to have. Volumes have been devoted to those subjects, and there is no need to reinvent the wheel. Rather, let us consider some lessons in IT-enabling policies from India, the Philippines, and Bangladesh.[114]

INDIA

By the middle of the 1980s, computerization already had begun in India.[115] Infosys—now India's third-largest quoted company—had begun to develop applications for mainframe computers, and banks had begun to automate their very paper-intensive systems. In 1989, the first batches of software written in India for U.S. clients were exported. But growth in IT was inhibited by the culture of excessive economic control by the central government.

Around 1998, Indian software engineers who had already been working for North American system integrators saw a significant opportunity unfold before them in the form of the year 2000 (Y2K) problem. Some of them responded entrepreneurially and set up their own companies to secure Y2K debugging contracts. As the rush to provide fixes for the Y2K problem gathered momentum, work expanded rapidly; India milked the Y2K cash cow like no other country. This was the first time that India's "software triangle," a trio of South Indian cities—Bangalore, Hyderabad, and Madras—with concentrations of technological savvy, began to exert substantial political influence nationally. The rapid growth of the Internet from 1995 to 1998 and a change of political guard in New Delhi during that same period together set the stage for a major shift of gears in Indian policymaking regarding the information economy.

Compared to other developing countries in Asia, the policy shifts in India—aimed at creating an economic environment conducive to the vigorous development of information technology—have certainly been among the most sweeping.[116] Recognizing the strength and low cost of Indian software skills, the government chose to fast-track reform of the legal framework and regulations affecting software and IT-led services. First off the block, the Software Development Promotion Agency was established in 1998 to help devise policies that would provide strong impetus to the growth of software and IT-enabled services industries. In the same year, a National Taskforce for Information Technology and Software Development was created. A working group on IT emphasized India's potential in research, design, and development and called for government-funded organizations to formulate long-run and short-run IT action plans. Dispensing with time-consuming and expensive investment sanctioning procedures, the government offered the following new policies:

- In Special Economic Zones, foreign equity participation up to 100 percent was permitted in all industries except cigarettes, alcohol, narcotics, or atomic substances;

- Up to 100 percent foreign equity investment was allowed for Internet service providers not having gateways, electronic mail, or voice mail;
- Offshore venture capital companies were given license to invest in Indian firms;
- Wholly owned subsidiaries of offshore parent companies were permited to repatriate royalty payments, on the order of 8 percent on export receipts and 5 percent on domestic sales;
- Firms providing and selling goods with brand names of foreign collaborators, where no technology transfer is involved, were permitted royalty payments of 2 percent on exports and 1 percent on domestic sales of these goods;
- The monopoly of Videsh Sanchar Nigam Limited in international Internet gateways was abolished;
- The Department of Telecommunications streamlined its operations, to the point that, in Bangalore, for instance, it takes only about two weeks to get a serviceable ISDN connection, whereas previously it took months of waiting;
- The Department of Telecom Services was turned into a public limited company effective October 2000, thus essentially privatizing a parastatal;
- A Telecommunications Regulatory Authority of India was established in 1997, with a significant degree of functional autonomy. This Authority has already succeeded in cutting down on anachronisms in the regulatory framework. For instance, differences in licensing rules based on the underlying technology have been eliminated, thus fundamentally simplifying that process. An influential Information Technology Committee was established in 1998 along with a fully fledged Ministry of Information Technology to implement a new vision for India's IT industry. Finally, approval of voiceover Internet protocol is expected in the near future; only a year ago this idea was anathema to the telecommunications bureaucrats who feared competition. Finally, the government is now actively seeking to unify three ministries—Information Technology, Information and Broadcasting, and Telephones and Telegraph—into one superministry to reflect the convergence of communications technologies.

Following policy reform, competition has increased among Internet gateway providers. Prices of Internet connections have fallen by about 20 percent annually in recent years as vendors sliced access fees. The cost of other services has fallen, too. As users have multiplied, entrepreneurs have found markets for specialized types of buildings in technology parks and in pivotal hubs outside them where lacunae in the public infrastructure are circumvented by privately provided power and satellite links.

The clearest sign that Indian information technology has come of age is this: when Bill Gates visited India in 1997, he loudly castigated the woefully deficient Indian infrastructure, but when he revisited in 2000, his comments were muted. (Lest one get carried away, note as well that the whole of India has less bandwidth capacity than the city of New York. Overall bandwidth supply in India was 345 million bytes per second in 2000, less than 1 percent of the 55 gigabytes per second installed in China.) India's information processing capabilities have become essential not only for multinational companies with their global computer networking and telecommunications links (such as the Bharti Group) but for staid domestic conglomerates like the Reliance Group traditionally associated with petrochemicals or textiles. India's recent regulatory relaxation has had much to do with this.

THE PHILIPPINES

The Philippines, a former U.S. colony, has always offered vigorous policy support for IT training.[117] With eighty-six universities and colleges offering courses in computer science and related subjects, the country has been rated second among fifteen of the fastest-growing Asian countries in the league tables concerning training. English, the language of instruction in secondary education and beyond, is widely spoken in the country. Interest in commercial data conversion came early to the Philippines. In 1989, export receipts from businesses that specialized in data entry was $10 million. With U.S., German, and Japanese software companies investing, the size of the domestic IT market grew rapidly. By 1998, American firms' investment totaled $2 billion.

The foundations for IT were laid by President Fidel Ramos when he created the National Information Technology Council, which drew up a National Information Technology Plan. This plan laid out a vision and associated milestones with respect to the regulation of electronic commerce, telecommunications facilities, and rapid development of technology-specific human resources in the country. In particular, the plan called for the creation of an information technology zone, featuring world-class data transport and bandwidth availability and enjoying fast-track approval for facilities. During the succeeding administration of President Joseph Estrada, the accent on IT was even more pronounced, with the development of blueprints for several ambitious, IT-based projects. These include:

- Nationwide Internet-based information exchange between government and private industry;
- Development of new methods of deploying information technology to provide rural services;
- Computerization of the social security system;
- Computerization of customs and internal revenue services;
- Electronic vehicle registration;
- Machine-readable passports;
- Computerization of land titles and other public records.

Export receipts from various IT-related services rose from $10 million in 1989 to $345 million in 1998. Software products of local Filipino companies have been used in banking, hotels, hospitals, and financial and insurance companies. Wireless communications services generated $1 billion in revenue in 1998. As happened in India, the Philippines is about to pass legislation that adapts regulation to the convergence of computing, telecommunications, and broadcast technologies.

BANGLADESH

Bangladesh is actively reviewing its information technology policies, which are still in the formative stage. The country has expressed a willingness to consider various new technologies that were not permitted at the beginning of 2000, such as voiceover Internet protocol. The state-owned telecom company is considering a proposal submitted by Singapore Telecom that would give the customer a break from high prices for long-distance calling. Singapore Telecom has even offered to provide Bangladesh the infrastructure needed to transport voice traffic over the Internet at no cost. In return, it has demanded a contract to roll out the Internet backbone for Bangladesh. The graduated tariff structure for this service proposed by Singapore Telecom shows rates falling fast between 2000 and 2002. The government already has lowered tariffs on long-distance telephone services and on leased lines.[118]

Policy planning, in Bangladesh as elsewhere in the developing world, should involve the following issues:

- Governments ought to disseminate information in an accessible manner (that means choosing the right media and using appropriate regional vernaculars, for instance) about opportunities created by IT. Such awareness campaigns can provide success stories featuring young people who have done well in neighboring countries as well as at home;
- There is a need to invest in networked computers, with access to the Internet, in public high schools;
- Affordable Internet access should be taken up as a matter of national priority. Experience in Bangladesh suggests that wireless local loops are a more business-friendly carrier option than wired telecommunications. Infrastructure requirements include reliable power supplies as well as communications network capabilities;
- Education and training are likely to be the policy arenas with the greatest prospective impact on youth employment. As well as revamping the curriculum of technical universities and colleges, importance should be placed on implementing web-based but compact modules of technical training in collaboration with the country's top public universities;
- Government credit interventions can relax capital constraints. For instance, recently the World Bank has teamed up with Citibank in India and India's largest IT training firm, the National Institute for Information Technology (NIIT), to create a $100 million credit facility. Children from poor families and street children would qualify for student loans that would be financed using this facility. Where nongovernmental organizations have a track record of working successfully in the field of education of the poor, as in Bangladesh or India, the Ministry of Information Technology could usefully engage them as conduits to deliver student loans to schools under their jurisdiction;
- Mobile education units offer a means for serving many schools even when capital is limited. The UNDP in Malaysia has mounted a program that deserves replication in Bangladesh and elsewhere. Buses have been fitted out with the necessary gear to become fully fledged IT laboratories. Wireless Internet connections are available on these "cyber-buses." Poor localities have been selected for the buses' circuits, and children from poor families have been signed up for training. Once every week, children, including those from aboriginal families, work on the Internet using the setup on the bus. Evaluations point out that such exposure is enabling poor children and teens not only to have technology dreams but also to begin to acquire the means of fulfilling them through skills learned. The program has been funded by UNDP, but local experts have done all

the developmental work. This has been a great learning experience not only for the students but for the administrators as well.

