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DISCUSSION PAPER

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**Leapfrogging?
India's Information Technology
Industry and the Internet**

Robert R. Miller

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Robert R. Miller

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Foreword

Information technology (IT) and the internet have been seen by some observers as a possible means by which developing countries might “leapfrog” past technologies, in the process accelerating their rates of economic growth. This discussion paper uses India, perhaps the most likely developing country to employ such a strategy, to assess the promise of IT in achieving faster economic growth. The conclusion is that, while the technology offers considerable promise for India, it will have to be combined with more widespread economic reforms if the promise is to be realized. Still, the IT industry’s rapid growth, in a climate of minimal governmental controls and regulations, has provided an example of how productivity might be enhanced throughout the Indian economy through the use of IT and the internet. Perhaps as importantly, however, IT can serve as an example to national and state governments of how growth might be encouraged more broadly in other industries through the relaxing of unnecessary controls and regulations.

A handwritten signature in black ink, appearing to read 'G. Pfeffermann', with a long horizontal stroke extending to the right.

Guy Pfeffermann
Director, Economics Department
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Abstract

The internet has been seen by numerous observers as a set of technologies that might enable developing countries to “leapfrog” over the development path taken by industrial countries, enabling poorer countries to increase their rates of growth and “catch up” sooner. Using India as a case example, this paper reviews the degree to which that promise might be realized. India, of course, differs from other countries in a variety of ways, some favoring it as an internet-friendly environment, some working against it.

The paper concludes that while internet development in India is still at a very early stage in terms of numbers of connections and overall use, the promise it offers for increased productivity and enhanced economic growth in the future is likely to be significant. Most benefits, at least for quite awhile, are likely to come from business use of the internet for both internal control and for dealing with business customers and suppliers, not from consumer use. In particular, for example, global connections will be much enhanced by India’s liberalized access to international internet gateways and to privately-provided undersea cable access. This access alone could offer Indian companies business opportunities that otherwise would flow to other, better connected Asian competitors.

Unlike other industries, the Indian government generally has strongly encouraged development of information technology, and the internet more specifically, through various incentives and, more importantly, through exempting the industry from many burdensome regulations and controls. One already apparent result has been that the software sector has become a large and growing export industry, hopefully leading the way for other technological developments to facilitate rapid internet expansion.

One should avoid too much enthusiasm, however. Much remains to be accomplished in freeing Indian businesses and financial institutions from the web of government controls and regulations that have in the past stifled the type of growth seen in other Asian countries. Poor infrastructure, along with low public investment, remains a difficult problem to overcome. Moreover, India’s overall educational attainment generally is poor, although technical education has been a bright spot. Lack of literacy will continue to be a critical limiting factor that will require many years of effort to overcome.

Such problems will limit any “leapfrogging” that might be anticipated from expansion of use of the internet alone. Economic growth depends on complementary and complicated interactions not only between private enterprises, which might be expected to benefit disproportionately from internet use, but also between the private sector and government, between governments themselves at various levels, and between the private sector and the government’s adequate provision of public goods. Shortcomings in any part surely will limit any growth stimulus that might come from internet use in and of itself.

Introduction

Using India as an example, this paper attempts to evaluate the potential benefits that the internet and, more broadly, the information technology (IT) industry promises to bring to developing country businesses. It addresses such questions as: how do the rapidly falling costs of communication and data processing promise to change how business is transacted in poorer regions of the world? To what extent will the internet in particular allow businesses in these regions to expand their horizons, tighten internal operations, or broaden supplier networks? How does the policy environment matter in the realization of public and private benefits from the IT industry and the internet?

For most developing countries, the internet has been of relatively little significance for the large majority of businesses, except possibly for some larger countries. The reasons are not hard to find. For most countries, the primitive state of communications infrastructure is a difficult barrier to internet development. In most, business operations involve mostly small firms, often the last to benefit from improved means of communications even in richer countries. And, not least, poor countries generally lack the pool of technically trained people necessary to fuel change.

With the possible exception of China, India has been affected more by changes in IT than any other developing country, yet the country remains very poor by any standard. The country's businesses have until early in the 1990s been heavily influenced in their growth by the government's licensing regime, several companies having become very large firms operating nationally mainly through their ability to garner licenses. The structure of many of these firms, therefore, has been dictated not by market demands, but rather by the availability of government licenses. In addition, many companies have benefited from the government's past policy of protection from international competition, a program that together with licensing has yielded gross inefficiencies and bloated enterprises.

All of this is changing. The licensing regime is largely gone, and protection is beginning to be pared away. Foreign direct investment, while still not exactly encouraged in some sectors, is far more welcome than it was. The results have been dramatic. Large conglomerates have had to give attention to their competitive viability in a much tougher economic environment. Reorganization and restructuring to achieve more competitive focus is becoming the rule. In IT more specifically, India has in some ways become a world leader, yet the degree of penetration of such new phenomena as the internet is still quite modest. Even so, at least the larger manufacturing companies and, perhaps more importantly, financial institutions have begun to use new technologies to improve efficiency and better serve customers. There seems little question that the gradual opening of the Indian market has been forcing businesses to pay more attention to competitiveness. This is the story that this paper hopes to relate.

One should recognize, however, that in some ways India is not representative of the larger developing world. Although illiteracy is still widespread, India has a long history of support for technical education and, as a consequence, has produced large

numbers of technically qualified personnel. The country is, in fact, a not inconsequential exporter of engineers and scientists; Silicon Valley alone boasts around 150 Indian millionaires, for example, and American immigration rules allowing thousands of visas for technical people have benefited disproportionately Indians. At home, the large group of technically-qualified persons in India, to some degree utilizing their Indian-American contacts, has formed the backbone of a rapid growth in IT investment in India, a growth that is continuing today.¹ Table 1 provides figures on the rapid growth in the availability of venture capital to Indian companies. Few developing countries can even approach this level of technological sophistication.

<u>Year</u>	<u>Rupees (Million)</u>	<u>U.S. Dollars (Million)</u>
1996	700	20
1997	3,200	80
1998	6,100	150
1999	14,000	320
2000	32,000	750

Source: National Association of Software and Services Companies (NASSCOM)

And too, India possesses a substantial middle class, variously estimated at between 150 and 200 million people, depending on criteria. This group is concentrated in perhaps 150 towns and cities scattered around this very large country, and it forms the major source of customers for a variety of businesses, either directly or indirectly. In an increasingly competitive environment, this group appears to have provided strong economic incentives for businesses to find ways to improve efficiency. IT provides an important vehicle to accomplish this goal and, as reviewed below, IT providers are being pushed incessantly to improve access and broaden services.

Finally, the IT industry has expanded relatively free of the kind of government regulation that has affected other industries. As a result, the industry has been the source of considerable entrepreneurialism and has fostered development of the growing venture capital industry described above. Moreover, as in the United States, the IT industry itself has been the source of productivity gains for the economy as a whole as manufacturers emulate production techniques in the West and output increases rapidly. The importance of the IT sector in India also is a feature not replicated in most other developing countries.

¹ For example, India's *Economic Times* reports that the year 2000 witnessed a seven-fold increase in venture capital funding, amounting to \$750 million. Of this, it estimates that 38 percent came from firms headed by India-born investors, including Vinod Khosia, co-founder of Sun Microsystems, K.B. Chandrashekar and B.V. Jagadeesh, co-founders of Exodus, and Kanwal Rekhi, former Chief Technical Officer of Novell. See www.EconomicTimes.com, February 21, 2001.

Internet Development

Because the internet provides the greatest possibility for overall economic gain among IT sectors, we begin with a description of the internet and how it is currently being utilized. Not surprisingly, India has lagged far behind many other Asian countries in the adoption of the internet. In a population of one billion people, there are fewer than two million internet subscribers, a figure that contrasts with India's closest comparator in size, China, which has more than three times as many telephone lines and four times as many internet users.² In fact, by the year 2000 India had only around 26 million fixed-line telephone connections and fewer than five million personal computers in place. Clearly, if the internet is to become a major vehicle in transforming the Indian economy, there is little question that rapid further development of India's communications and data transmission network is essential. Just as obviously, there is still a long way to go in this development.

