IT and Development: Prospects and Policies

IT AND DEVELOPMENT: Prospects and Policies

Introduction

Remarkable innovations based on information and communications technology (IT) are changing the way we live and the very nature of economic activity. In recognition of this phenomenon, the G8 (the G7 countries plus Russia) recently adopted the Okinawa Charter on the Global Information Society. The Charter, by declaring that "IT is one of the most important forces shaping the twenty-first century" has thrust IT to the very center of the development dialogue (see Box 1). The G8 also focused international attention on the issue of asymmetric access to IT, affirming that "Bridging the digital divide in and among countries has assumed a critical importance on our respective national agendas."

ADB is aware of IT's potential development impact. Through its loans and technical assistance, ADB has helped some developing member countries (DMCs) adopt and implement IT. However, it is aware that a number of DMCs are unlikely to benefit from the spread of IT unless concerted efforts are made to upgrade their capacities. The rapid pace of IT developments and the emergence of new opportunities and challenges also necessitate a more comprehensive and rigorous assessment of development prospects and policies.

This brief overview is intended to provide a contextual framework for the discussion on IT. It first describes the evolution of IT and its principal components and discusses IT's interaction with the rest of the economy, focusing on the features which have led to IT's significant and pervasive impact on other sectors. Further, it describes the development of IT in some developing economies in Asia, and makes the point that Asian economies straddle the "digital divide"—between those which have access to IT and its benefits, and those which do not—and that they have the potential for self-sustaining growth in IT. It then brings together some of the issues involved in devising an effective public policy for fully exploiting IT's potential. The overview gives a brief list of general directions for public policy initiatives to promote the growth of IT in the Asian and Pacific region.

The Evolution of IT

The last three decades have been characterized by rapid developments in IT. Although mainframe computers have been used since the early 1950s, a greater use of computer applications may be traced to the introduction of the personal computer (PC) in the 1970s. The 1980s were characterized by significant structural changes in the IT industry. These included the emergence of software as an independent and dynamic component segment of the IT industry and the growth of global production networks. During the 1990s, the Asia and Pacific region emerged as one of the major players in global IT production in all the core segments of the industry.

Some industry experts now expect IT's potential impact to be as significant and pervasive as the major technological innovations of the past, including the harnessing of steam, the use of electricity, and the adoption of the internal combustion engine. In this context, it is important to understand the development implications of IT's evolution and diffusion, and to examine how public policy can facilitate its advancement, mitigate asymmetric distribution of its benefits, and use its strengths for poverty reduction in Asia.

The principal components of IT include: hardware, designed around the "microchip" (semiconductor integrated circuit) and its associated peripherals; software, which includes programming languages and their applications; communications devices, comprising both terrestrial and wireless units and related equipment; and the Internet, which is based on a whole generation of new computer languages and protocols that link individual computers into a vast network through which information can flow unimpeded (see Box 2).

The exponential increase in the computing power of microchips led to the PC's widespread adoption and the application of IT in other sectors. Advances in microchip design and miniaturization have proceeded to such an extent that the prospect of developing atom-based chips is now under serious consideration. This could lead to the development of "intelligent" minerals and metals. Software developments have facilitated the spread of IT by enormously simplifying its usage. Some software packages are now so user-friendly that formal training is hardly required. Using computers to develop next generation software has helped programmers write increasingly sophisticated and complex software packages.

In communications, the development of broadband technology and mobile personal communications devices have provided a boost to IT. The broadband channels, based on the use of optical fibers, carry large quantities of voice communications and data around the globe. This has broken down barriers on the quantity of data—and consequently the type of data, i.e., video—that can be transferred to, or accessed by, PCs. The Internet, by allowing computer users worldwide to access and share a vast array of electronically stored information, is causing a revolution in the way business is transacted globally. Moreover, mobile or wireless technology, embodied in second and third generation mobile phones, has helped users break free from locational constraints and allowed them to access the Internet while on the move. IT applications are now available in interactive mode which enable two-way communication. This has resulted in yet another surge in demand for IT products. For example, a leading firm in East Asia signed up 6 million users within less than 16 months of the introduction of its system on the market.