APPENDIX

HOW IT WORKS ON THE GROUND: CASE STUDIES OF IT-ENABLED EMPLOYMENT CREATION

CASE 1: A MEDICAL TRANSCRIPTION START-UP: THE SOPHISTICATED ROUTE

This company, like many others in India, was started in 1999, after the National Association of Software and Services Companies, the Indian government, and McKinsey & Co. had forecast a bright future for medical transcription there. The developer of this venture had previously run one of the largest educational institutions in southern India. From the outset, the plan was to register the unit as a big, 100 percent export-oriented firm, something that took place in March 2000.

The business was meticulously planned. Early on, the company signed up a national leader in IT training. It continued in this vein by signing up two expatriate U.S. expert instructors in medical transcription. The business plan envisaged three revenue streams, namely, selling transcription services, training people in medical transcription, and selling consulting services to other training institutions that might be established in the country. Branding and quality assurance were essential to all three. And hiring top talents was the key.

The infrastructure and premises selected by the company were top-flight. About 4,100 sq-ft of prime real estate were obtained in a central location in a major southern Indian city. The building is fitted out with a generator imported from Germany, which provides buildingwide redundancy protection against power outages. A onetime payment of U.S. $23,250 was needed to secure the long-term lease for this space. The current monthly rent is US $4,884, or $1.19 per square foot. Space in the major Indian IT centers averages $0.80–90 per square foot, almost the same as in Manila.

The unit has sixty desktop personal computers from Hewlett Packard; in 1999, each machine cost about U.S. $837. It has four servers, Compaq machines with fifteen gigabytes of storage on hard disks, and an uninterrupted power supply device made in Taiwan, for the entire range of machines costing $5815. On top of all that, for redundancy protection, each workstation was fitted out with smaller uninterrupted power supply that would provide backup for a half-hour period if all else should fail. An ISDN line in 1999 cost $13,954, of which 60 percent is a refundable deposit. The unit also has a two megabyte per second leased line from one of the Internet gateway companies as well as a smaller backup leased line from another company. This company clearly is leaving nothing to chance. Hardware and infrastructure cost it in the neighborhood of some $1.163 million in 1999.

The unit runs three shifts a day, employing sixty general transcriptionists, seventy proofreaders, and thirteen "super-proofers." The proofreading capacity is used not only to assure quality control in-house but also to check the work done by 137 general transcriptionists belonging to two smaller subcontractors located elsewhere in the city. In all, the ratio of proofreaders to general transcriptionists in this company is 42 percent, which is quite high and suggests the same meticulous attention to quality as is seen in the redundancy of infrastructure capacity.

Forty percent of the general transcriptionists are women, as are 60 percent of proofreaders and super-proofers. General medical transcriptionists require about six months of full-time training and, at the time the fieldwork for this report was done, averaged about a half year's actual production experience. After training, medical transcriptionists still need about six months of production experience before they are ready for the daily workload, transcribing 250 lines a day. Wages averaged $128 a month. Proofreaders averaged two years of production/proofreading experience and $162 in monthly wages. Super-proofers averaged three to four years of work experience and $280 a month. That the most skilled group is primarily female suggests that young women started in medical transcription careers earlier in India than young men.

How many years of formal schooling does a medical transcriptionist bring to the job? In general, they have finished about twelve years of classroom education, a lot for the typical developing country.

Training is the company's second revenue source. In the past two years, it has trained eight cohorts totaling 720 medical transcriptionists, grossing U.S. $455 in tuition fees per trainee.

The third revenue stream is consultancy services in the field of setting up medical transcription training/production units elsewhere in India. This company has provided such services to about ten smaller, more provincial units setting up medical transcription capacity in various places in southern India. Each consulting contract is worth about U.S. $3,000–5,000.

The company works for U.S.-based transcription companies for a piece rate of between four and five cents per line of transcription. In the last quarter of 2000, its revenue from transcription per se was about $28,400. At the time the company was being profiled for this report, its leaders were visiting the United States, intent in setting up a marketing office there. They were using videoconferencing to show off their facilities to American clients.

CASE 2: A MEDICAL TRANSCRIPTION START-UP: SMALL-SCALE ENTREPRENEURSHIP

Siva is about thirty-six years old and, until the beginning of this year, was utterly ignorant of all aspects of computers. At the urging of a brother-in-law who practices medicine in the United States, he signed up for medical transcription training at the beginning of 2000, shelling out U.S. $410 for a two-month, full-time course. Armed with this training and with assurance from a friendly network of seven U.S.-based doctors including his brother, Siva set up a medical transcription shop in a 300 square foot space with eight personal computers (including one server). Each workstation is a 64 megabyte RAM, 133 megahertz Intel Celeron-powered desktop. Each machine cost $560 and was fitted out with a Yamaha sound card and a foot-pedal. Each transcriptionist also needed an earphone costing $10. A server costing $1,000; an uninterrupted power supply with four batteries, costing $350 and providing backup for a three-hour period; a hub costing about $45; and an Olympus Player costing about $100 completes the tally of hardware needs. In all, hardware and infrastructure costs totaled about U.S. $10,000.

Lacking all technical knowledge, Siva hired a “consultant” who, for a monthly fee of $195, said he would mop up all technical irritants and also would help with obtaining business. Siva now works full time along with two medical transcriptionists and one proofreader. The medical transcriptionists in his employ are in their mid-twenties, while the proofreader is thirty-seven years old. The medical transcriptionists average $115 a month in wages, and the proofreader makes 20 percent more. Utilities come to about $30 a month. There is a fixed monthly subscription to be paid to the Internet service provider for about $9 a month. Rent for the space is $100 a month.

The server is used to download the audio files containing the physician’s recordings from another server based in the United States. Often, when Siva comes to work during the day the U.S. server may be down, and downloading becomes impossible. Experience persuaded him to install another server machine at his home. He now downloads most of the time during the night, when American offices are open. If he needs to communicate to people in his brother's office in the United States, all he does is e-mail and then wait for a response. The occupational hazard in all this is that sometimes he is forced to work into the wee hours of the night in order to secure enough audio data for his staff to transcribe.

Having mastered all the techniques and having realized that the consultant was not producing his money's worth, Siva got rid of him at the start of the fifth month. That is when he broke even. Luckily, the seven physicians for whom he transcribes pay him an above-average rate, ten cents per line (on the typically small volumes). His proofreader guarantees the quality of the work of the transcriptionists. Siva also makes a small amount training about four trainees every four months, charging them $250 each. For the two most recent months, his gross income has come to about $350 a month, clearly a fortune compared to alternative uses of his time. He prays fervently that such good times should continue.

CASE 3: DIVERSIFICATION INTO INFORMATIONAL PROCESSING: FROM REAL ESTATE TO TRANSCRIPTION

Supra had made money in real estate developing land when demand for high-end housing suddenly boomed. In late 1998, as he was scouring the horizon for the next big thing, he hit upon information processing for overseas markets. All his friends were getting into medical transcription, riding the crest of favorable government policies and cheap infrastructure. Loath to keep cash in the bank, and by nature frugal, Supra went into medical transcription in early 1999. (He is so frugal that his own office does not have an air conditioner, although he can easily afford it and all his peers work in fully air-conditioned offices.) But he proceeded in a thoroughly professional way, seeking and paying for top professional help along the way.

He bought a package of consultancy services for U.S. $9,090. The consultant advised him on all technical aspects of the unit. He decided to set up shop in 2,200 square feet of space he owned in the city. Such a space could have been expected to bring in a monthly rent of about $2,400. He bought hardware (fifty desktops, three servers, leased and ISDN lines, uninterrupted power supply, hubs, foot-pedals, earphones) costing him a total of $50,000. His business model comprised the same three revenue streams as many of his competitors, namely, transcription, training, and consultancy.

He first trained, gratis, a batch of twenty young people over six months. The second batch was prepared at a fee of $220 per trainee. Of these forty trainees, thirty-five now work for him as medical transcriptionists. A full 70 percent are women, averaging about twenty-five years of age. According to Supra, each medical transcriptionist has fourteen or so years of educational background. Subsequently, he trained two cohorts, each about forty strong, for a unit fee of $455. In eighteen months, he has produced a total of 120 medical transcriptionists.

In response to generous incentives to technology-oriented service companies offered by the state government of Gujarat, many Gujarati businesspeople are proposing new ventures in the transcription field. They are looking to southern cities such as Bangalore and Madras to find expertise for setting up medical transcription units. Supra, who was himself new to the field only two years ago, has been approached by people in Ahmadabad, the principal city of Gujarat, about consulting contracts, each of which may be worth U.S. $6,000–$9,000. So confident is he about his core competency in systemwide transcription consultancy that he even reversed roles with the interviewer, asking him questions about whether Dhaka might be a promising market for his consultancy services.