Table 2
Growth of India's Internet Connections

<u>Year</u>	<u>Internet Connections (Millions)</u>
1995	0.002
1996	0.05
1997	0.09
1998	0.14
1999	0.28
2000	1.6

Source: NASSCOM

Why has the country lagged in its adoption of the internet? A number of factors have militated against wider use. Of major importance is the state of economic development in the country; India on average is still a very poor country, with a monthly per capita GNP of only 180 US dollars on a purchasing power parity basis. Despite the existence of a sizable "middle class," most people in India worry about obtaining the essentials of life, not in gaining access to telephones, much less internet service. Even so, given the availability of an adequate telecommunications network, India's internet audience could increase substantially.

But, that network, too, historically has been a major constraint. As noted, there exist relatively few telephone connections, and it is well known that the value of the internet increases geometrically with added connections. More importantly, however, the reliability of the system nationally has certainly not been adequate to support internet use, even if more connections were to become available. The country has lacked a high-speed data communications backbone to speed transmission and interconnectivity. In some ways, these constraints are a "chicken and egg" proposition: without a better national telecommunications network, there is little incentive to connect; without more

² Internet users are estimated to be around four times more numerous as subscribers in India.

connections, the incentive to build a more adequate high-speed network diminishes. Breaking this deadlock promises to be an important determinant to internet growth and, more broadly, to the attractiveness of the country as a destination for high-technology foreign investment.

Another constraint to Indian internet development has been the structure of telephone tariff schedules. As in many other countries, tariffs have been based on time charges which can make internet usage a very expensive proposition. These tariffs have been changing and are now based on larger units of time. But, even now, the cost of internet service from the telephone monopoly is not cheap. Five hundred hours *annually* of dial-up service can cost \$200 for a slow-speed connection, a figure that compares with a U.S. standard of perhaps \$180 for unlimited time. Beyond the 500 hour yearly base, time is billed at about 35 cents an hour, also not an insignificant charge for users.

Finally, internet expansion suffers from the generally poor condition of other parts of India's infrastructure. Internet use for commercial purposes is based importantly on increasing the speed of transactions, eliminating steps in the distribution chain and delivering products faster and more reliably. It is the last step of this process that is at risk in an India-like environment, because the physical infrastructure to deliver products from supplier to customer speedily is largely absent. Even if high-speed telecommunications were in place, which as yet it is not, much of the transactional advantages of the internet in commercial practice would be lost owing to poor roads and inefficient rail facilities. To be sure, internet use provides opportunities for both consumers and businesses to compare easily large numbers of products and prices. But, without the ability to deliver products expeditiously, this advantage can be largely negated.

It should be noted, however, that widespread internet use *within* India is not necessarily a barrier to increasing and potentially benefiting from use of the internet by Indian companies. For example, with the much improved access to international gateways now becoming available businesses can easily expand their potential customer base globally through the internet, even if their local clientele is not yet connected. In fact, buyers and, particularly, industrial purchasers in many industrial countries today are routinely posting detailed product and component specifications on specialized websites open to all with access to the internet. The purpose of such sites is to widen the net of possible suppliers, thus reducing costs. For Indian companies, therefore, opportunities to expand business relationships with foreign firms could be enormously enhanced through the internet, even though internet use in India remained relatively constrained.

Examples of Current Internet Use by Corporations Company utilization of the internet in India thus far is limited, but corporate interest in future use is intense. Firms are establishing special groups internally to investigate how the internet might be used both for internal control and for developing more efficient means for dealing with customers and suppliers. Generally, little will actually be done until the current efforts to upgrade India's telecommunications infrastructure are further advanced.

One exception, a company that has gone further than most, is Reliance Industries, a firm mostly engaged in chemical production and distribution, and a company actively involved in building a fiberoptic network linking Indian major cities. This company, in addition, expects that the internet will become a primary mechanism to improve operations, and it already has in place an internet-ready communications and control system. But, much of the system today uses leased telephone lines, not yet the internet.

For example, of the company's 20,000-odd customers around India, 3-4 thousand are major buyers, accounting for perhaps 75 percent or more of total sales. These major customers for chemicals are now linked electronically to an internet-based market exchange introduced by Reliance, one of several now existing in the country. In addition, through leased-line facilities, customers can process orders, and Reliance can deliver dispatching details, better manage inventory, carry out invoicing, and provide technical service, all done electronically. This customer network will be transferred to the internet at the earliest possible moment, since the internet should provide substantially lower operational costs.

To provide some measure of the benefits already apparent from this system, Reliance has been able to reduce receivables from 310 days to 90 days, only one area of savings. Cost improvements come primarily from a general tightening and acceleration of processing within the company and between the firm and its customers. Savings do not occur as a result of reducing manpower. In addition, the speed of order delivery has been improved greatly and inventories reduced in a system that is now integrated into the firm's overall management control function that links not only important customers but also over 50 of the company's own operations. These results for Reliance are similar in nature to cost reductions experienced by companies in industrial parts of the world, even though thus far the internet has not been much utilized. One might anticipate even greater savings in India, as compared with more industrialized countries, since operational efficiency prior to the introduction of electronic controls is likely to have been far lower than comparable figures for companies in the developed world.

Although the introduction of Reliance-like systems lags in India among larger manufacturers, there are other areas of the economy where considerable progress has been made, despite the as yet primitive nature of the country's telecommunications network. A few Indian private banks and financial institutions represent a sector that has become a leader in using electronics to offer new customer services. Though still early in the process, banks see the internet as a vehicle not only to improve current services but, in addition, to bring into the banks new types of businesses. For example, some banks look forward to the time when client companies will choose to delegate most "back office" functions directly to their banks. Moreover, banks are attempting to link with Indian commercial web-sites to offer clearing services to clients of these sites.

One interesting example of bank activity is HDFC Bank, started as an off-shoot of India's Housing Development Finance Corporation six years ago. The bank now has 125 branches and is adding new ones rapidly, including 60 last year. Branches have been connected to the home office from the outset through a private data network operated for

the bank by Wipro Infotech Software and Services Company, a large Indian software developer. HDFC Bank targets high-worth individuals and larger corporate clients but is also developing a sizable retail banking business. Telephone transactions of the type familiar in more developed countries (automatic payments, transfers, deposits, account balances, etc.) were introduced two years ago, but these functions are now also available through the internet.

Although precise cost estimates for serving customers via the internet are not available, banks have studied savings that are possible through telephone transactions, as compared with other means. For example, if a teller-based transaction costs, say, 150 rupees, the same transaction done via an automatic teller machine runs only about 15 rupees and via electronic connection 10 rupees, less than 7 percent of the teller cost. One other interviewed bank offering similar electronic services confirms these cost figures.

Internet-based services are a more recent introduction, but already demands for the services are expanding quickly. Today, HDFC Bank claims over 100,000 retail internet customers, almost half of whom utilize the service more than once monthly. Another aggressive bank, ICICI Bank, also is active both in telephone and internet service for its customers. Its internet customer base grew from 6,000 to 250,000 in a single year. As more customers are added in these banks, unit costs of transactions promise to fall rapidly, because the expense of adding more server capacity is minimal. In other words, the marginal cost of serving an internet customer is still falling.

In another aspect of its business, HDFC Bank is working closely with the Bombay Stock Exchange, which itself is in the process of automating transactions. Before automation was introduced, weekly reporting to the exchange was accomplished by brokers submitting floppy disks two days before each week's end. Today, through clearing accounts maintained at HDFC Bank and elsewhere, clearing is instantaneous, and 400 brokers maintain accounts at the bank for this purpose.

While such developments in the financial sector are encouraging, they should be kept in perspective. Private banks in India account for barely one-fifth of total deposits. Although this proportion has been increasing, the vast preponderance of Indian banking is still done in state-owned facilities, which, thus far, have shown only modest interest in increasing efficiency. There has been talk of increasing the proportion of private ownership in state banks in order to increase productivity, but resistance to such moves by still powerful unions and others has stalled much action.

Website Development Despite the lack yet of extensive broadband facilities in India, growth in the number of new websites has been explosive. There are today hundreds of Indian commercial websites. Although financial figures are unavailable, it is likely that most of these sites are not yet profitable and are based on the joint expectation of much improved internet infrastructure and perceived first mover advantages. As in the United States, some of these sites will succeed, but most in all likelihood will never reach financial viability for a variety of reasons. Some will fail because they were formed too early to take advantage of newer infrastructure advancements to reach potential users.

Advancements, in general, are not yet in place. Some will fail owing to their inability to change long-established commercial customs of their hoped-for clients quickly enough. And, still others will fall by the wayside because their creative motivations were not matched by realistic means to gain revenues from their clients, another cause familiar from the American experience.