Operating synergistically, technological advances in each of these areas—hardware, software, communications, and the Internet—have fast expanded and diversified the number of IT innovations and applications. Many of the IT products that were hard to imagine only a few years ago have now become standardized, inexpensive, and commonplace. And with each new application, hardware prices fall, software innovations accelerate, and the IT industry continues to evolve and reorganize itself on the run.

Box 1
Okinawa Charter on the Global Information Society

In July 2000, the G8 countries adopted the Charter on the Global Information Society at their summit meeting in Okinawa, Japan. This reflected G8's recognition that IT is one of the most potent forces shaping the twenty-first century. The Charter discusses the creation of a global information society and toward this end, the host country, Japan, has committed a sum of $15 billion.

The G8 vision of an information society is one that enables people to fulfill their potential and realize their aspirations. The Charter seeks to ensure that IT serves the mutually supporting goals of creating sustainable economic growth, enhancing public welfare, and fostering social cohesion. The ancillary objectives that IT growth is expected to achieve in developing economies include increasing transparency and accountability in governance, enhancing cultural diversity, and fostering international peace and stability.

The G8 Charter is a call to both public and private sectors to bridge the information and knowledge divide—the "digital divide". It underscores the fact that an effective partnership among stakeholders, through policy cooperation, is key to the sound development of a truly global information society. The Charter emphasizes the importance of building on the following foundations:

- economic and structural reforms to foster an environment of openness, efficiency, competition, and innovation;
- sound macroeconomic management to help economic agents plan confidently and exploit the advantages of new technology;
- development of information networks offering fast, reliable, secure, and affordable access through competitive market conditions;
- development of human resources capable of responding to the demands of the information age; and
- active utilization of IT by the public sector.

The private sector has to play a leading role in the development of IT networks. Governments, however, have to create a predictable, transparent, and nondiscriminatory policy and regulatory environment. They must also ensure that IT-related rules and practices are responsive to the emerging revolutionary changes in the way people conduct business using IT, while taking into account the principles of an effective public-private sector partnership.

IT and the Economy

The Rise of IT

The claim that IT's impact on the economy will be as pervasive as that of other major inventions has yet to be proven, and the evidence relating to IT's impact on the economy, though accumulating rapidly, is still incomplete. As with other innovations, IT's diffusion and impact, could, after a slow start and rapid expansion of diffusion and usage, follow the law of diminishing returns. What is not clear to observers is the likely duration of the increasing rate of diffusion of IT innovations and the consequent overall impact on global economic activity.

Four factors perhaps explain the rapid and pervasive impact that IT has had on the economy. The first and most important is the very

rapid decline in the price of computing power over the past three decades. This, especially when seen in real terms and taking quality improvements into account, has not only made the PC more affordable, but also encouraged the use of microchips in a wide range of machines and devices.

The second factor is the generic nature of IT innovation, resulting in strong "spread" effects and extensive linkages with the rest of the economy. IT's potential forward linkages extend to virtually all sectors of the economy as it effectively embodies basic intelligence in products and processes, spawning new products, and making existing products more versatile. Its backward linkages extend to material sciences, software, and communications technology where new cycles of processes for yet further improvements in IT are begun.

The third factor is the presence of positive feedback, which implies that new products and technology, engendered by upgraded computing power, reinforce the development of IT. In the process, further new demand is created, and prices of both computers and new products are reduced.

Finally, IT is a "systems" technology. This is different from the "standalone" technologies embodied in individual machines. For example, in most circumstances, the function of a car will not affect or be affected by the function of other cars. However, the function of a telephone depends on how many other telephones are connected. As more telephones are linked to the system, the value of each telephone increases. Thus, the diffusion and expansion of IT in one sector raises returns in connected sectors, thereby encouraging more widespread adoption.

