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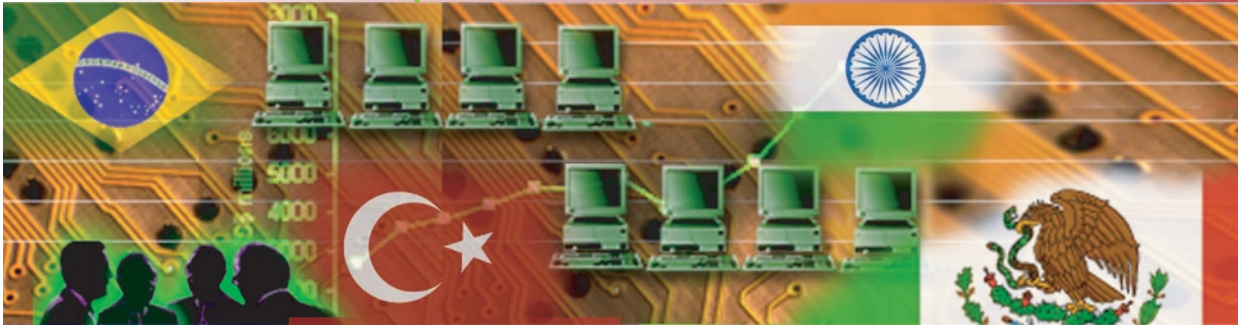
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Liberalization and the Computer Industry: A Comparison of Four Developing Countries

Short Title: Liberalization and the Computer Industry

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Liberalization and the Computer Industry: A Comparison of Four Developing Countries

I. Introduction

Market liberalization has been embraced by developing countries around the world since the 1980s, in the hope of achieving economic growth and development through participation in an increasingly interconnected global economy. Developing countries who once feared economic dependency on the industrialized world now fear being left out of the dynamic process of economic globalization. A key question after a decade or more of liberalization experiments is whether the expected benefits are being realized, and at what cost.

The information technology (IT) industry is an especially good industry sector to study this question. It is one of the most global of industry sectors, particularly since the ascendance of the personal computer, whose horizontal industry structure has replaced the vertically-integrated structure of the mainframe computer industry (Grove, 1996). While the mainframe industry was more nationally oriented, the PC industry has been organized around a global production network, with particular countries—mostly in East Asia—specializing in activities such as PC assembly and production of components and peripherals (Wong, 1995; Ernst, 1994; Borrus, 1997; Dedrick and Kraemer, 1998). Motivated in part by the success of these countries, newcomers such as China, India, Mexico, and several eastern European states have liberalized their computer sectors in hopes of joining the global production network and gaining access to technology and capital.

The emergence of the Internet has created new pressures for liberalization. The Internet represents a global infrastructure that can be exploited by developing countries to connect with markets and production networks around the world at a relatively low cost. The common standards and open nature of the Internet prevent it from being controlled by either by governments or corporations. However, lack of competition in the domestic telecommunications market has been linked to low Internet diffusion rates, due to higher costs of access in non-competitive markets (OECD, 1996). Thus, in order to take advantage of the potential benefits of the Internet, it is argued that countries should liberalize both telecommunications and IT markets.

This special issue includes case studies of four different developing countries' responses to the forces for liberalization. The Mexico case illustrates a shift from protectionism to nearly complete liberalization of the IT sector, accompanied by economic integration via NAFTA. Brazil and India likewise liberalized after years of highly protectionist policies, but moved more slowly and retained some policies favoring local production. The Turkey case focuses on telecommunications liberalization, showing how the failure to liberalize did not prevent the diffusion of the Internet due to the creation of a liberal market for Internet services. The authors present different points of view on liberalization, but all agree that while the old approach of import substitution is not viable in the dynamic, global IT industry, there is still a role for government policy in developing national capabilities.

II. Theory and Conceptual Framework

The economic policies of developing countries have been influenced by various development theories over the years. In the post-World War II era, the work of the

Economic Commission for Latin America (ECLA) argued that developing countries faced deteriorating terms of trade as their raw materials exports fell in price while the price of imported manufactured goods rose (Prebisch, 1950). The solution adopted by many developing countries was import-substituting industrialization (ISI), a process of developing local manufacturing industries behind protective trade barriers.