Still, as in more developed parts of the world, enough of the new websites could survive to at least begin to change how business is being conducted in India. In the process, these websites may be a harbinger of widespread efficiency gains in an economy plagued by slow transactions, sluggish order processing and unnecessarily high inventory levels. A brief review of some of these websites follows.

Business-to-consumer websites (B2C) Although there has been extensive development of websites intended to attract household consumers, their future viability can be seriously questioned. Part of the reason lies in the extremely limited penetration of personal computers among Indian households. Although the numbers are rising rapidly, there are fewer than 4 million personal computers in all of India and, of these, perhaps only 20 percent are used by households, including those used for home offices. Telephone access, the only means, has been expensive and unreliable, and methods of product delivery to customers are as yet underdeveloped. Even though a substantial middle class may exist among India's impoverished millions, a group who might eventually be attracted to electronic transactions, these handicaps present a formidable barrier to rapid development of B2C growth.

All of these problems, of course, are in the process of easing, but the transition will require substantial time. Meanwhile, B2C websites hope to make sufficient inroads among urban dwellers to at least survive until better times are possible. It will decidedly be an uphill fight. Some observers note that while the population of personal computers is relatively small and the technological means to connect them is still rather primitive, there are 37 million cable television subscribers. As the fiberoptic network now being laid out is completed, it is thought, these subscribers might furnish the foundation for successful B2C expansion. But, even if cable viewers could be connected to the fiberoptic grid, the paucity of personal computers would still provide a difficult environment for B2C transactions to expand.

One can conclude, therefore, that extensive development of B2C websites probably is premature at this stage of India's development. This conclusion is supported by results from a recent study by the Gartner Group, as reported in *India News*.³ Of the few internet subscribers in India, only 2.2 percent had engaged in B2C commerce or paid for services online. Only 3.6 percent had ever placed orders over the net, usually for such services as movie booking or for products like books, audio cassettes and CDs, and software. Customers were largely well-to-do families

Business-to-business websites (B2B) Use of the internet between businesses, on the other hand, offers greater promise, and a profusion of Indian websites is one result.

³ February 11, 2001.

As in the case of B2C sites, many of the B2B sites are likely to end up as casualties for many of the same reasons. But already there are indications that acceptance of the internet as a way of revising business practices to gain efficiencies is quite widespread. Many businesses are fully aware of the trade-related commitments the Indian government has made as a condition of joining the World Trade Organization and of the falling trade protection that will be one consequence. The internet is seen by many of these firms as one possible vehicle among many others for gaining increased competitiveness. Even so, present use of the internet, either for direct inter-company communications or through business websites, is still early in its development.

A few examples of websites now in existence provide background. Typical of cross-sector sites, ones involving a number of quite different sectors, is Indiamarkets.com, started by IMO Communications. Development of Indiamarkets began in March, 1999, with venture funding from the Warburg Pincus Fund among other sources. As the company's own literature puts it, Indiamarkets is "India's first comprehensive business-to-business infomediary, an aggregation of vertical supplier communities representing over a hundred diverse product categories. The site, launched only in January, 2000, offers a gateway to promote business between potential trading partners and provides transaction-enabling content that facilitates judicious business decisions."

To accomplish its objectives, the site offers a variety of on-line services: sector-specific news, reviews of state policies affecting the sector, a buyer posting facility, a supplier posting allowing one to compare offerings from across India, and an auction facility to sell machinery or excess inventories. By late 2000, the site claimed to have 30,000 subscribers, \$600 million in inventory up for sale, over 2,000 "hits" and 150 transactions arranged daily. IMO also is opening 70 business centers around the country to provide services to businesses without access to computer networking.

Indiamarkets.com faces a number of problems common to such sites. Of primary importance are the site's planned sources of revenue, mainly to come from a combination of advertising on the site, an "enhanced" listing for companies who pay an annual fee and, most importantly, planned fees for transactions completed using the website. Transactions fees had not been put in place by October, 2000, but arrangements had been made with Citibank for a payment gateway on the site for easy clearing. This will be facilitated by credit checks through Dun and Bradstreet. Whether or not users of the site will be willing to pay fees remains to be seen. However, IMO studies show that, aside from user savings from lower prices, transactions costs are reduced by 6 to 7 percent through use of the site, a not insignificant figure. Such sites also are likely to lower prices by bringing added competition to markets from better and more complete information.

The website, of course, also will be subject to its own competitive environment, as more B2B sites offering services to the same clients open up. Thus, while the availability of various savings might make customers more receptive to fees, the size of those fees could be constrained by competitive considerations. Much depends on the degree to

which the more generalized website, exemplified by Indiamarkets.com, succeeds in competition with sites that are more focused on particular sectors.

One such portal is Kagaz.com, constructed by Ecomedia Infosystems to service only the pulp and paper industry. Kagaz.com is a subscriber site, with a subscriber base now numbering about 10,000 (half of whom are foreigners), each of whom pays a small monthly fee for access. The site offers news, data, and bulletin board-type notices on paper availability. India has relatively few paper manufacturers, but there are about 80,000 paper traders who act as middlemen between manufacturers and converters, cutters and printers. Traders exist because of their local knowledge of customers, taxes and regulations.

The ultimate objective of sites like Kagaz.com, of which there are now an abundance in India, is to offer a full e-commerce portal where transactions can be facilitated for a fee. For example, when new deals are arranged between sellers and buyers, Kagaz guarantees the deal and accepts payment, which is released when delivery has occurred.

The problems faced by Kagaz.com are typical of many other such sites. The very low overall penetration of personal computers and internet connections in India is matched by the spotty existence of PCs among potential customers of the site. Most traders, for example, have no access presently to a PC. Yet, these traders ultimately are the foundation of the site's hoped-for business, because they, not manufacturers, are the ones who maintain inventories in the system and understand intimately their customers needs and peculiarities. The intention for now is to work through these traders, not to work around them. Therefore, one major marketing task of Kagaz.com and like sites obviously will be to broaden the base of internet-connected and conversant traders and dealers.

Such a task will not be a simple one, even if the expansion of high-speed data links across India in the next two years proceeds as anticipated. The trader community is likely to be tradition-bound, accustomed to carrying out business successfully in time-honored fashion. Breaking old habits doubtlessly will prove much more difficult than has been the case in more industrialized societies, where PC use was common long before the advent of internet possibilities. Even so, if portals can demonstrate significant cost savings through internet use, a substantial marketing effort, competition should force change over time.

Business-to-government websites (B2G) The Indian government and some state governments have made a commitment to increased transparency and simplified procedures through their adoption of internet-based access to government functions. Today, for example, governments account for over 28 percent of IT spending in India. In much of this effort, regional units have been in the forefront, computerizing operations to streamline services and, hopefully, reduce bureaucracy. Among the functions being made available through the internet are government procurement bidding and various application procedures, both familiar from more economically advanced countries.

Whether or not such efforts do, in fact, reduce bureaucracy and lower government costs remains to be seen. With burgeoning fiscal deficits at both national and regional levels, saving are obviously needed badly. In India, however, government service has often been seen as a sinecure, where employment is a continuing obligation. Transferring internal operations and some public functions to electronic forms may not have much in the way of employment effects, at least not in the short run. Still, to the extent that the internet makes dealings with government at all levels easier and more transparent for non-governmental entities, and particularly for businesses, gains in efficiency could be substantial as internet use expands throughout the country. Moreover, to the extent that increased transparency and efficiency are accompanied by lower government employment and fewer opportunities for corruption, one might also anticipate that such advances will be fiercely opposed.

Other Internet Possibilities One rapidly expanding business for Indian companies is the provision of back-office services to international clients. The basic business has a long history globally; Ireland, the Caribbean and the Philippines, for example, have provided such services to companies in the United States for many years. The typical task involves the transcription of raw data into electronic databases, where paper records are shipped in by air, local residents transform the data into electronic form, which is then transferred back to the developed country company via the internet. The business today involves a wide number of industries including, to name just a few, airlines, banks, insurance companies and medical establishments.

Currently, India employs between 50,000 and 100,000 people in what are termed "internet-enabled services," producing \$500 million in export earnings. Growth has been so rapid that some observers anticipate employment of well over one million within ten years generating income of \$10 billion. Although such expectations may be overly optimistic, India does have some competitive advantages: like the Philippines, India has an abundance of English-speaking people, many with university educations, who are willing to work for a fraction of the cost similar workers earn in the client's home country.