CASE 4: SHIFTING INTO IT: FROM LITERATURE GRADUATE TO NETWORK ADMINISTRATOR

Anita is twenty-seven years old and hails from southern India. The eldest among six children of a schoolteacher with an ardent love for English literature, she faced family pressure to pursue a literary career. While all her cousins studied math and science at school, she leaned toward the humanities, obtaining a masters degree in literature by the time she was twenty-three. When she hit the job market, however, she found her degree in literature was a kind of a baggage: the many jobs she was offered—whether as a junior teacher or as a secretary who could answer the phone in nicely accented English—paid atrociously.

Anita accepted one of those low-paying jobs, but she had resolved to retrain. After hours she enrolled in a six-month course for computer network specialists at a private training school for a cost of U.S. $500. All her life she was a serious student, and she did well in her training. When it was over, she quit her teaching job and, in 1997, landed an entry-level job at the help desk in a small firm in the hospitality industry. There, with hands-on practice, she mastered Windows NT and e-mail servers. She started at $200 a month.

At the start of 2000, she changed her job and accepted the position of network administrator at one of the largest five-star hotels in India's "software triangle." There she manages the network and has the rare privilege of lecturing the multimillionaire owner of the hotel about the dire need for him to become computer literate, in the name of doing well in the information society. She makes $320 a month (four times what her peers pursuing literature-related careers are making), rides her own Vespa to office, and supervises a crew of three junior-level technicians. She continues to pursue IT training, working her way along the

Cisco certification track, anticipating future opportunities. She contributes to the education of five of her siblings and visits her parents every weekend. Anita personifies the opportunities that IT has brought to young, ambitious women in India.

CASE 5: FROM DATA ENTRY OPERATOR TO COMPANY BOSS

Niranjan is thirty-one years old. He started working for a major multinational bank in a large city in southern India in the mid-1980s, when he was only seventeen. He had just finished his secondary education. Beginning as a teller, he eventually became conversant with all procedures of a typical Indian bank. Indian banks were just introducing computerization, using magnetic ink character recognition. With the bank, he worked in four cities by 1988. Niranjan taught himself touch typing, and when desktop computers were introduced to the bank in 1992, he acquired on his own a fair degree of computer literacy.

The introduction of charge or debit cards in India, around 1990, underscored the importance to bank management of data entry systems. The number of debit card accounts at the bank piled up rapidly, and the resulting mountains of paperwork swamped the conventional system. Thus, the bank commenced a strategy to develop "data centers." It did not take long to realize that outsourcing was a cheaper option than developing in-house competence. Indeed, it was Niranjan who first figured it out that he could make money by selling data entry services to the bank. This is how WiseHire Accounts, a data processing consultancy, was born in 1992. Niranjan quit his job at the bank after persuading the manager to give him the contract to help with data entry for the thousands of debit card accounts.

In the meantime, credit cards were fast replacing debit cards. Between 1994 and 1999, the number of credit cards in India grew from next to nothing to about 3 million. The detailed information sought from potential customers on an application form for a credit card and the subsequent flow of communication between the bank and the cardholder are data that need processing, indexing, and archiving. The bank that Niranjan had worked for gave him the contract to process this information and prepare subsequent correspondence for all of its Indian accounts. He expanded his production crew, hiring only high school graduates who knew the basics of computers and could touch-type. Most were in their early twenties. On his watch, the number of credit card accounts at this multinational institution rose from nothing in 1994 to about 1.1 million in 1999. By that year, employment of data entry keyers in Niranjan's company had risen to 150, with salaries averaging $60 a month.

However, all changed in 1999. The bank decided that software for imaging and character recognition had become sufficiently robust to dispense with conventional teams of word processors. Niranjan had already anticipated the move: by spending $4,400, he had installed intelligent character recognition technologies developed by an Indian company based in New Delhi, ICPL. So laborsaving was this new technology that he had to let go about a hundred of his data entry personnel. Now his imaging business operates with just forty workers. These employees scan the filled-in credit card application forms and then index them with unique identifiers. Easy retrieval of such digitized forms is one of the chief attractions of this technology. Seventeen of his employees are in the imaging section of his business, while another seventeen are in the mailing section. His company oversees all production, indexing, and maintenance of customer correspondence (preparing letters to be signed by authorized bank staff, and so forth). He has four entry-level software developers who write plain-vanilla applications in Visual Basic and Access. He managed to negotiate new jobs in the bank, as junior officers, for all of the hundred employees he had to lay off. Because of their experience at WiseHire Accounts, these workers had become conversant with many aspects of financial back-office work and thus had become highly employable. Niranjan used this experience to diversify his business, adding a temporary help agency for people with some IT skills. This has become a second revenue source.

As of 2000, Niranjan's company did monthly business with the bank to the tune of about U.S. $7,800. His monthly total costs ran about $6,000. Depreciation on equipment was expected to add another $750. Niranjan's net earnings from the imaging business were therefore about $1,000 a month. He has unspecified income from his placement business, too. All in all, with an annual income before taxes of at least $12,000, Niranjan is fifteen times as well off as his peers who have worked for foreign banks in India for a similar period as he has. This young entrepreneur has bet the farm on more than one occasion. And he has come out on top of his challenges. Asked where he would like to go next, he replied with impressively quiet confidence that he was hoping to snag the account of a second large multinational company for his imaging business, and that would be it!

CASE 6: FROM BASIC TO JAVA: THE ODYSSEY OF A NEW ECONOMY INDIAN ENTREPRENEUR

Mittal Junjuniwalla is thirty-three years old. He attended a vocational institute in Bombay, earning a diploma in electrical engineering, in 1985. His first job, with a Bangalore-based software development company, was writing reservation and billing applications in Wang

Basic for a major hotel chain. Next, he was writing code for a government department whose mandate included monitoring pollution. Between 1988 and 1990, he wrote programs in C that would help with updating databases on minicomputers about emission of pollutants by chemical companies.

Restless and innovative, Mittal set up his own company in southern India in 1990, specializing in professional publishing software, written in C++, for non-Latin alphabets. This software permitted text editing and formatting. His first major Indian clients included some of the best-known mass-circulation dailies, such as the *Times of India*, *Ananda Bazar Patrika*, and the *Hindu*. Gradually, he became quite good at developing word processors for regional languages, like Hindi, Tamil, and Urdu. He began to give well-regarded U.S. companies a run for their money in competing for contracts. In 1993, he demonstrated his software for Urdu in a trade show in Lahore, and his work received rave reviews.

Then, in 1994–95 he received a contract to add full-color capabilities to his software, modified to suit the new Pentium microprocessors from Intel. For a British client, he developed C++ software that would facilitate proofing, data compression, and messaging from remote locations. In 1998, he produced software (again in C++) for high-end image scanning, which includes scanning, cropping, color processing, and data compression.

The industry was meantime migrating to Java, and Mittal got on the bandwagon. He picked up Java in about two months, and once he felt surefooted, he began trawling for small contracts, first with his old British clients. His first “Java break” came in early 2000, when his British client offered him a contract to write electronic commerce applications for an online betting company specializing in sports. The first module was for soccer. Future modules will cover cricket, horse racing, and Formula-1 racing. Mittal’s young Java programmers and ancillary staff, as of November 2000, included six senior developers, two graphics experts, two design specialists, eleven junior developers, and two “office boys.” He had no resident accountant or secretary; he answers his own phones. He paid his senior people about U.S. $325 a month and the junior developers about $240–275 a month. Most of his staff are under thirty, and two of the developers are young women. These are not computer science graduates but have nonetheless had a college education and have since been certified, mostly with the Microsoft Certified Solution Developer credential. Mittal taught them Java himself.

The environment in which this team works resonates with its no-nonsense, capitalist business practices. The office is on the fifth floor of a building that does not have an elevator. The floor, all 1,500 square feet of it, is uncarpeted, and the rooms are not air-conditioned;

they are cooled by four ceiling fans. Lighting is unremarkable. Mittal is cooled by a tabletop, sixteen-inch-diameter fan. This spartan simplicity, combined with Mittal's meritocratic practices in employment, evoked the credo "plain living, high thinking." The staff looked competent, and yet the office had none of the bells and whistles that legend associates with Silicon Valley.

Mittal told me that he bills at the rate of U.S. $20 an hour for his firm's work, which may be an exaggeration. But there is no reason to doubt his claim that he had billed about 18,000 hours since May 2000. Asked whether his staff gripes about poor working conditions, he replied, far from it. His employees are beholden to him because, by constantly challenging them, he keeps them on software development's leading edge. These guys, he said, are keen learners. They value the experience they are getting at his firm, regardless of the inadequacy of ceiling fans and the long climb. In India's software triangle, their IT experience is a golden key to later riches. Mittal ploughs back earnings into products that he himself designs and fleshes out. He then mobilizes his team of developers to help with these in-house projects. Thus, he generates work for his staff, contract or no.

Mittal mentioned that he was off to Europe to negotiate an extension of his contract, which would necessitate ratcheting up his employment of professionals from twenty-one to forty-one. He was going to have to find additional space in the same building. His total billing during the two next years from the same British client could top 60,000 hours, with his gross being well in excess of a million U.S. dollars.