The impact of IT on the economy can be viewed from several different angles. It can be discussed in a fourfold classification which focuses on its information-induced impacts; engineering-induced changes; networking impacts; and changes due to better monitoring and evaluation of outcomes. Alternately, the impact of IT can also be discussed in terms of how it is affecting consumption, production, factor use, and markets, the nature and quantum of investment, and the quality of management. In addition, IT's impact on the economy can also be looked at in terms of its effects felt in greater integration of products and service markets across countries, which is also described as globalization. At enterprise and sectoral level, the impact may be analyzed in the consequential changes in organizational design and structures as well as in regulatory practices. The impact of IT could also be empirically examined in its effects on labor productivity, transactions costs, scale economies, research and development (R&D) costs, and generating and diffusing technology.

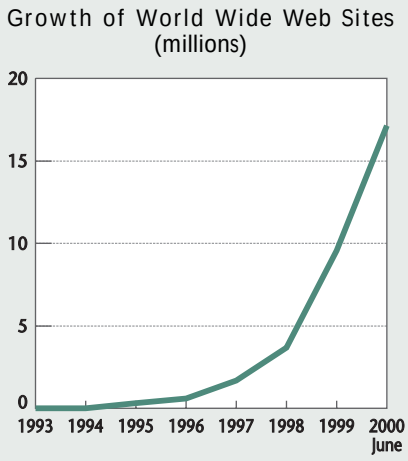
Generic Effects of IT

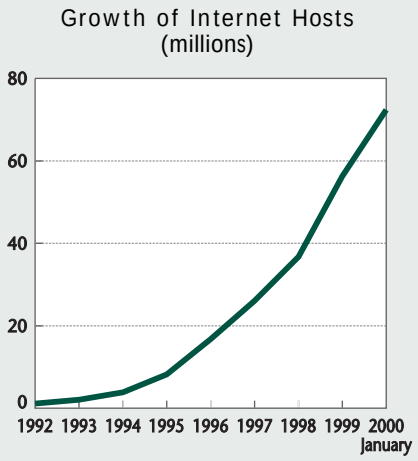
Notwithstanding the number of approaches that can be used to understand IT's impact on the rest of the economy, three features of IT which can be seen as having a generic impact across sectors merit attention. These are:

(i) the impact on information quality, coverage, and accessibility;
(ii) the impact on R&D and on product and process technologies;
(iii) the "disintermediation" effect which implies a reduction in the layers of intermediaries and improves information and data exchange.

Box 2
Internet Milestones

1958 US Government forms the Advanced Research Projects Agency (ARPA) to establish US lead in science and technology, for military purposes.
1970 Birth of Internet: ARPANET commissioned by US Department of Defense.
1971 Electronic mail (e-mail) invented.
1972 First public demonstration of ARPANET between 40 machines. Telnet specification made (still relevant for inter-machine connection).
1973 First international connection to the ARPANET, with UK and Norway. File transfer protocol specified. Ethernet outlined. Internet ideas start.
1975 First all-inclusive e-mail program with forwarding, replying, and filing capabilities written.
1976 Networking becomes popular. Unix to Unix CoPy developed. E-mail takes off, Internet becomes operational.
1979 Newsgroups born. USENET established (still in use).
1981 Minitel deployed across France.
1984 Growth of Internet continues: number of hosts exceeds 1,000.
1986 Power of Internet recognized: 5,000 hosts, 241 newsgroups.
1987 Beginning of commercialization of Internet: 28,000 hosts.
1990 ARPANET ceases to exist.
1991 The world wide web (WWW) established at the European Centre for Nuclear Research (CERN). Most important development to date.
1992 Multimedia changes use of Internet: number of hosts exceeds 1 million mark.
1993 The WWW revolution truly begins. White House and United Nations go online.
1994 Shopping malls, banks arrive on Internet.
1995 Traditional dial-up systems begin to provide Internet access in the US. Internet-related companies go public and commercial use begins. Domain registration no longer free. Search engines arrive. Mobile code JAVA emerges.
1996 WWW browser war begins.
2000 Number of internet hosts exceeds 70 million. G8 adopts charter on the Global Information Society at Okinawa.