Internet-enabled services have changed in recent years to involve other areas. For example, the transcribing of voice dictation by medical practitioners and others in the United States has become a big business. A more sophisticated trend recently has been the transfer to India of some research and development operations, made possible by the instantaneous transfer of data and information through the internet. All of these services also rely not only on English language capability but also the availability of a reservoir of well-educated, yet under-employed, people. For example, typical employees in the Indian industry include graduates of university programs in science, liberal arts and even such professions as medicine or law.⁴

⁴ An interesting article on the Indian scene appears in the *Wall Street Journal* of March 16, 2000, entitled "America Talks, India Types Up the Transcript."

Potential Development Contributions from the Internet

Because the internet is only now just beginning to make its impacts felt across India, any discussion of development impacts is, at best, premature. Unlike in software development, discussed below, now well established as an internationally competitive industry, use of the internet either by individuals or most businesses is still at a primitive stage. This picture almost certainly will change rapidly, however, as high-speed data networks are completed linking at least the larger cities. How rapidly, of course, will depend on the speed of finishing not only the underlying network but also “last mile” connections to individual homes and businesses. For larger businesses, this process is likely to proceed quickly, as the gains are clearest there. For others, one can anticipate that existing cable networks will provide the most likely vehicle, but the process will take longer.

The extent of gains from wider internet penetration is, at this stage, a matter of conjecture. Even in the United States, estimates of productivity gains as a consequence of information technology generally and the internet more specifically vary widely. The range of opinion runs from Nobelist Robert Solow’s well-known remark 13 years ago, “We see the computer age everywhere except in the productivity statistics,” to much more optimistic statements from a variety of other economists more recently.⁵ Clearly, productivity has jumped in the United States in the past five years from some set of causes, but the sources continue to be elusive. It suffices here to note that the U.S. Congressional Budget Office and the Office of Management and Budget both project productivity gains in the next ten years to be about 0.5 percentage point higher than the average for the years 1973 to 1995.⁶

In the developing world, estimates are even more perilous, but it does seem clear that one cannot simply extrapolate the industrial country experience to developing countries. Some observers believe that efficiency gains are likely to be smaller in poorer countries. They point out that developing countries depend more on production in small and medium-sized enterprises, and these are less likely to experience substantial gains from internet use, at least not in uses internal to the organization, as compared with larger organizations. Moreover, poorer countries typically rely more on commodity production and exports, which, in comparison with the manufactured goods produced and marketed by industrial countries, are less likely to find material productivity improvements from use of the internet. Finally, the point has been made that introducing technologies from industrialized countries, possibly including the internet, can result in smaller productivity

⁵ A more recent article compares the importance of the internet to other great inventions of the past. It concludes that productivity gains from the internet anticipated by many observers are likely not to be experienced. See Robert J. Gordon, 2000, “Does the ‘New Economy’ Measure Up to the Great Inventions of the Past?,” National Bureau of Economic Research Working Paper Series, Number 7833, Cambridge, MA. (<http://www.nber/papers/w7833>)

⁶ Taken from Robert E. Litan and Alice M. Rivlin, 2000, “The Economy and the Internet: What Lies Ahead?” Brookings Institution (December), Washington, D.C. This rate, however, represents a substantial reduction in the realized average productivity of 3 percent between 1995 and 2000, an acceleration usually attributed to increased use of information technology and one many analysts think will be exceeded.

gains in developing regions, as compared with gains in the technology-innovating area. These technologies tend to be biased toward skill-intensiveness, which produce fewer gains in productivity when transferred to a developing country.⁷

These observations are, of course, entirely speculative at this stage, since the internet is in its infancy in most poor regions. But, there seems little doubt that gains from the internet could be substantial and, despite more skeptical conclusions, could affect developing economies in even more profound ways than is the case for industrialized regions. The case of intra-corporate use of the internet is illustrative.

In industrial countries, use of the internet for coordination between geographically widespread units represents only an incremental change from the way in which business had been done. For larger companies, management control typically had been exercised through dedicated networks long before the internet came into existence. Companies like Texas Instruments have operated sophisticated global networks linking their subsidiaries for decades. For such firms to move from these networks to the internet was really only a small, if less costly, step. In fact, many of these firms thus far have continued to use older networks in preference to the internet.

For a developing country like India, on the other hand, even dedicated networks are a relatively new phenomenon and are far less pervasive than in more industrialized parts of the world.⁸ Delivery of reliable telephony, the backbone of any dedicated system, has occurred only recently. As a consequence, use of the telephone system as a vehicle for internal management controls has not been widespread, as the earlier Reliance Industries example illustrates. Assuming the internet, utilizing still-to-be-provided broadband facilities operated privately, becomes widely available in coming years, reliable opportunities for better management controls should become more popular. Even smaller companies may be well placed to take advantage of it. The result might well be a much more productive industrial system made possible through better managerial controls. Again, however, at this stage much is conjectural.

The gains from improving transaction capabilities *between* firms should be even more striking in a developing country environment, particularly in a large country like India. Part of these gains will come through the B2B portals noted above and are similar to gains found already in industrial countries. Part will be the result of company-specific uses of the internet to increase awareness of procurement needs among a larger audience of potential suppliers. Again, tightening relationships between buyers and suppliers has been under way for many years in developed countries, starting with Japan and later being transferred to firms in other industrialized countries. It antedates internet development in these parts of the world. In India, on the other hand, the distribution system at

⁷ For a discussion on this point, see Jorg Mayer, 2000, "Globalization, Technology Transfer and Skill Accumulation in Low-Income Countries", UNCTAD Working Paper 150 (August), Geneva, Switzerland.

⁸ Discussion here focuses on use of networks within the country. Dedicated satellite facilities have been in use for some time by the software industry, allowing companies to serve clients in Europe, Japan and the United States.

all levels remains antiquated and inefficient.⁹ The gains to be made from tightening this system, even apart from fixing the abundant remaining problems in physical distribution, are likely to be substantial.¹⁰

In addition, although services in India are far less important as a proportion of GDP compared, say, with the United States, the internet still promises to yield efficiencies in the service sector. The examples of banks given above provide concrete evidence. Clearly, financial clearings, among other financial services, can be enormously accelerated through the introduction of electronic banking, with commensurate savings in working capital requirements throughout the economy. To be sure, the larger benefits are not likely to be in consumer banking for some time to come, since internet penetration is so limited, even among the well-off, and overall income levels so low. For businesses, on the other hand, the much greater ease of accomplishing financial transactions through the internet promises important gains. Similar benefits could be available in other services, including insurance processing, government licensing and permits, health care and transportation, among others.

Adding more competition to existing markets promises to be another development contribution, especially in the Indian context. Aside from a few large firms, markets in India tend to be regional and even local, isolated from one another by poor communications and inadequate roads. The internet can at least partially alleviate these problems, in the process widening sources of information and, in all likelihood, lowering prices. The active interest in several B2B portals, as evidenced by the number of “hits” and associated transactions, provides some evidence that these benefits already are being found. To be sure, much remains to be achieved in physical infrastructure improvement to assure that gains are truly widespread, but even in the short-run the evidence seems to be that through better information markets are broadened and prices reduced.¹¹

Finally, India’s efforts vastly to improve connectivity internationally by allowing private parties to offer their own gateway facilities can be seen as belated recognition that the future of global commerce will more and more be intimately dependent on high-speed access to the internet. The need for improved international connectivity goes well beyond the requirements of internet-enabled services, although for India these are likely

⁹ One indicator of progress in distribution system efficiency might be the use of bar-coding, currently not prevalent in India. The government, however, is mandating that all products sold in India must be bar-coded within five years.

¹⁰ Physical infrastructure involved in moving goods (roads, railroads, ports, etc.) remains a critical problem in India, discouraging the development of a truly national marketplace. Some efforts to lessen the deleterious effects of poor infrastructure have been made in connection with developing B2C and B2B web portals, especially through expanded courier services and the like. But, for many of the still potential efficiency gains to be achieved through internet use, infrastructure promises to be a serious constraint for some time to come, especially considering low rates of public investment.