Leading by example, teaching and shaping, this aggressive, young entrepreneur presents the face of a new India to the Western world. Speaking with self-assurance, always careful to document a point he was making with graphics from his well-worn laptop, occasionally requesting priority on the lone Internet access line but always in touch with his staff's activity at the workstations, in the course of a three-hour interview he demonstrated the latest from his firm's research and development. This features an application that can handle online customer service using interactive voice response; another project is a job placement portal for IT professionals. Mittal was in the midst of looking for U.S.-based companies that would be willing to market his products in the United States or would help him land contracts in exchange for agreed commissions.

CASE 7: FROM STOCK MARKET MAVEN TO INFORMATION TECHNOLOGY TRAINING CZAR IN BANGLADESH

Kibria is thirty-eight years old. He spent the first ten years of his working life with a multinational organization, away from his native Bangladesh. While working there, he also played the stock market with his own money. In 1994 he returned to Dhaka and set up his own company. In 1996 Bangladesh's stock market had its only episode of "irrational exuberance," during which valuations soared. Kibria had entered the market at the ground floor, and his luck panned out. When the economy went into a tailspin in early 1997, he astutely bailed out. He emerged with fat profits from his stock market forays.

Trawling for his next business idea, Kibria, at the suggestion of a former colleague with roots in India, visited that country. It was then that the idea of setting up a company to train young people in information technology crystallized in his mind. Once back, he floated a company in the summer of 1997. He bought into the franchise of one of India's major training enterprises. He took in his first batch of trainees in the summer of 1997. This was a first in Bangladesh. That he was ahead of the competition gave his company a big advantage. It has used its early start to defend its market leadership successfully in the face of entry by nominally higher-octane competition, featuring one of Bangladesh's better-known conglomerates and another of India's "training majors."

In the past three years, Kibria's company has sold, for undisclosed sums, franchises to seven other concerns in Dhaka and other major Bangladesh cities. Experts estimate that each franchisee pays U.S. $20,000–25,000, depending on the course content. (Franchisees do not mind paying such high entry fees because the prevailing notion is that these training institutes have strong prospects.)

In the main facility of Kibria's company is located on a top floor of a building without an elevator. A total of 1,500 square feet of space is densely populated by rows of computers arranged into five classrooms. Some two hundred students train here five days a week. Microsoft software and relational database management systems from Oracle are the staples of the training. The Microsoft Certified Systems Engineers qualification is the strongest draw, with Oracle Relational Database Management Systems a close second. A place in the Microsoft track costs a student $1,000, for a course that lasts about three months. At the time field interviews were being conducted for this report, Kibria was in the United States, talking to electronic commerce companies about software distribution and training rights in Bangladesh.

TABLES

Table 1: GDP by Industry and Industrial Segments, U.S., 1998

Industry/Industry Segments	Gross Output (Current $ in billions)	Percentage of Total
Gross Domestic Product	$8,782	100%
Private Industries	7,678	87.4
Agriculture and Mining	228	2.6
Construction	381	4.3
Manufacturing	1,432	16.3
Industrial machinery and equipment	159	1.8
Electronic and electrical equipment	159	1.8
Transportation and Public Utilities	732	8.3
Telephone and telegraph	179	2.0
Radio and television	59	0.7
Wholesale and Retail Trade	1,398	15.9
Finance, Insurance, Real Estate	1,709	19.5
Services	1,830	20.8
Business services	440	5.0
Amusement services	70	0.8
Government services	1,103	12.6

Source: U.S. Department of Commerce Survey of Current Business, November 2001, p. 26.

Table 2: Revenue Growth Rates in Telecommunications, Information, and Mass Media Industries, U.S., 1995–1998

(Table 2 continues on the next page)

Subsectors and offerings	**Current dollars in billions Year**		**Rate of growth (compounded annually)**
	1995	**1998**	
III. Electronic Mass Media	100.5	143.8	12.68
(A) Services	71.8	99.64	11.6
(i) Television	32.4	49.8	15.4
(ii) Television broadcasting	27.9	34.8	7.6
(iii) Radio broadcasting	11.47	15.05	9.5
(B) Equipment	28.7	44.1	15.4
IV. Grand Total	638.4	858.7	10.38

Subsectors and offerings	**Current dollars in billions Year**		**Rate of growth (compounded annually)**
	1995	**1998**	
I. Telecommunications	246.8	304.1	7.2
(A) Services	185.0	234.9	8.3
(i) CLECs	46.0	56.4	6.91
(ii) Toll services	83.8	106.0	8.16
(iii) Wireless	12.54	18.2	14.6
(iv) Network access	29.6	34.3	5.0
(B) Equipment	61.8	96.2	3.8
(i) Telephone apparatus	26.2	35.0	10.2
(ii) Fiber optics	3.7	5.7	15.4
(iii) Search and navigation equipment	32.0	28.5	(3.8)
II. Information industry	291.1	410.8	12.1
(A) Services	110	165.2	14.5
(i) Professional computer services	71.6	110.4	15.6
(ii) Data processing/network	33.4	48.3	13.2
(iii) Electronic information services	5.05	6.5	8.8
(B) Equipment	181.1	245.6	10.7
(i) Computer equipment/peripheral	86.1	115.0	10.1
(ii) Software	95.1	130.6	11.2

Source: Data from materials from the Federal Communications Commission. Note: Growth rates are compound annual rates in percentages based on current dollars.

Table 3: Employment Growth Rates in Telecommunications, Information, and Mass Media Industries, U.S., 1995–1998

Subsectors and offerings	Number of jobs in millions Year		Annual compound growth rates (percentage)
	1995	1998	
I. Telecommunications	1640	1838.8	3.89
(A) Services	908	1033	4.39
(i) CLECs	…	…	…
(ii) Toll services	…	…	…
(iii) Wireless subscription	….	…	…
(iv) Network access	…	…	…
(B) Equipment	731.8	805.6	3.25
(i) Telephone apparatus	111.7	125.5	3.96
(ii) Fiber optics	459.4	520.4	4.24
(iii) Search/navigation equipment	160.7	159.7	(.21)
II. Information industry	1385	1908	11.29
(A) Services	852	1265	14.1
(i) Professional computer services	546.2	866.6	16.63
(ii) Data processing/network	248.7	306.1	7.1
(iii) Electronic information Services	56.9	92.4	17.5
(B) Equipment	533	644	6.5
(i) Computer equipment/peripheral	352.2	374.8	2.1
(ii) Software	180.8	268.9	14.1
III. Electronic Mass Media	516.0	552.0	2.3
(A) Services	391.2	430.5	3.24
(i) Television	155.5	185.0	5.96
(ii) Television Broadcasting	122.7	128.0	1.45
(iii) Radio Broadcasting	113.0	117.4	1.28
(B) Equipment	124.7	121.9	(.75)

Source: Data from materials from the Federal Communications Commission.

Table 4: Employment in U.S. Banks and Financial Institutions, 1990–1999

(All numbers are in thousands of workers)

Year	Depository institutions			Nondepository institutions	Banks	Insurance and all other financials	Grand total
	Banks	Others	Total				
1990	1,564	438	2,002	373	2,375	4,085	6,460
1991	1,529	382	1,911	379	2,290	4,109	6,399
1992	1,490	346	1,836	406	2,242	4,102	6,344
1993	1,497	324	1,821	455	2,276	4,214	6,490
1994	1,484	305	1,789	491	2,280	4,339	6,619
1995	1,465	276	1,741	463	2,204	4,318	6,522
1996	1,458	266	1,724	522	2,246	4,371	6,617
1997	1,462	260	1,722	577	2,299	4,504	6,803
1998	1,472	256	1,728	658	2,386	4,684	7,070
1999	1,476	252	1,728	710	2,438	4,797	7,235

Source: Historical data from U.S. Department of Labor, Bureau of Labor Statistics, B tables of the Employment Situation Release, available online at www.bls.gov/webapps/legacy/cesbtab1.htm

Note: “Banks” corresponds to figures for all depository and nondepository institutions. Insurance and all other financials includes insurance company workers, insurance brokers, security brokers, real estate agents, etc.

Table 5: Employment in Several Service Industries, U.S., 1990–1999

(All numbers are in thousands of workers)

Year	Computer and office equipment industry	Electronic components	Computer and data processing services	Professional supply services	Help supply services	Total
1990	438	582	772	1,534	1,288	4,614
1991	415	555	797	1,484	1,268	4,519
1992	391	527	836	1,629	1,411	4,794
1993	363	528	893	1,906	1,669	5,359
1994	354	544	959	2,272	2,017	6,146
1995	352	581	1,090	2,476	2,189	6,688
1996	362	617	1,228	2,654	2,352	7,213
1997	376	650	1,409	2,985	2,656	8,076
1998	382	660	1,615	3,278	2,926	8,861
1999	370	636	1,831	3,600	3,228	9,665

Source: Data from U.S. Department of Labor, Bureau of Labor Statistics establishment data on employment (seasonally adjusted), Table B-3 from Current Employment series. First two columns covered under "manufacturing"; the three others are part of "business services." Help services is subsumed under professional services. Total is author's addition of previous columns.

Note: "Electronic components" mainly constitutes manufacturing of telecommunications equipment.