Import substitution did lead to rapid industrialization in some countries, such as Brazil and Mexico, but domestic markets became saturated and the costs of imported materials and capital goods were a drain on foreign exchange. By the 1980s, economic stagnation and financial crises in Latin America and elsewhere led to a search for new models of development. Most influential were the neoliberal theorists (e.g., Friedman and Friedman, 1980; Balassa, 1988; Boskin, 1986), who argued that the market is the best mechanism for allocating resources and determining investment decisions in nearly every case. Their prescriptions included liberalization of trade and foreign investment, privatization of state enterprises, and deregulation of industry sectors such as finance, telecommunications and transportation. The adoption of such reforms is well known in developed countries such as the U.S., U.K., and New Zealand, but in fact, neoliberalism found some of its most enthusiastic adherents in the developing world. In the 1980s, countries such as Chile and Mexico adopted liberalization strategies guided by technocrats trained in the economics departments of North American universities.

The theoretical case for such market-oriented policies was reinforced in a number of studies of the “East Asian miracle.” These included the work of Little (1982), Findlay (1984), and most famously, the World Bank (1993), which argued that “(o)penness to international trade, investment, and ideas has been critical in encouraging domestic

producers to cut costs by introducing new technologies and developing new and better products. By the same token, protection for domestic industry can hold back development for decades” (p. 85).

In contrast to neoliberal theory, other analysts have argued for a stronger government role in promoting national industrial development, based on a different interpretation of the East Asian miracle (e.g., Amsden, 1989; Anghosca, 1989; Wade, 1990). They argue that Asian countries allowed limited foreign competition in domestic markets while pursuing export-led industrialization. These scholars argue that simply opening up a country to international competition without a period of adjustment and without providing support to domestic producers will result in the destruction of national industrial capacity. They likewise argue that government intervention in capital markets is necessary to direct investment into riskier investments in capital goods and into R&D needed for industrial development.

Facing these conflicting schools of thought, policymakers in developing countries must consider whether and how to liberalize different segments of their economies. A key question is whether to throw open the doors to trade and investment as the neoliberals would advise, with faith in the wisdom and benevolence of free markets, or to adopt a more selective and strategic approach to liberalization as the revisionists would argue, attempting to position one’s country to benefit from participation in the global economy.

The case studies in this issue look at one industry—information technology—and the impacts of liberalization on different elements of the IT sector (e.g., hardware and software production, IT services, Internet diffusion). While such a focus limits somewhat

the ability to generalize, it offers the opportunity to delve in greater depth and detail into the process of liberalization than would a study of entire national economies. Also, given the technological and market dynamism and high degree of globalization in the IT sector, as well as the belief of many that a “new economy” is being created around IT and the Internet, the findings should be of interest in their own right. If IT is changing the world, then new ideas are needed as to how particular policy approaches might shape the role of developing countries in that changing world.

This overview presents a comparative analysis based on the framework presented in Figure 1, which posits that the *impacts of liberalization* are influenced by national context, including: (1) the *environment* in which it takes place, particularly the global environment, the national economic and political environment, geographical location, information infrastructure, national capabilities such as human resources and technology, and the nature of computer production and use at the time of liberalization; and (2) the *nature of the liberalization process*, including the timing, pace and extent of liberalization, as well as related IT policies such as investment incentives, export promotion, incentives for IT use, training in IT skills, and telecommunications policies.

*****INSERT FIGURE 1 HERE*****

Some of the key impacts of liberalization include the effects on industry structure, computer production, trade, the domestic IT market, and the nature of IT and Internet use.

III. Environment for Liberalization

Global environment

The global environment influences the policies of national governments and defines the opportunities and challenges facing policy makers and business leaders. The computer

industry is highly globalized, with common technology standards used around the world. This means that thousands of companies are doing research, designing and manufacturing products, and developing software for a few major technology platforms, most importantly the IBM/Wintel personal computer. In the face of such global economies of scale and technological dynamism, it is impossible to develop a competitive computer industry in an isolated national market. Instead, successful countries such as Taiwan, Singapore, and Ireland have integrated themselves into the global production networks led by multinational computer makers (Dedrick and Kraemer, 1998).

By the 1990s, the global production system was well established for computer hardware, with the U.S., Japan and East Asia dominating the industry. Newcomers faced dim prospects for entry unless they had a unique asset to attract MNC investment, such as China's large domestic market. However, the industry has seen a shift toward build-to-order production in the late 1990s, requiring PC assemblers and some of their suppliers to locate production close to the final market. This trend has led to regional production strategies, with major PC makers having separate assembly plants in Asia, North America, and Europe in order to serve the three major markets. The result has been new opportunities for countries such as Ireland, Hungary, and Mexico.