¹¹ Lower prices in the absence of efficiency gains, of course, can represent a transfer of income from one set of companies to another or from companies to consumers, thus resulting in no overall benefits to the economy as a whole. However, to the extent that falling prices motivate companies to improve efficiency and productivity to remain competitive, the resulting savings represent a potentially large gain to the economy as well. Moreover, falling prices are likely to reallocate production to lower cost producers, a move that also can be a source of economic gain.

to be rapidly expanding areas of business. The wider reality is that if Indian manufacturing companies are to become more internationally competitive, as they hope to be, ready access to wideband internet services will be of paramount importance. Buyers in the industrialized countries that Indian companies hope to service expect to be in instantaneous and continuous contact with suppliers through the internet, and firms that have inadequate electronic connections already find their possibilities compromised. The Indian government has recognized this requirement and is moving quickly to improve both international gateways and the country's fiberoptic infrastructure, both largely through incentives directed to private sector providers.

The Information Technology Industry in India

As in most countries, computers and IT have been around for a long time in India. But, considered as an industry gaining global recognition and as having an internationally competitive future, IT's much-publicized growth in India has been a much more recent phenomenon. Software exports, the earliest harbinger of a more widespread IT expansion, began only in 1985, when Texas Instruments established its subsidiary in Bangalore.¹² This move was followed not only by other foreign software companies setting up operations in that city and elsewhere but also by a number of domestically-established software companies (Tata Consultants, Wipro, Infosys, HCL Technologies and others). In more recent years, as the internet has expanded globally, these earlier investments have been followed by an explosion of start-up internet companies and by early efforts of a few well-established manufacturing companies at using the internet and other forms of communication to improve efficiency in their operations.

IT manufacturing also has occurred in India for many years and has included investment by multinational companies, as IBM's early involvement in India suggests. Today, many foreign producers of computers and peripherals (HP, IBM, Compaq, Canon, etc.) have manufacturing operations in the country, often in joint ventures with Indian companies. There are in addition a number of wholly Indian companies, exemplified by HCL, a company that formerly had a joint venture with HP but has now taken over the enterprise. A variety of other manufacturers exist, including producers of peripherals, electronic supplies and fiberoptic equipment, among others, including Modi Xerox, Tata Liebert and Wipro as examples. Some idea of the growth of these manufacturers in recent years can be gained from Table 3.

¹² Among other possible locations in India, Bangalore was selected as an attractive city with agreeable weather, a place likely to appeal to both Texas Instruments expatriates and Indian software engineers.

Table 3
Indian Sales of Computer Hardware and Peripherals
(Millions of US\$)

	<u>1994-95</u>	<u>1995-96</u>	<u>1996-97</u>	<u>1997-98</u>	<u>1998-99</u>	<u>1999-00</u>
Hardware						
Domestic Sales	\$590	\$1,037	\$1,050	\$1,205	\$1,026	\$1,434
Exports	177	35	286	201	4	n.a.
Total	767	1,072	1,336	1,406	1,030	1,434
Peripherals						
Domestic Sales	\$148	\$196	\$181	\$229	\$329	\$453
Exports	6	6	14	19	18	n.a.
Total	154	202	195	248	347	453

Source: NASSCOM, *The IT Sector and Service Industry in India: Strategic Review*, February 2000

As the figures suggest, manufacturing growth in computers and peripherals has been less than spectacular in India.¹³ This is a reflection partly of the thus far limited growth in the domestic end user market and partly of the inability of the volume-limited manufacturers to be competitive. In addition, in recent years unit sales of equipment have grown faster than the dollar figures would indicate, as unit prices have fallen in response to more competitive moves by both domestic manufacturers and multinationals.

Historically, IT manufacturing has been a protected industry in India but, as in other technically-based industries, this policy has been changing. By and large, manufacturing in India has not been internationally competitive.¹⁴ As one consequence, India has been unsuccessful in following the lead of other Asian nations in developing robust export markets for IT equipment or components. However, as a signatory to the IT Agreement of the World Trade Organization, the government has committed to a zero duty regime by 2003. This, together with a simplification of procedures for transacting business in the sector, could have positive competitive outcomes for the Indian industry, but it remains to be seen who will be the major beneficiaries: local businesses, foreign investors, or some combination of the two:

One possible vehicle for bringing IT manufacturing to the fore, through direct foreign investment as in Singapore or Taiwan (China), has not been successful for a variety of reasons. Foreign investors might have taken the lead in introducing leading edge technologies and manufacturing methods. But, when such investors did attempt to break into the Indian market, their hopes often were dashed. Disagreements over intellectual property protection was one cause of difficulty, as IBM's early departure illustrates. This development, a result of India's sensitivity to foreign influence, alone

¹³ For comparison, South Korea's exports of semiconductors alone were \$18.9 billion in 1999, according to the Economist Intelligence Unit.

¹⁴ India's manufactured exports, for example, are concentrated mainly in such labor-intensive industries as textiles, garments and footwear. One exception is the chemical industry, derived originally as a supplier of raw materials for artificial fibers.

discouraged other investors for many years afterwards. More recently, attempts at joint ventures between Indian firms and outside technology investors, such as that between HP and HCL, often have failed, owing in part to inconsistent objectives among the participants. Foreign investors were interested mostly in producing for local markets, whereas Indian companies wanted eventually to develop export markets as well.

Unlike software development, which can begin small and technically simple, efficient hardware output in IT depends on a minimal scale of operation and continuous access to technological innovations largely derived in industrialized countries. Protection doubtlessly was conceived as a way eventually to develop adequate scale but, as in most other cases, has resulted only in inefficient producers without easy access to technology. Moreover, manufacturing is more susceptible to India's familiar inadequacies in highways and port facilities which, particularly if exports are a goal, can add materially to delivery costs for goods shipped by methods other than air transportation.

The reality in any case is that IT hardware production is as yet an insignificant industry in India. This situation, of course, could change rapidly if the internet and associated computer technology use expands as some anticipate will occur in India. After all, the same technological talent that produced international competitiveness in some software areas, a development discussed in the next section, could be brought to bear on hardware design and production. But, success in hardware will come with considerably more difficulty than in software, where government influence has been minimal and where production has relied almost entirely on highly skilled engineers and technicians working in relatively small groups.

Software Development For now, India's major comparative advantages in the IT sector is software development. Software had its modest beginnings, at least as an internationally competitive sector, with the Texas Instruments investment in Bangalore noted earlier (See also the accompanying box). Today, the business is both large and expanding rapidly, directed almost entirely to overseas clients, and involves both domestic and foreign firms. Most companies, multinationals and domestic firms alike, today use dedicated satellite links in their contacts with either their home offices or customers. Eventually, however, the speed and cheapness of internet connections may substitute for dedicated means, as international internet connections become better established and security issues are overcome.

Two Software Operations

Texas Instruments (TI), the first of several multinationals to establish operations in India, began as a wholly-owned operation intended to enable the company to continue software development 24 hours a day and to do so with decreased costs. At the time, engineering salaries in India were only 10 percent of those prevailing in the United States, which translated into software development costs of fifty percent less than in the US. Today, owing to its early positive experiences, TI assigns not only much more sophisticated applications of software but also has expanded to include the design of integrated circuits. Although still dedicated entirely to TI's internal needs, the much-expanded facility in Bangalore now employs 350 people in a world-class computing and communications environment equal to any in the company's global operations.

Infosys Technologies, Limited, began in 1981 as essentially a two-man applications software shop for large companies. By 1985, sales had already reached \$18.1 million. In the 1990s the company added satellite transmission capabilities to ensure reliable and fast connections with clients in the industrialized world. Rapid growth has continued, with fiscal year 2000 sales at \$203.4 million, over 90 percent North America and Europe. Today the company employs around 5,000 software professionals in seventeen development centers located throughout the world, up from just 585 professionals in 1985. Infosys is not the largest of India's dedicated software firms, as both Tata Consultancy and Wipro have greater sales, but in terms of its growth rate, employment expansion and customer base, it is a prototypical Indian applied software company.

Table 4 provides statistics on the dimensions of software sector in India. As the table indicates, the sector's growth has exceeded 50 percent annually in the period shown.¹⁵ Today, software shipments count for over 10 percent of India's total exports and two-thirds of sales for the entire IT sector, including equipment, training and maintenance. Preliminary figures for 1999-2000 show exports of software totaling nearly \$4 billion, a continuation of the past expansion and an indication that the sector has successfully moved beyond its heavy focus on Y2K problems to develop new and innovative solutions to its customers' needs. Part of this success is based upon the strong prevalence of English-speaking technical personnel, but it also attests to the quality of engineering education in the country.

¹⁵ In fact, although the table does not include the figures, this rapid growth in the sector goes back to at least 1990.