Table 6: Wages of Production Workers in Several Industries, U.S., 1990–1999

Year	Nominal hourly wage rate ($/hour)		Real hourly wage rate ($/hour)	
	Financial industries	Manufacturing industries	Financial industries	Manufacturing industries
1990	10.00	10.86	10.00	10.86
1991	10.45	11.22	10.00	10.75
1992	10.84	11.48	10.06	10.66
1993	11.40	11.74	10.30	10.61
1994	11.83	12.05	10.40	10.59
1995	12.34	12.40	10.56	10.61
1996	12.82	12.81	10.65	10.64
1997	13.34	13.12	10.84	10.66
1998	14.07	13.44	11.25	10.74
1999	14.67	13.98	11.48	10.94

Source: Employment, hours, and earnings data from U.S. Department of Labor, Bureau of Labor Statistics, Current Employment Statistics Survey time series, Table B-11 in each of the relevant years.

Table 7: Projected Percentage Change in Total U.S. Employment by Major Occupations, 1998–2008

Types of jobs	Rates of growth (Percent)
Professional specialty	27
Technicians and related support	22
Executive, administrative, and managerial	16
Marketing and sales	15
Operators and fabricators	9
Administrative support	9
Precision crafts	8
Agriculture	2

Source: Data from U.S. Department of Labor, Bureau of Labor Statistics, 1998–2008 Employment Projections, released November 30, 1999

Note: Professional specialties include computer system analysts, computer engineers and scientists, social education teachers, and social/recreational workers. These four are the fastest-growing occupational categories under the rubric of professional. Technicians include network support and help-desk staff.

Table 8: IT-enabled Services in the Indian Economy: 1998 Figures and Forecast for 2008

Types of jobs	**1998 number of jobs and annual revenue**		**Forecast for 2008**	
	Revenue ($ million)	**Jobs**	**Revenue ($ million)**	**Jobs**
Back-office jobs	96	9,700	4,360	260,000
Remote maintenance support	15	1,600	3,100	180,000
Medical transcription	32	3,800	2,530	160,000
Call center agents	9	1,400	1,380	100,000
Database services	10	1,000	1,500	100,000
Content development	62	5,500	5,747	300,000
Total	224	23,000	18,617	1,100,000

Source: McKinsey and Co., 1999

Note: Data pertaining to 1998 are industry estimates from the report cited, prepared by McKinsey and Co. The forecasts for 2008 are not necessarily based on a time trend extrapolating from some kind of public domain historical data regarding size of the individual segments of the market. Rather, the estimates are made working backward from the forecast size of the world market for the individual market segments and making inferences about the percentage market share for India in each case.

BIBLIOGRAPHY

Annan, Kofi. 1999. "Issues in Youth Employment." Speech delivered at joint World Bank/International Monetary Fund meeting, Washington, D.C., August.

Arthur Young. 1988. "The Potential for Data Entry Operations in the Caribbean: Final Report." Report prepared for the Office of the Private Sector Coordinator, U.S. Agency for International Development.

Aspinall, Richard. 1999. "Putting VSAT Networks to Work." *Telecommunications* (May): 4–8. Available online at http://www.telecoms-mag.com/default.asp?journalid=2&func=articles&page=vsat&year=1999&month=5.

Autor, David H. 2000a. "Outsourcing at Will: Unjust Dismissal Doctrine and the Growth of Temporary Help Employment." NBER Working Paper no. 7557, National Bureau of Economic Research, Cambridge, Mass., February.

———. 2000b. "Why Do Temporary Help Firms Provide Free General Skills Training?" NBER Working Paper no. 7637, National Bureau of Economic Research, Cambridge, Mass., April.

Autor, David H., Lawrence F. Katz, and Alan B. Krueger. 1998. "Computing Inequality: Have Computers Changed the Labor Market?" *Quarterly Journal of Economics* 113, no. 4 (November): 1169–1213.

Autor, David H., Frank Levy, and Richard Murname. 2000. "Upstairs, Downstairs: Computer-Skill Complementarity and Computer-Labor Substitution on Two Floors of a Large Bank." NBER Working Paper no. 7890, National Bureau of Economic Research, Cambridge, Mass., September.

Baran, Barbara. 1985. "Office Automation and Women's Work: The Technological Transformation of the Insurance Industry." In *High Technology, Space, and Society*, Urban Affairs Annual Reviews, vol. 28, edited by Manuel Castells. Beverly Hills, Calif.: Sage Publications.

Bayes, A., J. von Braun, and R. Akhter. 1999. "Village Pay Phones and Poverty Reduction: Insights from a Grameen Bank Initiative in Bangladesh." ZEF Discussion Papers on Development Policy no. 8, Zentrum fuer Entwicklungsforschung [Center for Development Research], University of Bonn, June. Available online at http://www.zef.de/download/zef_dp/zef_dp8–99.pdf.

Bedi, Arjun S. 1999. "The Role of Information and Communications Technologies in Economic Development: A Partial Survey." ZEF Discussion Papers on Development Policy no. 7, Zentrum fuer Entwicklungsforschung [Center for Development Research], University of Bonn, May. Available online at http://www.zef.de/download/zef_dp/zef_dp7–99.pdf.

Bhattacharjee, A. 1998. "The Big Glitch: India Turns the Bug into a Cash Cow." W*orldPaper Online*, June. Available online at http://www.worldpaper.com/syndication/archive.html.

Bond, James. 1997. "Telecommunications Is Dead, Long Live Networking: The Effect of the Information Revolution on the Telecom Industry." *Public Policy for the Private Sector*, Note no. 119, World Bank Group, Washington, D.C., July. Available online at http://www.worldbank.org/html/fpd/notes/119/119bond.pdf.

Breman, Jan. 1985. "A Dualistic Labour System? A Critique of the 'Informal Sector' Concept." In *Planning for Small Enterprises in Third World Cities*, edited by Ray Bromley. Oxford: Pergamon Press.

Bresnahan, Timothy F. 1999. "Computerisation and Wage Dispersion: An Analytical Reinterpretation." *Economic Journal* 109, no. 456 (June): 390–415.

Bresnahan, Timothy F., and Manuel Trajtenberg. 1995. "General Purpose Technologies: Engines of Growth?" *Journal of Econometrics* 65, no. 1 (January): 83–108.
Bruno, Catherine, and Sandrine Cazes. 1998. "French Youth Unemployment: An Overview." Employment and Training Papers no. 23, International Labor Organization, Geneva. Available online at http://www.ilo.org/public/english/employment/strat/download/etp23.pdf.
Brynjolfsson, Erik, and Lorin M. Hitt. 1995. "Information Technology as a Factor of Production: The Role of Differences among Firms." *Economics of Innovation and New Technology* 3, no. 4 (Fall): 183–99.
———. 1998a. "Beyond the Productivity Paradox: Computers Are the Catalyst for Bigger Changes." *Communications of the ACM* [Association for Computing Machinery] 41, no. 8 (August): 49–55.
———. 1998b. "Information Technology and Organizational Design: Evidence From Micro Data." Unpublished manuscript, MIT, October.
Brynjolfsson, Erik, and Shinkyu Yang. 1996. "Information Technology and Productivity: A Review of the Literature." *Advances in Computers* 43: 179–214.
———. 1997. "The Intangible Costs and Benefits of Computer Investments: Evidence from the Financial Markets." Proceedings of the International Conference on Information Systems, Atlanta, December. Revised April 1999.
Bureau of Economic Analysis, U.S. Department of Commerce. 1999. *Survey of Current Business.* Washington, D.C.: U.S. Government Printing Office, November.
Bureau of Labor Statistics, U.S. Department of Labor. 2000. *Current Employment Statistics 2000.* Available online at http://www.bls.gov/ces/home.htm#ee.
Business Week. 1998. "India's Whiz Kids: Inside the Indian Institutes of Technology's Star Factory," December 7. Available online at http://www.skyblaze.com/Recent_News/whizkids.htm.
Cairncross, Frances. 1997. *The Death of Distance: How the Communications Revolution Will Change Our Lives.* Boston: Harvard Business School Press.
Chowdhury, Nuimuddin. 1999a. "Putting Bangladesh's Poor Women on the World Wide Web Using Electronic Commerce: Towards a Global Economic Village." Paper prepared for the International Development Research Centre, Ottawa, October.
———. 1999b. "Bangladesh's Information and Communications Technology Infrastructure: First Thoughts on a Roadmap." Paper presented to a session under the auspices of Expatriate Bangladeshi 2000, Oak Hill, Va., November. Available online at www.eb2000.org.
———. 2000. "Divining the MNC Mind: Locational Drivers of Multinational Corporations' Investments," mimeo, December.
Cosper, Amy C. 1997. "VSATs Find Their Voice: When Terrestrial Infrastructure Falls Short, VSATs Fill in the Telephony Gaps." *Global Telephony,* September. Available online at http://industryclick.com/magazinearticle.asp?magazineid=2&releaseid=3082&magazinearticleid=19555&siteid=3.
Craig, Ben. 1997. "The Long-run Demand for Labor in the Banking Industry." *Economic Review* (Federal Reserve Board of Cleveland) 33, no. 3 (Quarter 3): 23–33.
Dertouzos, Michael. 1997. *What Will Be: How the New World of Information Will Change Our Lives.* New York: HarperBusiness.
Duncan, Nancy B., 1995. "Buying Core Competencies? A Study of the Impact of Outsourcing on IT Infrastructure Flexibility." Kent State University, October. Available online at http://hsb.baylor.edu/ramsower/acis/papers/duncan.htm.
Economist. 2000. "A Survey of Electronic Governance," June 24.