National economic environment

Brazil, Mexico, India and Turkey are all relatively large developing economies with significant growth potential. In terms of income, Brazil, Turkey and Mexico are all in the US\$3,000-5,000 range in per capita income. India is much larger in population, but is much poorer, with per capita income of only US\$390 (Table 1).

These economies each were large enough to tempt policy makers to try import substitution in the computer industry, but in the end were not large enough to support high-volume hardware manufacturing. Ultimately, each decided to lower trade barriers and open domestic markets to international competition.

*****INSERT TABLE 1 HERE*****

Political environment

Decisions over whether and how to liberalize are shaped by domestic political factors, including constitutional restrictions, ideology, and the influence of interest groups. For instance, Turkey's constitutional requirement that the government provide communications services has limited the scope of telecommunications liberalization, while entrenched interest groups have hampered the process of privatization. By contrast, Mexico's institutionally powerful presidents have been able to overcome domestic opposition and institute sweeping liberal reforms. The pluralistic governments of Brazil and India have taken a more gradual approach to liberalization of the IT industry, responding to internal and external pressures to open up, but retaining some protection for domestic producers.

National capabilities

The potential impacts of liberalization on a country are affected by its national capabilities, i.e., those resources needed for production or use of computers and information technology. Most important of these are the quality of the telecommunications infrastructure and human resources, and the size and competitiveness of the IT industry before liberalization. Telecommunications infrastructure is vital to effective use of IT, especially in the era when the Internet and other network technologies

are coming to dominate. Human resources include everything from literate workers for advanced manufacturing facilities to engineers and technicians needed by the IT industry, to scientists and researchers who can conduct R&D and develop new technologies.

The capabilities of the existing IT industry also can affect the results of liberalization. If domestic companies are already exporting and are internationally competitive, they are likely to survive and even thrive under liberalization. If they have succeeded only by taking advantage of the protected domestic market, they are unlikely to survive the onslaught of foreign competition after liberalization. However, even if existing companies do not survive, there may be a cadre of individuals who have gained experience starting and managing companies, and these skills will still prove valuable to the country after liberalization. They can shift to different industry sectors, start new companies, or help foreign MNCs carry out higher value-added activities within the country. The ability of a country to participate in a global, post-liberalization environment and realize the potential benefits of that participation depends to a great extent on whether it has or can develop these capabilities.

Turkey has the highest level of telecommunications infrastructure, while Mexico tops the four countries in PC and Internet penetration, and Brazil is investing most heavily in IT (Table 2). Mexico, Turkey and Brazil have similar literacy rates, with India much lower, but all four countries now have similar rates of secondary school enrollment (Table 3). Each country also has similar numbers of scientists and technicians per 1,000 people, meaning that India has a much higher absolute number.

*****INSERT TABLE 2 HERE*****

*****INSERT TABLE 3 HERE*****

The significance of these data is that each of the four countries has sufficient resources and capabilities to take advantage of opportunities in IT, both as producers and users. And in fact, each country has excelled in one or more areas, such as software development in India and banking automation in Brazil. There is plenty of room for improvement in each case, but these countries did not liberalize without having important capabilities already in place.

IV. Liberalization of the Computer Sector

Pre-liberalization policies

Before liberalization, Brazil, India and Mexico all protected their domestic IT markets to varying degrees, creating space for local firms to enter the industry. India's policies in the 1970s were the most restrictive, leading IBM to abandon the Indian market rather than submit to government requirements that it enter a joint venture with local partners (Dedrick and Kraemer, 1993). Brazil's "market reserve" policy reserved the minicomputer and PC markets for local companies and joint ventures, but allowed MNCs (mainly IBM) to retain their position in the mainframe market. The market reserve policy was protested vigorously by foreign companies and the U.S. government, but remained in place throughout the 1980s. Mexico took a similar approach in the early 1980s, but bowed to pressure from the U.S. and IBM to give up its joint venture requirement, and later eased other restrictions. In the end, however, all three countries banned or severely limited at least some categories of computer hardware imports.