Table 4
Indian Software Sales
(Millions of US\$)

	<u>1994-95</u>	<u>1995-96</u>	<u>1996-97</u>	<u>1997-98</u>	<u>1998-99</u>	<u>1999-00</u>
Domestic Sales	\$350	\$490	\$670	\$950	\$1,250	\$1,700
International Sales	485	734	1,083	1,750	2,650	4,000
Total	835	1,224	1,753	2,700	3,900	5,700

Source: NASSCOM, *The IT Sector and Services Industry in India: Strategic Review 2000*, February 2000

The emphasis seen in the figures on software exports is, according to industry sources, a result mostly of business opportunity. The software market in the United States and Europe is simply orders of magnitude larger than in India. Moreover, potential customers in developed countries have dealt with software consultants for a long time. They tend to have a clear picture of software development costs and are, commensurately, receptive to the cost-saving opportunities Indian companies potentially make available. Professionals in India earn perhaps \$12,000 annually, high by Indian standards but one-quarter or less of western salaries for like work. And, according to sources in the United States, the quality level of major Indian software producers can exceed typical standards in the U.S. for the types of programming undertaken.

Fast growth has been paralleled by a rapid expansion in the need for technically trained personnel in the sector. Professional employment for software production, according to NASSCOM, reached 280,000 in 1999, up from only 6,800 when Texas Instruments formed its subsidiary. Companies have projected a need for another 140,000 professionals in the next year, far more than the 85,000 becoming available from various Indian educational institutions under the most optimistic projections. McKinsey consultants, who have done a major industry study for NASSCOM, estimate that India could absorb 2 million software engineers in various capacities by 2008. Clearly, the rapid expansion of both private and public institutions for technical education now going on in India is badly needed.

Development Contributions of Software Operations Taken in a narrow context, the software sector cannot be said to have had a major development impact on a country as large and as poor as India. Direct employment in the industry is minuscule in relation to the country's population and is concentrated in only a few metropolitan centers. Most of the sector's output is directed abroad, applications software presumably intended to improve operational efficiencies in US and European, not Indian, companies. Few ordinary Indians can be said to have been affected one way or another by the software sector's astronomical growth and increasing international prominence.

And yet, a case can be made for taking a somewhat broader view of the sector in terms of its potential effects on the larger economy. Some of these impacts are apparent already; others may take somewhat longer to come to fruition.

- Aside from India's very large informal sector, software development is probably the only sector to have grown up largely free of inhibiting governmental regulation or interference. In fact, central and state governments have provided such incentives as tax exemptions, investment concessions and setting aside areas for technology parks, among other steps, to encourage the sector's growth. Nurtured by these incentives, the sector has provided the primary example in India of the growth potentialities that can occur by allowing relatively unfettered entrepreneurialism to flourish. One consequence has been a commensurate growth in venture capital availability, as investors see the chance of multiplying their investments by a hopefully propitious selection of opportunities.¹⁶

The example set by the software sector has not been lost in government circles, where a similar growth pattern in a number of other high technology areas is a fervent hope, if not quite yet an expectation. Plans that are afoot include the creation through private companies of a fiberoptic "backbone" linking the nation's cities and towns, a rapid expansion in the availability of fast internet connections, the building of a system of "info-kiosks" to bring internet availability even to rural areas, and an overall improvement in telephone service nationwide.¹⁷ The hope is for India to become an international leader not only in software development, by now an accomplished fact, but to leapfrog many other developing countries by establishing a world-class telecommunications infrastructure and associated technology capabilities.

Matching these plans to reality, however, will require enormous efforts, including close coordination among and between central and state government units, and very large amounts of private investment capital. To attract the capital, private investors will need to be assured that they can move ahead without inordinate interference from various governmental units. It is not entirely clear, even in high technology sectors, that this freedom will be forthcoming, despite a new telecommunications policy. This is particularly true in areas where, in the past, government has maintained a monopoly, as in local telephone provision.

Still, the point to be made here is that the success of the software sector has provided a useful role model for developing further high technology sectors and the message has not been lost even among the entrenched bureaucracies in the various capitals. Long distance voice and data communications, for example, have been opened up to private competitors, following the earlier lead of wireless communications.

¹⁶ The attractions are obvious. Infosys, for example, reports that it now boasts 150 dollar millionaires among its staff of 5,000 professionals, a result of its soaring share price and the firm's bonus system.

¹⁷ The government has licensed one private basic service operator in each state to set up an independent telecommunications network. These networks are expected to provide inexpensive internet connections and long-distance services in competition with the state-run company Videsh Sanchar Nigam, Limited (VSNL).

- The software sector also has been a source of additional export earnings for India, and one not dependent on the country's grossly inadequate rail, road and port network. Software now contributes ten percent of total export earnings, and it is a percentage that is growing rapidly as the industry expands at rates exceeding 50 or 60 percent annually, far higher than other, more traditional export industries. Yet, although export growth by India's companies has been rapid, the Indian share of software production in global markets is still minuscule. In the year 2000, for example, Indian exports of software to developed country markets represented less than 2 percent of total production in those countries.¹⁸ Clearly, there remains ample opportunity for rapid growth to continue for some time to come.
- Although direct employment in the software sector is both small in relative terms and specialized, there are a number of indirect employment effects that can be mentioned. Most obvious are the opportunities in other areas that have opened up as the sector has expanded, including jobs in construction, infrastructure improvements and suppliers. No estimates of such "trickle down" effects exist, but the impacts cannot be trivial if one judges by the large construction projects supporting the sector's expansion that can be seen around such cities as Bangalore, Mumbai, Hyderabad or New Delhi.
- The fact that India is demonstrably competitive internationally in the production of sophisticated software brings other advantages to the country. Indian technological sophistication, though still narrowly defined, has begun to alter international perceptions of the country. Instead of viewing India as a country burdened by decades of heavy-handed government regulation of the economy, foreigners now view the country somewhat more favorably, though not yet as a country where future growth will approximate that of China and several of the Southeast Asian countries.

Whether or not much enhanced foreign direct investment and technological transfer will follow such changes in perception is, of course, decidedly problematical in today's political and economic environment in India. A weak set of national and state governments is plagued by high fiscal deficits and seems unwilling or politically unable to rein in the subsidies that are largely the cause. This weakness, together with a long-standing suspicion that foreign investment represents a continuation of imperialism under a different guise, continues to make life difficult for those investors who have shown recent interest in establishing a greater Indian presence. Even domestic investors have had difficulty with the crowding out effects of Indian deficits. Add to all of these concerns the paucity of Indian public investment to improve physical infrastructure or general educational standards, and it should come as no surprise that investors still see India as one of the

¹⁸ See S.S. Kantilal Ishwari Securities, Ltd, 2000, "Software: Sector Strategy" (November 22): 6, Mumbai. It should be noted, however, that the Indian market share of sub-markets where its firms compete can be much higher, in some cases approaching ten percent.

world's more difficult economic environments. The positive example of software obviously has much to overcome.

- Even so, the software sector's success has at least given greater voice to demands for educational improvements to support not only this sector but also other related sectors (telecom, internet, data processing, etc.). The immediate impact has been in the expansion of technical colleges and universities as well as more attention to lower-level training institutes. While not helping directly with the more basic problems of illiteracy and inadequate primary and secondary education, such moves certainly do support not only software producers but also other technology-based sectors that have been receiving attention as sources of more general economic growth in India.

Building Internet Infrastructure

For the reasons noted above, then, internet use has been relatively slow to evolve in India. This slowness has been characteristic not only of personal use of the internet but includes business use as well. Although there are abundant internet sites devoted to business-to-business (B2B) and business-to-consumer (B2C) transactions (reviewed earlier), few are yet successful in a financial sense. Moreover, employing the internet for internal corporate transactions is still in its infancy in India, mostly because the underlying communications facilities are as yet not fast enough or sufficiently reliable for most corporate uses. It is fair to say that most data links used within large companies in India are not internet-based, but rather are dedicated leased telephone facilities.

But, awareness of internet potentialities as a valuable tool for future business communications is now widespread. In fact, planning for internet use by corporations is advancing rapidly. On a more general scale, the internet is being seen as a necessary vehicle for improving the country's global prospects and, therefore, essential for contributing to further economic development, a view involving not only business interests but, as importantly, government ministries.¹⁹ As a consequence, several initiatives have been advanced to accelerate India's development of required infrastructure to support wider internet use, particularly by business interests. Several of these initiatives are reviewed briefly below.