Evans, Philip B., and Thomas S. Wurster. 1998. "Strategy and the New Economics of Information." In *Perspectives on Strategy from the Boston Consulting Group*, edited by Carl W. Stern and George Stalk, Jr. New York: John Wiley and Sons, pp. 102–23.

Executive Office of the President. 2000. "Information Technology Research and Development: Information Technology for the 21st Century," January 21.

Fernie, Sue. 1999. "Brave New World? It's Those Call Centres Again." *CentrePiece* (Centre for Economic Performance, London School of Economics) 4, no. 1 (Spring 1999).

Fernie, Sue, and David Metcalf. 1999. "Ricky Don't Lose that Number: Payment Systems, Monitoring and Performance in Call Centres." Centre for Economic Performance Working Papers no. 1047, London School of Economics, October.

Gormley, J., W. Bluestein, J. Gatoff, and H. Chun, 1998. "Runaway Costs of Packaged Applications," *Forrester Report* 3, no. 5, Forrester Research, Cambridge, Mass.

Greenspan, Alan. 2000. "The Revolution in Information Technology." Remarks before the Boston College Conference on the New Economy, March 6. Available online at http://www.federalreserve.gov/BoardDocs/Speeches/2000/20000306.htm.

Greenstein, Shane M., and Pablo T. Spiller. 1996. "Estimating the Welfare Effects of Digital Infrastructure." NBER Working Paper no. 5770, National Bureau of Economic Research, Cambridge, Mass., September.

Greenwood, Jeremy, and Boyan Jovanovic. 1999. "The Information-Technology Revolution and the Stock Market." *American Economic Review* 89, no. 2 (May): 116–22.

Greider, William. 1998. *One World, Ready or Not: The Manic Logic of Global Capitalism*. New York: Simon and Schuster.

Hamel, Gary, and C. K. Prahalad. 1994. *Competing for the Future.* Boston: Harvard Business School Press.

Hamelink, Cees J. 1997. "New Information and Communication Technologies: Social Development and Cultural Change." Discussion Paper no. 86, United Nations Research Institute for Social Development, Geneva, June.

Heitzman, James. 1999. "Corporate Strategy and Planning in the Science City: Bangalore as 'Silicon Valley.'" *Economic and Political Weekly* (Bombay) 34, no. 5 (January 30-February 5): PE2–11.

Helpman, Elhanan, editor. 1998. *General Purpose Technologies and Economic Growth.* Cambridge, Mass.: MIT Press.

Herren, Kim A. 1998. "Outsourcing Business Communications in the Insurance Industry." DST Output website, available online at http://www.output.net/docs/newsroom/outsourcing.html. Reprinted from *Handbook of Technology in Financial Services*, edited by Jessica Keyes. Boca Raton, Fla.: Auerbach.

Hitt, Lorin M., and Erik Brynjolfsson. 1996. "Productivity, Business Profitability, and Consumer Surplus: Three Different Measures of Information Technology Value." *MIS Quarterly* 20, no. 2 (June): 121–42.

Howland, Marie. 1991. "Computer Services in the Rural Economy." Report to the Ford Foundation. Department of Urban Studies and Planning, University of Maryland.

Immergluck, Daniel. 1999. "Cities and Finance Jobs: The Effects of Financial Services Restructuring on the Location of Employment." Discussion Paper no. 99:11, Center on Urban and Metropolitan Policy, Brookings Institution, Washington, D.C., November. Available online at http://www.brook.edu/dybdocroot/es/urban/immergluck.pdf.

Jorgenson, Dale W., and Kevin J. Stiroh. 1995. "Computers and Growth." *Economics of Innovation and New Technology* 4, no. 4 (October): 296–316.

———. 1998. "The Role of Computer Investment and Consumption in U.S. Economic Growth." Harvard University, mimeo. Quoted in Jorgenson and Stiroh (1999).

———. 1999. "Information Technology and Growth." *American Economic Review* 89, no. 2 (May): S109–15.

Kenney, Martin. 1999. "Merger Activity in the Global Economy: Implications for Korea." Paper prepared for the "Conference on Industrial Globalization, East Asia's Strategic Importance and the Role of Korea," Honolulu, August. Available online at http://hcd.ucdavis.edu/faculty/Kenney/merger.html.

Krueger, Alan. 1993. "How Computers Change the Wage Structure: Evidence from Micro Data." *Quarterly Journal of Economics* 108, no. 1 (February): 35–78.

Krugman, Paul. 1995. "Growing World Trade: Causes and Consequences." *Brookings Papers on Economic Activity*, no. 1: 327–77.

Lawrence, Robert Z. 1996. *Single World, Divided Nations? International Trade and the OECD Labor Markets.* Washington, D.C.: Brookings Institution Press.

Lawrence, Robert Z., and Robert E. Litan. 1997. "Globaphobia: The Wrong Debate over Trade Policy." Policy Brief no. 24, Brookings Institution, Washington, D.C., September. Available online at http://www.brook.edu/dybdocroot/comm/PolicyBriefs/pb024/pb24.htm.

Lee, Eddy. 1996. "Globalization and Employment: Is Anxiety Justified?" *International Labour Review* (International Labor Organization, Geneva) 135, no. 5: 485–97.

Leiner, Barry M., Vinton G. Cerf, David D. Clark, Robert E. Kahn, Leonard Kleinrock, Daniel C. Lynch, Jon Postel, Larry G. Roberts, and Stephen Wolff. 2000. "A Brief History of the Internet." Internet Society, Reston, Va., August 4. Available online at http://www.isoc.org/internet/history/brief.shtml#Introduction.

Lent, John A. 1991. "The North American Wave: Communication Technology in the Caribbean." In *Transnational Communications: Wiring the Third World*, edited by Gerald Sussman and John A. Lent. London: Sage Publications.

Lichtenberg, Frank R. 1995. "The Output Contributions of Computer Equipment and Personnel: A Firm-Level Analysis." *Economics of Innovation and New Technology* 3, no. 3 (July-September): 201–17.

Lipsey, Richard G., Cliff Bekar, and Kenneth Carlaw. 1998. "What Requires Explanation?" in *General Purpose Technologies and Economic Growth,* edited by Elhanan Helpman. Cambridge, Mass.: MIT Press, pp. 15–54.

McLaren, John. 2000. "'Globalization' and Vertical Structure." *American Economic Review* 90, no. 5 (December): 1239–54.

Madhavan, Ravi. 2000. "The Globalization of the U.S. Venture Capital Industry: A Network Perspective." Center for International Business Education and Research, University of Illinois at Urbana-Champaign.

Mann, Catherine L., Sue E. Eckert, and Sarah Cleeland Knight. 2000. *Global Electronic Commerce: A Policy Primer*. Washington, D.C.: Institute for International Economics.

Marquand, Robert. 1999. "Rise of 'Techno-Coolies'? Fast, Cheap, and in English, India Clerks for the World." *Christian Science Monitor*, April 30.

Matloff, Norman. 2002. "Debunking the Myth of a Desperate Software Labor Shortage." Testimony before the U.S. House Judiciary Committee, Subcommittee on Immigration, April 21, 1998, updated February 4. Available online at http://heather.cs.ucdavis.edu/itaa.html.