The impact of these policies was higher prices and limited availability, which hurt domestic users and also hampered the development of software and service industries. This led to pressure from computer users and software makers (especially in India, with

its large pool of software professionals) to liberalize. There was also ongoing external pressure from the U.S. government acting on the behalf of U.S. companies, and in the cases of Brazil and Mexico, from the IMF and World Bank in the wake of the Latin American debt crisis. Ultimately each of these countries liberalized their IT sectors, although in different manners. Turkey, driven by economic decline and social turmoil, introduced market-oriented reforms and invested heavily in telecommunications in the 1980s, but did not privatize or liberalize the telecommunications sector, even in the 1990s.

Computer industry liberalization

The process of liberalization among the four countries has ranged from sudden and complete to gradual and partial. Liberalization of Mexico's computer sector took place in a sweeping move when the Computing Program was abandoned in 1990. The only remaining barrier to the Mexican market was a 20% tariff on hardware imports, which was phased out by 1998 within NAFTA. Since liberalization, Mexico has taken a laissez faire approach to IT, even at the cost of losing out on potential foreign investment to countries that offer incentives.

Brazil likewise removed most barriers to its computer market in 1992, but left in place a somewhat complex mix of tariffs, and taxes, which could total over 30% of the cost of a computer. By maintaining these taxes, Brazil could offer exemptions as a means of promoting domestic production. Brazil also has pursued various policies to promote the local industry through investment incentives, incubators for startup companies, and software export promotion.

India has liberalized in two phases. First, from 1991 to 1997 it lowered trade barriers and promoted the software industry through policies such as export zones. Second, since 1998 it has created free-trade zones and enacted other policies to promote hardware production. Turkey has not liberalized telecommunications, but it has created a competitive Internet services market built on a backbone infrastructure provided by the state telecoms monopoly.

The differences in the nature of liberalization can be attributed to the economic and political factors discussed above. More interesting from a comparative point of view are the results of liberalization.

V. Impacts of Liberalization

Liberalization has led to many positive results in the four cases, as neoliberal economists would have predicted. IT use has expanded as prices have dropped and a greater selection of hardware and software has become available. In addition, local software and services companies have benefited from access to cheaper hardware and a growing domestic market. On the other hand, in Mexico and Brazil, many local computer makers have been driven out of business (or at least into different markets) by foreign competition. In India, local computer companies have retained their leadership in a somewhat more protected domestic market.

The result of de facto liberalization in Turkey's Internet services market has been an impressive growth in availability and use of the Internet. The beneficiaries have been local Internet service providers, which operate under minimal regulation and do not face competition from Türk Telekom, the state-owned telecoms monopoly. However, Türk Telekom's control of the TURNET backbone and the high costs of international leased

lines has restricted the ability of local ISPs to improve their infrastructure. In this case, the continuing lack of liberalization puts limits on the development of the Internet.

However, factors other than liberalization help explain many differences among the countries' IT sectors. For instance, in recent years the PC industry has become extremely time sensitive, thanks to the rapid depreciation of products and the build-to-order production model pioneered by Dell Computer (Kraemer et al., 2000; Curry and Kenney, 1999). This has pushed PC makers to locate production close to the end market. As a result, Mexico has experienced a large inflow of foreign investment by computer makers and contract manufacturers seeking a low-cost production site for the huge North American market. The result has been a boom in computer exports, which topped US\$3 billion in 1996, the last year for which comparable figures are available (Table 4)

Brazil and India are too far isolated from the major world markets to serve as export platforms, and have attracted much less foreign investment. In reality, while they are touted as emerging markets, the combined IT markets of the four countries is less than 6% of the U.S. market. Surprisingly, Turkey, which is well-situated geographically for serving the European market, has yet to develop a computer industry at all, with production of just US\$217 million in 1998.

*****INSERT TABLE 4 HERE*****

Other idiosyncratic factors have affected outcomes in each country. For instance, the success of Brazilian firms in banking automation is often attributed to the exceptionally high inflation rates that prevailed throughout the 1980s and early 1990s. Banks were able to take advantage of constantly shifting prices and exchange rates by automating their processes during this time. As a result, Brazil was an early adopter of

banking automation and has used those capabilities more recently for applications such as online banking and risk management analysis.

In addition to liberalization of the computer sector, broader liberalization policies can also influence outcomes. For example, IT use in Mexico and Brazil has been spurred by increased competition across newly liberalized segments of the economy such as banking, retail and manufacturing. As foreign competitors have entered these previously protected markets, they have brought in advanced information systems and exposed Brazilian and Mexican managers to those technologies. Domestic companies have either looked for foreign partners to gain access to such systems, or have worked with foreign and domestic IT companies to develop their own capabilities.