- **Fiberoptic "backbone":** As noted, one of the major impediments to more advanced uses of the internet, particularly for business use, is the primitive nature of the country's communications system. While telephone quality has been much improved, India has lacked the necessary infrastructure for high-speed data transmission. It has been clear for some time that if such a system is to be built, it will not be done by governmental interests, national or local. In the face of large fiscal deficits in both national and state budgets, public investment has remained low. Nor has there been any expectation that the national telephone monopoly would find the enormous amount of funds to support the creation of country-wide, high-speed data networks.

To break this obvious logjam, permission has been given for private companies to lay optical fiber cable along road and highway rights-of-way at no charge and to allow private right-of-way arrangements with such other entities as power distributors and Indian railways. Moreover, permission has been granted to private parties to enter the long-distance telephone business. One result of such

¹⁹ In a recent survey by NASSCOM, for example, a primary finding was that "more than 55 percent of corporate respondents said that e-commerce transactions were integral to their corporate *plans* (italics added)." Twenty-three percent of the top 500 companies in India already had started some form of e-commerce, nearly all facilitated by upgrading existing IT systems in order to provide a learning period for when systems can be converted to the internet. See, NASSCOM, 2000, "E-Business & E-Commerce: Background and Reference Resource" (July): 27, New Delhi.

changes has been a number of privately funded efforts to build an interconnected system of fiberoptic cables to link at least the major cities in the country in relatively short order. Problems still remain on so-called “last mile” connections, but the apparent hope is that, for larger businesses, these problems will not be insurmountable and, for residences and small-businesses, ways can be found to link through existing cable television lines or through information kiosks.

One example of a company that has entered the fiberoptic cable business is Reliance Industries, a company cited earlier regarding its present and future use of the internet. This firm is committed to developing a national fiberoptic network linking 115 cities which, together, represent about 50 percent of India’s GDP. This \$3-4 billion set of projects in a short time will permit Reliance to offer long-distance and local telephone service, internet service and high-speed data transmission. Eventually, the company expects to enter the already competitive business of selling back-office services. Reliance is only one of several private companies in India determined to profit from the provision of internet infrastructure.

- **Wireless services:** By 2005, it is estimated that 1.2 billion people worldwide will be able to access the internet using mobile communications. And, for many, mobile connections may well be cheaper and more convenient than fixed lines. For relative latecomers to the cellular telephone explosion, like India, who can initiate digital systems from the start, wireless services may be one method for avoiding some of the disadvantages stemming from inadequate and often expensive dependence on landlines.

Wireless services in India, which have been digital from the beginning, are furnished largely by several large, private providers. The state-owned operator, MSNL, is only now beginning its own services. Although growth in the market for mobile communications has been disappointing, mostly owing to high costs of both equipment and service, this picture is changing. Costs have been coming down, and the response thus far has been encouraging for providers. Today, there are perhaps 2-3 million subscribers in India, a very low number compared even with other developing countries. Growth, however, has approximated 85 percent over the past year, a figure that obviously is based on the low user base noted above.²⁰ To provide a comparison, China has 54 million subscribers.²¹

Whether or not mobile communication becomes at all important as a vehicle to access the internet remains to be seen in India. Thus far at least, mobile internet service is yet to be offered.

- **Fixed telephone service:** In a recent enumeration of internet readiness, the Economist Intelligence Unit ranked India fiftieth of the sixty countries ranked.²²

²⁰ See the “Special Section on Indian Information Technology”, *Financial Times*, July 4, 2000, p. 2.

²¹ See the “Survey of the New Economy”, *Economist*, September 23, 2000, p. 38.

²² See “Introducing the EIU’s e-business-readiness rankings”, *ebusinessforum.com*, May 4, 2000.

A major reason for the low rating was India's connectivity ranking, a measure taking into account not only the state of the existing telephone network but also other factors affecting access, such as dial-up costs and literacy rates. In this ranking, India was rated 3 on a scale of 10 in connectivity, along with such other countries as Egypt, China and Pakistan, among others. There are about 2.0 main telephone lines in India per 1,000 inhabitants, a strikingly low number but one that has increased by 60 percent in the past four years.²³

One corollary of low telephone density is that service has not yet reached thousands of villages. And, while major cities are largely serviced, the quality of many lines is poor, largely owing to low quality last-mile connections. While telephone access and quality of service have both been improving rapidly, the system is still often subject to dropped connections, obviously a bane for reliable internet services.

Provision of telephone communications in India has until quite recently been a province exclusively of government as was the provision of internet services. Although local land-line service remains in the public domain, both long distance and internet services have been opened up to other providers. One consequence has been an explosion of internet service providers (ISPs); in 1999 alone new ISPs established over fifty sites. Interestingly, the potential presence of this new competition apparently motivated Videsh Sanchar Nigam, Limited (VSNL) dramatically to expand its own presence by adding thirty cities to its ISP network and to lower fees. One can anticipate a similar reaction as private long-distance providers gear up to enter aggressively into that market.²⁴

As to local services, the market is still reserved to the Department of Telecommunications, except in Mumbai and New Delhi, where Mahangar Telephone Nigam, Limited (MTNL), is sole provider. MTNL also is a public sector company under the Ministry of Communications. Both the DOT and MTNL have been under great pressure from within the government to expand telephone access, and the result has been a quite rapid expansion of services. Still, insofar as the internet is concerned, competition for the public companies to increase the quality of services and lower prices is likely to come not from within but rather from cable television providers linking with some of the private companies laying down fiberoptic cable across the country. Here a number of constraints unfortunately apply (high modem prices, little interest thus far among cable television suppliers, etc.).

²³ One rough measure of the inadequacy of land lines often is the number of cellular subscribers. In India, there are more cellular subscribers than there are main telephone lines.

²⁴ On many of these points, see Peter Wolcott, 1999, "The Diffusion of the Internet in the Republic of India", *The Global Diffusion of the Internet Project*, (December). For example, Wolcott notes that in the face of new ISP competition, VSNL dropped prices by 30 percent in December, 1998, and reduced them twice more in 1999.

- International Linkages: until recently, all telecommunications gateways in India were the province only of the government through VSNL. Needless to say, with internet and other users seeking high-speed connections, the demand for international bandwidth already far exceeds the supply. And, demands are increasing rapidly, even with only limited use of the internet thus far. Most Indian websites, particularly those being designed to service non-resident Indians, have attempted to evade this bottleneck by establishing their sites in the United States. But, in the longer run, if the internet is to become the vital communications means hoped for, the gateway constraint must be breached.

Recent changes in Indian telecommunications policy have opened up international gateways anywhere in the country to private internet service providers (ISPs). These new carriers hope to team with foreign providers of undersea cable to rapidly expand international services. Although limited only to internet providers, not voice traffic, and burdened by somewhat excessive security requirements, the new licensing provisions promise to reduce the supply-demand gap in the near future.

Limitations to Internet Expectations

There is, of course, much more to business success than access to the internet. Firms exist in an environment that is either supportive of their competitive efforts, not supportive, or something in between. Even with a completed high-speed fiberoptic network connecting most cities and with much-improved international gateways, both expected within the next two years, India's economic environment could, at best, be ranked as "something in between." For purposes here, it is unnecessary to run through the litany of well-known difficulties businesses face (continued government interference at both national and state levels, remaining protection, even in the IT sector, inadequate public investment owing to high fiscal deficits, the associated 'crowding out' effects in capital markets, government subsidies, sectors reserved to very small firms, labor laws, etc.).

The fact is that today few firms in India outside the software, textile and chemical industries are truly competitive internationally, especially among locally controlled companies. Even within the IT sector, domestic manufacturers of personal computers, peripherals and other equipment are concerned that opening markets in response to India's joining the WTO could be devastating if and when lessened levels of effective protection are introduced. Adjusting to increased international competition, in other words, could present difficult problems for many Indian companies.

Two negative factors affecting the growth and success of the internet in affecting productivity improvement seem particularly important. The first has been mentioned earlier, poor physical infrastructure for moving products within the country and, for export and imports, through ports. The inability to ship goods easily and cheaply is a major constraint in building a true national marketplace in India and a constraint that will not easily be overcome. Some efforts have been made to improve ports through private sector initiatives, but much remains to be done both here and, particularly, in highway construction. Given low public investment and the apparent discomfort in relying on private methods of financing infrastructure projects, this constraint is likely to persist for some time to come.²⁵

The other factor that ultimately promises to compromise success, certainly as compared with several other Asian nations, is educational achievement. Fewer than 60 percent of Indian children complete the fifth grade, and 45 percent are illiterate. These percentages compare poorly with such competitive countries as Thailand, Indonesia or, especially, the Philippines.²⁶ Although lack of literacy has not thus far been a major

²⁵ The continuing problems with the Dholal power plant, erected by a private consortium led by Enron, provide ample evidence that the anticipated financial returns needed to encourage private entrepreneurs to invest in infrastructure remain elusive and, therefore, discouraging to prospective investors, domestic and foreign.