McKenney, James L. 1995. *Waves of Change: Business Evolution through Information Technology.* Boston: Harvard Business School Press.
McKinsey and Co. 1999. "India's Software and Information Technology-enabled Services Industry: Forecasts." Report prepared for the National Association of Software and Service Companies, New Delhi.
Mitra, Raja. 2000. "Recent ICT Developments in India: Industry Trends, Project Proposals, Institutional Arrangements and Contacts." Report prepared for the Global Information and Communications Technology Department, World Bank Group, draft, June 7.
Mitter, Swasti. 2000. "Teleworking and Teletrade in India: Diverse Perspectives and Visions." *Economic and Political Weekly* (Bombay) 35, no. 26 (June 24–30): 2241–52.
Morgenson, Gretchen. 2001. "Eroding Paper Gains May Undo a Remarkable Resiliency." *New York Times*, January 28, sec. 3, p. 1.
Mulgan, Geoff. 1998. *Connexity: How to Live in a Connected World.* Boston: Harvard Business School Press.
National Science Foundation. 1997. *Industry, Technological Change, and the Global Marketplace*. Washington, D.C., July.
Nunamaker, C. 1997. "Management Inefficiencies and Information Technology Spending in U.S. Businesses." Paper presented at InfoWeek 500 Conference, Dana Point, California, September.
Okinawa Charter on Global Information Society. 2000. Signed at Group of Eight summit, Okinawa, July. Text available online at http://usembassy.state.gov/tokyo/wwwhg063.html.
Panos Information Technology Briefing no. 33. n.d. Panos Institute, London.
Posthuma, A. 1987. "The Internationalization of Clerical Work: A Study of Offshore Office Services in the Caribbean." Science Policy Research Unit Occasional Papers no. 24, University of Sussex.
Prahalad, C. K., and Gary Hamel. 1990. "The Core Competency of the Corporation." *Harvard Business Review*, May-June 1990, pp. 79–90.
President's Information Technology Advisory Committee. 1999. "Information Technology Research: Investing in Our Future." Report to the President, February 24.
Ramani, S. 2000. "IT-Enabled Services: A Growing Form of Telework," and "Internet Kiosks in India." *Economic and Political Weekly* (Bombay) 35, no. 26 (June 24–30).
Rajan, Parvati. 2000. "Training and Educational Needs for Teletrade." *Economic and Political Weekly* (Bombay) 35, no. 26 (June 24–30).
Roach, Stephen. 1998. "No Productivity Boon for Workers." *Issues in Sociology and Technology Online*, Summer. Available online at http://www.nap.edu/issues/14.4/roach.htm.
———. 2000. "The Globalization of Venture Capital." Global Economic Forum, Morgan Stanley Dean Witter, New York, June 21. Available online at http://www.morganstanley.com/GEFdata/digests/20000621-wed.html#anchor0.
Rosenberg, Nathan. 1976. *Perspectives on Technology.* Cambridge: Cambridge University Press.
Samuelson, Robert J. 1999. "The PC Boom—and Now Bust?" *Newsweek*, April 5, p. 52.
Schantz, Herbert F. 1998. "Technology and Issues on Data Capture, Forms Processing and Electronic Data Management Systems." White Paper, HLS Associates, International, Sterling, Va.
South China Morning Post. 2001. "Venture Capitalists Move on Beijing." February 1, business section, p. 14.

Stiglitz, Joseph. 1998. "The East Asian Crisis and Its Implications for India." Commemorative Lecture for the Golden Jubilee Year Celebration of the Industrial Finance Corporation of India Ltd., New Delhi, May 19.

Strasser, Steven, and Sudip Mazumdar. 1997. "A New Tiger." *Newsweek*, August 4, pp. 42–46.

Strassmann, Paul A. 1990. *The Business Value of Computers: An Executive's Guide.* New Canaan, Conn.: Information Economics Press.

———. 1997. *The Squandered Computer: Evaluating the Business Alignment of Information Technologies.* New Canaan, Conn.: Information Economics Press.

———. 1999. *Information Productivity: Assessing the Information Management Costs of US Industrial Corporations.* New Canaan, Conn.: Information Economics Press.

Sussman, Gerald. 1991a. "Telecommunications for Transnational Integration: The World Bank in the Philippines." In *Transnational Communications: Wiring the Third World,* edited by Gerald Sussman and John A. Lent. London: Sage Publications, pp. 42–65.

———. 1991b. "The Transnationalization of Philippine Telecommunications: Postcolonial Continuities." In *Transnational Communications: Wiring the Third World,* edited by Gerald Sussman and John A. Lent. London: Sage Publications, pp. 125–49.

Triplett, Jack E. 1989. "Price and Technological Change in a Capital Good: A Survey of Research on Computers." In *Technology and Capital Formation,* edited by Dale W. Jorgenson and Ralph Landau. Cambridge, Mass., MIT Press, pp. 127–213.

United Nations Conference on Trade and Development. 2000. *World Investment Report 2000: Cross-border Mergers and Acquisitions and Development.* Geneva.

U.S. Department of Commerce, Office of Technology Policy. 1999. "The Digital Work Force: Building InfoTech Skills at the Speed of Innovation," June. Available online at http://www.ta.doc.gov/reports/techpolicy/digital.pdf.

Vaitsos, Constantine. 1996. "Policy Agenda for the Information Revolution and Exclusion Phenomena in Developing Countries." Paper presented to the International Workshop on the Information Revolution and Economic and Social Exclusion in Developing Countries," October 23–25, Maastricht. Available online at http://www.intech.unu.edu/publications/discussion-papers/2000–2b.pdf.

Wilson, Mark I. 1991. "Offshore Relocation of Producer Services: The Irish Back Office." Paper presented to the annual meeting of the Association of American Geographers, Miami, April.

Wolff, Edward N. 1986. "The Productivity Slowdown and the Fall in the Rate of Profit, 1947–1976." *Review of Radical Political Economics* 18, nos. 1–2 (Spring-Summer): 87–109.

———. 1996. "The Growth of Information Workers in the U.S. Economy, 1950–1990: The Role of Technological Change, Computerization, and Structural Change." Working Paper no. 96–41, C. V. Starr Center for Applied Economics, New York University.

Woodward, Paul. 1990. "Getting a Start in Data Entry." *China Business Review* 17, no. 11: 20–23.

World Bank. 1998. *World Development Indicators 1998–1999: Knowledge for Development.* New York: Oxford University Press for the World Bank.

NOTES

[1] A definition of information and communications technologies is needed at the outset. A working definition is from Hamelink (1997): they process different kinds of information (voice, video, audio, text, data) and facilitate different forms of communications among human agents, among humans and information systems, and among information systems.
These technologies can be further subdivided into capturing, storing, processing, sharing, display, protecting, and managing technologies.

[2] As with previous major clusters of technological innovations, this one, too, has contributed to wage and earnings inequality, even within developed countries. Panos Institute briefing (2000).

[3] Bedi (1999); Mulgan (1999); Cairncross (1999).

[4] The "death of distance" is equivalent to the transformation of the world of economics and finance into a large networked community in which communication costs are independent of distance, thanks to the Internet.

[5] Wolff (1996).

[6] Autor, Katz, and Krueger (1997).

[7] Jorgenson and Stiroh (1999).

[8] McLaren (2000).

[9] Bruno and Cazes (1998).

[10] Breman (1985).

[11] Jorgenson and Stiroh (1995); Jorgenson and Stiroh (1998).

[12] Helpman (1998).

[13] Bresnahan and Trajtenberg (1995).

[14] Lipsey, Kekar, and Carlaw (1998).

[15] Brynjolfsson and Hitt (1995); Lichtenberg (1995).

[16] Greenwood and Jovanovic (1999); Brynjolfsson and Yang (1999).

[17] Leiner et al. (1998).

[18] The idea of establishing local area networks comprising mainframes and minicomputers had already been tested around the late 1970s (ibid.).

[19] Bresnahan (1999).

[20] WANs subsequently became the basis of sharing "expensive" wireline connections within densely populated urban settings, such as those prevailing in India. This has made it possible to leapfrog the extremely low telephone densities in such countries and make Internet access much cheaper than it otherwise might be.

[21] Mann, Eckert, and Knight (2000).

[22] World Bank (1998).

[23] Business Wire (January 21, 2001).

[24] Growth in satellite communications capacity slowed down in the second half of 2000. This is associated with the severe curbing of technology stock prices on NASDAQ.

[25] Executive Office of the President (2000). There are a variety of sources for the number of workers in America with IT-related jobs. In 1998, the Department of Commerce estimated that in 1996, 4.2 million people worked in IT-related occupations in the United States, a forecast expected to grow to 5.6 million by 2006. The Executive Office of the President put that estimate at a much higher level. Perhaps a resolution may exist. As information technologies have permeated deeply the U.S. economy in the 1990s, the number of IT workers in the economy is of course likely to exceed greatly the number of workers in telecommunications and informational industries. Of the four technology-intensive manufacturing industries, namely, aerospace, computer and office machinery, electronics communications, and pharmaceuticals, the first and last are nontrivial employers of IT workers (while the second and third may well be included in Table 3). Similarly, there are at least five categories of "knowledge-based service sectors" that are nonnegligible sources of employment of IT workers. These sectors are financial, communications, business, educational, and health services. Of these five, only the second category is covered in Table 3. There is really no contradiction between the large and small estimates of IT workers in the economy; the number depends on sectoral coverage.

[26] Brynjolfsson and Hitt (1998b).

[27] Autor, Katz, and Krueger (1998).

[28] Gormley et al. (1998).

[29] National Science Foundation (1997).

[30] Ibid.

[31] Strassman (1997). A more recent estimate does not seem to be available.

[32] Figures available online at http://www.imf.org/meetings/19990821/speeches.html. There is difference of opinion on this. Robert Samuelson has written that the proportion of IT spending by U.S. firms rose from 20 percent of total investment in the early 1990s to about 40 percent in 1998. Samuelson (1999).

[33] Dertouzos (1997).

[34] Strassman (1997).

[35] Roach (1998); Bresnahan (1999).

[36] Federal regulation mandates that customers have access to their deposits within a specified period of time (two days for checks drawn on local banks). Regulations also require a bank to return paper checks to the banks on which they were drawn in order to receive payment. Both increase the premium on the rapid processing of paper checks. Banks and finance and insurance companies generate a tremendous amount of paper-based information (customer responses, complaint-resolution, market promotion, etc.) that need processing, storage, retrieval, and, increasingly, data mining and warehousing.