IT is rapidly lowering the costs of gathering and disseminating information. This is removing an important source of market failure and distortion. Buyers can now have better knowledge of choices available and exercise their options even remotely, as demonstrated by e-auctions. Similarly, suppliers can reach consumers across national boundaries as IT lowers information-based entry barriers. Easier access to larger markets also implies that first-mover advantage in product innovation can be stronger as higher revenues can be generated before substitutes enter the market. Using interactive systems, manufacturers can now secure feedback from a larger number of customers, and more frequently. This can shorten the time taken for incorporating changes in products or processes based on market feedback. The information-enhancing impact of IT can thus be seen to make markets more complete and competitive, which is likely to raise both productivity and welfare.

IT is facilitating R&D and accelerating the pace of innovations in both product and process technologies. Collecting market feedback is easier, data gathering and processing are faster, collaborating on research projects and sharing results at great distance are more feasible, simulating different operating conditions becomes easier, and revising designs with the help of computer-aided design and manufacturing systems is less difficult and expensive. All this implies a more dynamic technological process. Changes in process technology can also be better documented and disseminated, facilitating technology transfer. One possible result of this IT-induced acceleration of the innovative process is the shortening of the product-life cycle that is beginning to change the nature of competition in some sectors. The introduction of a new car, for example, can now take only two years from conception to "roll-out", as opposed to six years in the past.

IT-enabled production technologies may be leading to reorganization of industries through greater ancilliarization, flexible production methods, and custom-built options. IT is also helping to "unbundle" some technological processes that until now could only be undertaken by big corporations as they involved large sunk costs. This unbundling is helping the growth of dynamic small and medium technology-intensive enterprises that can now compete successfully in cutting-edge technological areas.

Faster and more direct data exchange is helping reduce costs of production on the one hand and improve the quality of products and services on the other. Direct data exchange and real-time contact between suppliers and buyers has further improved, "just in time" delivery and inventory management systems, thereby reducing costs of inventories both of inputs and finished products, and raising productivity. The reduction in the layers of intermediaries is taking place in a number of sectors. In business-to-business activities, this is most visible in the establishment of Internet-based commodity exchanges. In business-to-consumer activities, this is seen primarily in travel and tourism-related services, newspapers, and music sales. One significant impact of disintermediation could be the lowering of entry barriers for firms and a greater competitive pressure on existing market players.

All these productivity-enhancing effects of IT can be seen to be at work in varying measures in almost all industrial and some developing economies. But they seem to have interacted with each other and have led

to the significant changes in the US economy. The spread of IT into many sectors of the US economy is arguably one of the major factors contributing to the prolonged cycle of prosperity and rise in productivity. In 1999, the US Department of Commerce announced that the share of IT-producing industries in the economy had increased from 6 percent in 1993 to over 8 percent in 1999. Between 1995 and 1998, IT-producing industries contributed, on average, more than one third of total real economic growth in the US. Productivity growth in the US, which came in at 6.0 percent in 1999 and at about 6.5 percent in the first half of 2000, was reportedly 4.0 percent in the 1990s as compared with 2.9 percent in the 1980s and 2.5 percent in the1970s. The contribution of IT to this increase in US productivity levels is still being debated but the evidence is beginning to tilt in favor of IT's contribution.

IT's impact on the US economy is described as having resulted in the birth of the "new economy" there. The term has also come to imply not merely advances in IT, but an array of associated changes as well: increased globalization as characterized by greater integration of global financial and capital markets; larger cross-border trade and investment flows; a greater share of services in national economies; and other technological advances in biotechnology, material sciences, and alternate energy sources.