After a slow start, the Internet has caught on in recent years. One reason has been the availability of lower-cost PCs to access the Internet in Brazil, Mexico and India, and a competitive ISP market in Brazil, Mexico and Turkey. India still lags far behind the others, due partly to the lack of telecommunications infrastructure and partly to its much lower income level.

VII. Conclusions and Implications

In conclusion, we would argue that some degree of liberalization was necessary and probably inevitable for all of the countries discussed here, given the nature of the global computer industry in the 1990s. The idea of promoting a domestic computer industry behind protective barriers is not tenable in an industry marked by rapid technological change and dominated by multinational companies who control global technology standards. The question was no longer whether to liberalize, but how to do so.

Each country took a different approach to liberalization, and each had different results. The differences in results cannot be separated from differences in environment (size, location, capabilities), but they also are related to the nature of the liberalization process. Mexico's sweeping liberalization led to the demise of much of the local industry, but also created a more attractive environment to become an MNC export base. Brazil and India, with their more gradual liberalization, left more local firms intact, but have not developed export-oriented hardware production, partly due to their more remote locations from major markets. Brazil has, however, seen significant growth in production for the large local market.

More interesting perhaps is the evolution of the software, services and Internet sectors. As we have argued before (Dedrick and Kraemer, 1998), there are great opportunities for developing countries to promote "production close to use." This means promoting IT use because of the benefits from using the technology, and also because domestic use creates opportunities for local entrepreneurs. This part of the market does not require the massive economies of scale needed for hardware production, and local companies can get started by finding niche opportunities in the domestic market. This was the case with Brazil's banking automation industry and Internet content developers, and Turkey's Internet service providers. By contrast, import restrictions on hardware limited the local market for Indian software makers and forced them to rely on "body shopping" and subcontracting, rather than on developing original products. As a result, India's software industry is large, but has developed few successful commercial products.

To summarize, we would make the following points about liberalization:

- On the positive side,

- Liberalization in the computer sector has resulted in lower prices and greater use of computers. Broader liberalization of the economy has likewise spurred demand for computers and IT as companies respond to new foreign competition.
- Liberalization of telecommunications related to the Internet has resulted in rapid growth in Internet use, further stimulating demand for computer hardware and software, and creating a market for local Internet service and content providers.
- Liberalization of foreign investment laws and lowering of trade barriers on parts and equipment has led to investment in computer production in those countries that are located close to major markets, or that have large internal markets.
- However, on the negative side, liberalization has often driven local computer makers out of business, as those companies lack the resources to compete with foreign multinationals who enter the market. It also is possible that liberalization discourages local entrepreneurs from entering some segments of the IT industry where they are likely to face foreign competition.

Regarding the argument as to whether countries are better off following the neoliberal prescription of complete liberalization or the revisionists' strategic approach, the case studies suggest more nuanced conclusions. Removal of barriers to trade and foreign investment will bring significant benefits, although some transition period is likely to help local companies adjust and find new market opportunities. More importantly, liberalization does not preclude the adoption of policies to better prepare a

country's economy and people to function in the global computer industry and take advantage of opportunities in both production and use of IT.

What then can we say to developing countries trying to develop such policies? First, the key to a successful policy is to understand one's own circumstances and develop policies that are appropriate for those circumstances. Simply trying to follow another country's model is not likely to work very well. What worked for Mexico will not work for countries that are not located next to the U.S. market, and what worked for Brazil will not work for countries with very small domestic markets. India's software export success will not be duplicated by a country without a large pool of software professionals.

Second, even after liberalization, there is a role for government. In Brazil, the national government and state governments are promoting production of hardware, software and services. In Mexico, the state government of Jalisco has been especially active in promoting the IT industry in conjunction with MNCs and local universities. We would argue that the policies most likely to succeed are those that enhance national capabilities, including education of engineers, programmers and other IT professionals, investment in communications infrastructure, and support for science and technology.

Finally, liberalization of the computer sector is not enough in the Internet era. Equally important is liberalization of telecommunications, which creates competition and drives down the cost of Internet service. Even selective liberalization, as in the case of Turkey, can make a difference, but more complete liberalization will have broader impacts. The greatest benefits of IT in the future will come from being linked to the

global Internet, so policies that lower the cost of connecting are a must for developing countries.