[37] In the United Kingdom, call center employment rose from next to nothing in 1991 to as much as 200,000 by 1997. The average earning of these workers was estimated in 1999 at the equivalent of U.S. $9 an hour. Fernie and Metcalf (1999). Fifty-eight percent of these centers used to practice some form of performance-related pay. An average call center had 167 employees. This sample, about three-fifths of the call centers, all unionized, belonged to finance companies, banks, and utilities. The Netherlands is home to more than 125 pan-European call centers spread all over the country, all established since 1998. This country has become the top choice as a nexus of multilingual call centers: a surprisingly large percentage of Dutch workers are polyglots. See http://www.nfia.com/html/solution/fact.html.

[38] The apparent discrepancy can be readily reconciled: a large, even preponderant, proportion of all call centers are operated by enterprises as own-account communications workers or telephone operators. These are shown under respective industry headings, not under the service category "call centers." Some sources have pointed out that the total number of call centers, inside or outside large enterprises, in the United States would be more like 250,000, if the number of automatic call distributors—the heart of call centers—is any guide.

[39] Since average wages in dollars mean little across time and space, all wages are reported relative to the median wage of the U.S. production worker the year of the survey.

[40] In certain categories, including call centers, New Brunswick subsidizes employment costs to the tune of 40 percent.

[41] The following discussion focuses on data entry keyers. For more details regarding word processors and typists and note readers, see BLS (2000).

[42] This figure for the number of data entry keyers is much lower than the number of workers in data processing industries according to BLS figures presented in Table 4. Data processing involves more than data keying activities. BLS (2000).

[43] Evidence on the employment trends by temporary help firms in the United States makes this quite clear. See Table 5.

[44] Immergluck (1999).

[45] McKenney (1995); Autor, Levy, and Murname (2000).

[46] Immergluck (1999), quoting the Report of the Committee to Study the Impact of Information Technology on Performance of Service Industries, 1994.

[47] Bresnahan (1999). The versatility of technology is often noted. After very small aperture terminals were brought into wide use in the United States for credit card verification, enterprise users soon found that the same network could be used for other purposes.

[48] This description is from Autor, Levy, and Murname (2000).

[49] Wachovia Bank has to process roughly 101 million checks a month and had assets of $39 billion in 1999.

[50] U.S. banks in total process about 320 million checks a night—or more than 10 billion checks a month. Despite the increased use of electronic transfers, the Federal Reserve Bank projects that check volume in the United States will increase by 1 percent per year over the next fifteen years. Autor, Levy, and Murname (2000), ff. 11.

[51] As we will see, similar pressures are leading to the introduction of imaging technology for paper documents in the back-office work of major foreign banks in India, such as Standard Chartered Bank.

[52] More recently, IBM has entered into similar deals with Chase Manhattan Bank.

[53] The period under study here also has been one of significant consolidation in the U.S. banking industry. Immergluck (1999). Such restructuring has contributed to job losses.

[54] Craig (1997).

[55] Duncan (1995).

[56] Ibid.

[57] Baran (1985); Wilson (1991).

[58] Chowdhury (1999a); Greenstein and Spiller (1996).

[59] Bhattacharjee (1998).

[60] Autor (2000a); Autor (2000b).

[61] Hamel and Prahalad (1994).

[62] UNCTAD World Investment Report (2000). We are talking here about the stock of equity capital owned by people overseas.

[63] Stiglitz (1998).

[64] UNCTAD (2000).

[65] Roach (2000).

[66] Ibid.

[67] Krugman (1995); Lee (1996); Lawrence (1996); Lawrence and Litan (1997); Greider (1997).

[68] All the information about direct foreign investment is from UNCTAD (2000).

[69] Ibid.

[70] Ibid. 1980 may not represent an ideal year for the purpose of this comparison, in that it was a year of recession in the United States. However, the United States commands only a portion of global output and direct foreign investment.

[71] Vaitsos (1996).

[72] Chowdhury (2000).

[73] UNCTAD (2000).

[74] Ibid.

[75] James Bond dates the commercial debut of the Internet to around 1994. Bond (1997).

[76] Roach (2000).

[77] The collapse of the dot-coms does not have much to do with the importance of the Internet for personal and business communications, commercial collaboration, and remote buying and selling.

[78] *International Herald Tribune* (January 31, 2001).

[79] Ibid.

[80] *Times of India* (January 3, 2001).

[81] Leiner et al. (1998).

[82] *Business Week* (1998).

[83] One famous professor's grading rule was this: The one who topped the class would get an A; the one who was second would get a B. The rest would get C's D's, or F's. This grading system was applied to a class of forty students winnowed from forty thousand applicants. Such grading naturally brings out the "the most sadistic gladiators" among the students. The result is a pack of ultracompetitive students, who typically worked sixteen-hour days while on IIT campuses. *Business Week* (1998).

[84] Ibid.

[85] Sun Microsystems was quick to recognize this. Sun hired a very large number of these low-cost chip designers and system programmers in 1992 and 1993. As a result, it went a leg up on the competition. Legend has it that an Indian member of the cabinet of Prime Minister P. V. Narasimha Rao had made assiduous efforts to persuade him to create an open-door policy so these Russian technologists could be brought into India after Russian defense industries went into doldrums in 1991 and 1992. This minister recently passed away. *Times of India* (September 17, 2000). However, the Indian government did not buy this vision. Sun Microsystems made its bold move at about the same time. *Economist* (August 8, 1993). Sun was able to spot a market opportunity and seized it before the competition.

[86] *Business Week* (1998).

[87] Vivek Ranadive of TIBCO (NASDAQ symbol TIBX), Surjit Sidhu of iTwo Technologies (ITWO), Naveen Jain of Infospace (INSP), Anil Despande of Sycamore (SCMR), and Rajeev Gupta of Hewlett Packard (HP) are just some of the examples that come to mind.

[88] On a rough basis, one medical transcriptionist can transcribe one doctor's dictation plus most of another doctor's dictation.

[89] Both Nortel and Sycamore Technologies—two of the leading names in optical networking—are dominated by technologists of Indian origin.

[90] Rosenberg (1976).

[91] Madhavan (2000).

[92] *South China Morning Post* (2001).

[93] Posthuma (1987).

[94] See Sussman (1991a); Sussman (1991b) on the Philippines; see Lent (1991) on the Caribbean.

[95] Wilson (1991).

[96] Howland (1991); Arthur Young (1988).

[97] Woodward (1990).

[98] Marquand (1999); Strasser and Mazumdar (1997); Rajan (2000); Mitter (2000); Heitzman (1999).

[99] Dertouzos (1997); Goldhaber (1997).

[100] Ramani (2000); Chowdhury (1999a).

[101] Ramani (2000).

[102] McKinsey and Co. (1999), Table 8.

[103] *Times of India* (April 24, 2001).

[104] Figures were taken from the website http//www.mtindia.com, which is no longer in operation. In July 2000, HealthScribe India, which is a fully owned subsidiary of its U.S. parent, sold off 72 percent of its stake to an Indian conglomerate, Max India, for a price of U.S. $8.4 million. This implies that the total market value of Healthscribe India was about $11.3 million.

[105] This estimate is from Dondi Mapa, managing director, HatchAsia.com in Manila.

[106] From the IndiaSoftware website, available online at http://www.indiasoftware.com.

[107] From the World Socialist Web Site, available online at http://www.wsws.org.

[108] Chowdhury (1999b).

[109] Bayes, von Braun, and Akhter (1999).

[110] South Indians are leaders in computer programming as well. The cochair of PITAC is a southern Indian, as is the chief executive officer of Computer Associates. Casual empiricism suggests that the United States alone has something like thirty thousand skilled programmers and IT professionals of southern Indian origin. Regional data in India show that the southern states, which make up some 33 percent of India's population, account for more than a half of India's computing hardware and software production. (Of course, this also reflects the south's high per capita incomes and literacy rates.) This is not lost on U.S. software and IT firms operating in India. Oracle shipped its Internet database software in India featuring Tamil as well as Hindi. See http://dqweek.ciol.com/content/search/showarticle.asp?artid=15996.

[111] From the IndiaSoftware website, available online at http://www.indiasoftware.com.

[112] It would be very limiting to restrict a discussion of policies to IT policies alone. Other policies—toward education, physical infrastructure, foreign direct investment, intellectual property rights, the characteristics of the telecommunications regulation, the professionalism of the legal system, etc.—also are clearly important to whether the developments mentioned here will bring new jobs and opportunities to developing countries.

It would be useful to think about the type of environment in which IT-enabled activities will flourish and the areas where governments need to get their policies right. Firms are footloose, and a number of countries are competing, so governments should avoid policies that needlessly repel foreign or domestic investors.

[113] Okinawa Charter on Global Information Society (2000).

[114] The names of the exact locations of fieldwork for this paper in India, the Philippines, and Bangladesh have been intentionally obscured in the interest of confidentiality. The detailed accounts of the economics and finances of the companies and individuals interviewed are accurate.

[115] The following sources were consulted on India: http://www.timesofindia.com; http://www.tradeport.org/ts/countries/india/isa/isar0011.html.

[116] Mitra (2000).

[117] All information about the Philippines is from http://www.tradeport.org/ts/countries/philippines/isa/isar0006.html.

[118] Chowdhury (1999b).