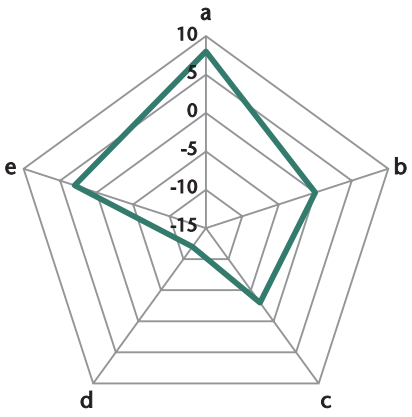
IT's emergence has been characterized by an asymmetric access to its benefits. This has thrown up yet another dimension in which the world is dividing into "haves" and "have nots". For example, more than half of the world's Internet users, whose numbers increased from 1 million in 1992 to more than 70 million in 2000, live in the US and Canada, which have only 6 percent of the world's population. At the other extreme, two thirds of the world's children have never used a telephone. Many developing economies are mere observers of the digital economy as they lack the basic "info-structure", namely, telephone lines, electricity, and adequate literacy rates. As a result, the growth of the Internet across and within these developing economies has been much more limited and uneven. This digital divide reflects the relative underdevelopment of IT sectors in developing economies and the consequent widening of productivity and income gaps across countries. The table below presents some indicators that reflect the digital divide between two industrial countries, the NIEs, and selected DMCs.

Development of IT in the Region

As mentioned earlier, the economies of the Asian and Pacific region are playing an important and active role in the development of IT and its diffusion around the world. Japan; Korea; and Taipei,China have been in the vanguard and have contributed significantly to making the information revolution possible. In addition, several other economies, such as People's Republic of China (PRC); Hong Kong, China; India; Malaysia; and Singapore have contributed to building the global IT industry in several ways.

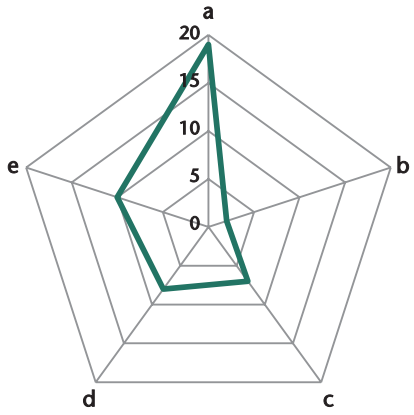
Following Japan, both Korea and Taipei,China for example, have devoted large resources to R&D for the promotion of new technologies. In 1999, these two economies spent about 2.7 percent and 2.0 percent, respectively, of their GDPs on R&D. This has enabled them to develop significant technological capability. The emphasis in these two economies

Export Performance by Product: Taipei,China (1994–1998)



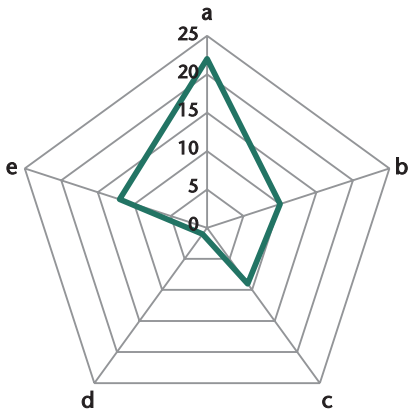
a Technology intensive manufactures
b Resource intensive manufactures
c Labor intensive manufactures
d Primary products
e Human capital intensive manufactures

Export Performance by Product: India (1994–1998)



a Technology intensive manufactures
b Resource intensive manufactures
c Labor intensive manufactures
d Primary products
e Human capital intensive manufactures

Export Performance by Product: People's Republic of China (1994–1998)



a Technology intensive manufactures
b Resource intensive manufactures
c Labor intensive manufactures
d Primary products
e Human capital intensive manufactures

has been on improving technology absorption and adaptation capabilities. More recently, a small but increasing share of R&D expenditure in these two economies has been directed to applied and even fundamental research. As a result, they have been able to carve out a niche in the world market for their IT products. Taipei,China is the third largest producer of IT products, next to the US and Japan; in 1999, exports of IT products were worth $34.3 billion (about 28.4 percent of total exports). These exports include a wide range of products, from computer components, assembled computers, and telecommunications products to fabricated semiconductor chips. Similarly, Korea is now the world's third largest producer of semiconductor chips; exports amounted to $20.3 billion (about 14 percent of total exports) in 1999. It is also one of the few developing countries in the forefront of mobile-phone technology. Exports of code division multiple access (CDMA) equipment and handsets alone were worth about $6.8 billion in 1999, an increase of more than 100 percent over 1998 levels.