The debate over liberalization has shifted from whether or not to liberalize, as the process is already far advanced in most developing countries. Liberalization is now seen as a first step to ensure that countries have access to international markets, technology sources, and foreign investment. Beyond that, the issue is how to realize the potential benefits from increased competition at home and participation in global markets and global production networks. One point that has been made clear by the case studies in this special issue is the importance of developing national capabilities such as human resources, high-quality and low-cost telecommunications networks and Internet connections, and financial systems capable of supporting local entrepreneurs. By doing so, countries can take advantage of opportunities in the global market as well as develop unique national applications of information technology.

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*****FIGURES AND TABLES (IN THE ORDER THEY APPEAR)*****

Figure 1. Framework for comparison

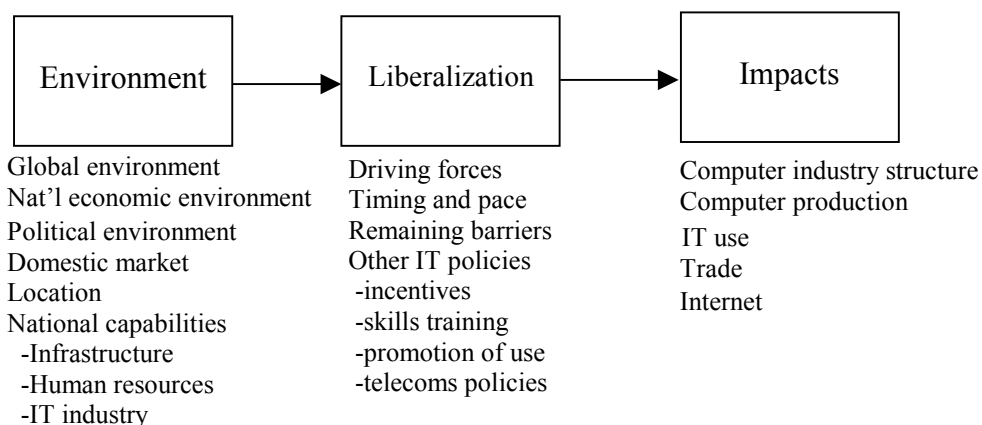


Table 1. Economic indicators for Brazil and Mexico

	India	Turkey	Brazil	Mexico
Population, 1997 (millions)	961	64	164	95
GNP, 1997 (US\$ billions)	373.9	199.5	773.4	348.6
GNP per capita, 1997 (US\$ millions)	390	3130	4720	3680
GDP growth rate 1980-1990 (%)	5.8	5.3	2.8	1.1
GDP growth rate 1990-97 (%)	5.9	3.6	3.1	1.8
Average inflation, 1990-97 (%)	9.4	78.2	475.2	18.5
Manufacturing as % of GDP, 1997	19	18	23	20
Exports as % of GDP, 1997	12	22	6	22

Source: World Bank, 1999.

Table 2. Comparative IT and telecommunications indicators

	Main lines per 100 inhabitants ^a	Cellular mobile subscribers per 100 inhabitants ^a	PCs/100 inhabitants 1997 ^a	Internet hosts per 10,000 people, January 2000 ^b	IT spending as % of GDP (1998) ^c
Mexico	9.6	1.8	3.7	42.6	1.1
Brazil	10.7	2.8	2.6	27.2	1.6
Turkey	22.4	2.6	2.0	15.1	0.7
India	1.9	0.1	0.2	0.2	0.6

Sources: ^aITU, 1999, *Yearbook of Statistics*. ^bInternet Software Consortium, 2000,

<http://www.isc.org/ds/WWW-200001/report.html>. ^cIDC, data provided to authors.

Table 3. Human resource indicators

Country	Mexico	Brazil	India	Turkey
Adult Literacy (%) ^a	90	84	54	83
Secondary enrollment ratio (%) ^a	66	66	60	58
R&D scientists and technicians per 1,000 people ^a	0.3	0.2	0.3	0.3
Professional software staff ^b	275,000	475,000	750,000	210,000

a. UNDP, 1999. *Human Development Report*.

b. Jones, 1998. *The Year 2000 Software Problem*.

Table 4. Computer production and exports

	Computer hardware production, 1998 (US\$ millions)	Hardware exports, 1996 (US\$ millions)
Mexico	4,856	3,180
Brazil	8,395	205
India	974	281
Turkey	217	15

Source: Reed Electronics Research, *Yearbook of World Electronics Data*, various years.