²⁶ Comparable figures for the Philippines, for example, are about 70 percent completing 5th grade and only 5 percent illiteracy. Figures from the World Bank's *World Development Report, 2000/2001: Attacking Poverty*, New York: Oxford University Press.

problem for those parts of the IT sector that have been successful, particularly the software industry, the much wider impacts from the internet that are anticipated across the economy will depend increasingly on availability of trained or trainable workers. In some ways, India appears bifurcated between an educated middle-class, from which the technical schools draw, and the vast majority of the population with little, if any, formal education. For the software industry, such a bifurcation may still allow for rapid expansion, at least for a time. For other industries, however, servicing an increasingly 'wired' economy promises to require a workforce much more competent than is widely available at present.

Conclusions and Policy Implications

It is still premature to determine whether or not the internet will become a “leap-frogging” technology for India, enabling it to radically improve economic growth. As might be anticipated, given its stage of development, use of the internet in India is not yet widespread by either consumers or businesses. Consumer use has been constrained not least by the relatively low number of personal computers found in the country but, in addition, by unreliable telecommunications and electric power infrastructure, and by a financial system that has not encouraged the use of consumer credit to support commercial transactions. In corporate use of the internet, more progress is evident, again as might be anticipated. But, even here firms have been limited by some of the same infrastructural inadequacies that have plagued consumers. Companies, moreover, have had to deal with long-established modes of conducting business, including government policies that historically were established to foster greater government control over the economy, not productive efficiency. Thus, the type of competitive forces that might have forced companies to search for more efficient ways of doing business have until quite recently been largely absent in India.

Much, though not all, of this description is rapidly being relegated to the past. Within two or three years, at least the major cities of the country will be knitted together into a web of high-speed, fiberoptic networks. Although such networks will not solve all of the problems affecting consumer use of the internet, businesses should be able to build applications rapidly. Many companies, in fact, are already in the process of developing their own applications to utilize the internet for both internal data processing and for customer and supplier relationships. With the availability of greater bandwidth and much higher reliability, business uses of the internet promise to expand rapidly. The government’s current efforts to comply with WTO obligations, resulting in less tariff and quota protection, should provide added stimulus for businesses to find ways of improving productivity, enhance product and service quality, add transparency, and tighten organizational efficiency, certainly within the next decade. Unfortunately, however, substantial effective protection will remain in place for many industries, even as quotas are eliminated (replaced by tariffs) and overall tariff levels are reduced modestly.

Widespread use of the internet will require more time and, in addition, will depend in large part on various state and national governments’ continued liberalization efforts. Much remains to be accomplished in opening local telephone services to competitive forces, for example, and in upgrading and expanding electric power supplies. Both affect particularly consumer use of the internet for information and, as importantly, for commercial transactions. Continued restructuring of local telephone rates, including reductions in the cost of local telephone service to be more consistent with more widespread internet use, will be required. Clearly, there are plenty of potential individual users of the internet in India, if the appropriate conditions for their participation can be established.

From a governmental policy perspective, many recent pronouncements have been distinctly positive. The recent policy allowing private internet service providers to estab-

lish international gateways is one example. Prior to this policy, only VSNL was allowed to operate such gateways, and the new opening has had two positive effects. First, it has introduced competition into the provision of gateways, a result that should improve quality and bring down costs. Second, the competition has brought new vigor to VSNL which, in turn, has begun to offer new services and wider coverage. Although the government has retained some rather draconian security measures, the overall effect of the new policy clearly has been positive.²⁷ In addition to international gateways, the government ended its monopoly on undersea telecommunications cable, a move intended to much increase the availability of international bandwidth through private parties. Already, private efforts are underway to lay a submarine cable to Singapore.

The new telecom policies of 1999-2000 also is intended to provide additional opportunities to private entrepreneurs, a recognition that India's ambitions with respect to telecommunications and the internet far exceed the government's ability to finance them. Included in the policy are a number of features, some an expansion of efforts begun in 1994 especially to encourage expansion of cellular networks, some intended to bring private companies more actively into various parts of the communications infrastructure. In cellular services, for example, the 1994 policies resulted in the issuance of more than twenty licenses covering four metropolitan areas and eighteen states. Although there are now some one million subscribers to cellular service in India, revenues have been well below expectations and, as a result, companies have had difficulties raising needed financing to complete their networks. The new policy allows providers to offer other services, if necessary in cooperation with other private partners.

The new policy also envisions more competition in the fixed line segment of the sector. This is to be accomplished in two ways. First, direct competition with VSNL and MTNL is to be fostered through encouraging private parties to provide "last mile" connections, if required through existing providers for an agreed-upon fee. In addition, fixed line companies are allowed to offer long-distance services in cooperation with other firms. Second, cable service providers, now mainly in the business of transmitting television, are permitted to enter two-way communications, including voice, data and information services. Clearly, for cable competition to begin in earnest, completion of the fiberoptic network will be necessary.²⁸

Private companies, of course, have welcomed such policy initiatives but, perhaps naturally, have pointed out the need for further changes. There are, for example, concerns that in the implementation of the 1999-2000 policies, too much influence in the

²⁷ On security, the government insists on a detection system to monitor traffic through the gateway to prevent voice transmissions and to filter information and data content, where the system is to be designed, paid for and maintained by the licensee.

²⁸ In addition to policy measures directed toward encouraging expansion of the internet, there are a plethora of incentives intended to expand software exports, foster exports of IT "enabled services" and, not least, encourage domestic production of technology-based equipment. Among other policies are: establishment of export processing zones, software technology parks, import tariff exemptions on selected technology items and software, income tax exemptions on profits derived from some export operations, accelerated depreciation of computer equipment, and tighter restrictions on intellectual property use. Full coverage of such policies is beyond the scope of this paper.

certification of new competitors might reside with the government agencies now providing monopolistic telephone services, the very agencies that would be financially compromised if competition became at all severe. Other concerns focus on internet security provision, consumer protection on electronic transactions, the future state of e-commerce taxation, copyright protection, high fees for telephone use and for international connectivity, facilitating internet connections through cable, e-commerce fraud and a number of other issues.

Most of these issues, while certainly important, are peripheral to the more important issues already addressed in the new telecom policies. Assuming smooth implementation of the new policy, the way seems clear for a rapid expansion of internet connections and, derivatively, of an expansion of both consumer and business e-commerce. With such an expansion, one might anticipate substantial gains in efficiency in both corporate management and in commercial transactions, certainly on a scale comparable to gains in industrialized countries, at least for a short time.

In a longer period, the continuation of productivity gains will, as always, be contingent on more focused governmental attention on its basic functions: providing a better educational foundation, improving physical infrastructure and, more generally, continuing the reform path begun ten years ago intended to reduce government involvement in the economy.

Finally, there is the question of how much India's IT experience can be interpreted as an example for other developing countries to emulate. Certainly there are stark differences between India and many other poor countries. While India is poor, it also is a large country with an expanding middle class and a variety of large manufacturing companies. Even so, its industrial sectors are, on the whole, not internationally competitive. Although its educational attainment, as measured by literacy, is still low, India has some of the world's premier technical universities with its graduates actively sought by firms in many industrialized countries. Such differences certainly set India apart from many other developing countries.

Despite differences, however, there are still wider lessons one can learn from the Indian experience that might be applicable to many other developing countries. Most obvious is the Indian example that private businesses, in this case in the information technology area, grow more robustly in an environment of competition and minimal government intrusion. This lesson needs to be expanded not only to other developing countries but to other Indian industries as well. Secondly, growth occurs best where governments focus on such core tasks as the provision of adequate physical infrastructure, of primary/secondary education and, perhaps most importantly, of a predictable and equitable legal structure for businesses. If the internet is to be part of a set of "leapfrogging" technologies, as it clearly could be, then the set of conditions that made possible the expansion of the internet needs to be extended to most other sectors of the economy.

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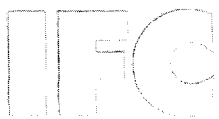
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