Singapore has also invested significant resources to develop its high-technology capabilities in biotechnology, semiconductors, and other IT products. This has transformed it into a high-technology manufacturing and design center and developed it into a regional hub for commerce, communications, and transportation. It is one of the few countries in the world to have comprehensively used IT to upgrade governance capacity and modernize the delivery of public services. This has helped it in staying ahead in trading activities, port management, public administration, and good governance. It is also one of Asia's most "wired" economies, with one third of households having access to the Internet.

IT is also beginning to emerge as a major industrial component in both India and the PRC. India's software skills are internationally recognized and the country is providing a complete range of software products, including technical support, intermediate products, and integrated software systems that are custom-built for worldwide export. Export earnings from software have increased significantly in the last 10 years and showed an increase of 57 percent to about $4 billion in fiscal year 1999/2000 over the previous year. Moreover, a large number of Indian software professionals are working on frontline applications in IT enterprises in the US and Europe, making a significant contribution to the development of the global IT industry.

Given its large population and strong economic growth, the PRC has emerged as one of the largest potential markets for IT products. For example, with a telephone mainline density of 70 per 1,000 people in 1998 and a lack of telephone cables in many parts of the country, mobile phones are beginning to play an important part in communications. This has caused the mobile phone market in the PRC to explode in the latter half of the 1990s with the number of mobile phone subscribers increasing by more than 30 times since 1995; they are expected to exceed 60 million by the end of 2000. The number of Internet users is also soaring and is expected to more than quadruple between the beginning of 1999 and the end of 2000.

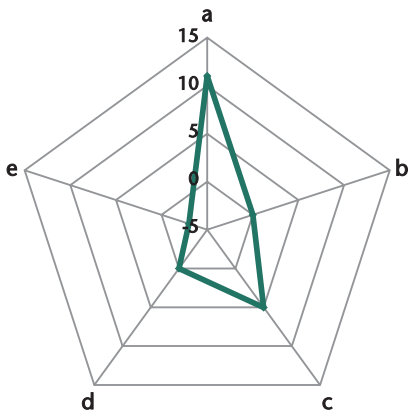
Malaysia is already a prominent center of semiconductor chip packaging. The Government launched the national initiative of a "Multimedia Super Corridor", which it intends to use as a catalyst to expand IT products and industries synergistically. The Government also intends to create a stronger enabling environment for IT in the country. Indeed, several

The Status of IT in Selected Economies

Economy	Telephone main lines	Mobile telephones	Personal computers	Internet Hosts	Scientists & Engineers in R&D
	per 1,000 people			per 10,000 people	per million people
	1998	1998	1998	July 1999	1987-1997
Newly Industrialized Economies					
Hong Kong, China	558	475	254.2	142.8	—
Korea	433	302	156.8	55.5	2,193
Singapore	562	346	458.4	322.3	2,318
Taipei,China	526	216	—	—	3,532
PRC	70	19	8.9	0.5	454
Southeast Asia					
Indonesia	27	5	8.2	0.8	182
Malaysia	198	99	58.6	23.5	93
Philippines	37	22	15.1	1.3	157
Thailand	84	32	21.6	4.5	103
Viet Nam	26	2	6.4	0.0	—
South Asia					
Bangladesh	3	1	—	—	52
India	22	1	2.7	0.2	149
Pakistan	19	1	3.9	0.2	72
Central Asian Republics					
Kazakhstan	104	2	—	1.4	—
Kyrgyz Republic	76	0	—	4.1	584
The Pacific					
Papua New Guinea	11	1	—	0.5	—
Industrial Countries					
Japan	503	374	237.2	163.8	4909
United States	661	256	458.6	1,508.8	3,676

other governments in the Asian and Pacific region are attaching top priority to establishing the preconditions for accelerated growth and diffusion of IT in their economies, such as Singapore's national initiative for making the country an "intelligent island"; Taipei,China has an initiative for a "green silicon island;" while some states in India have set up large science and technology parks. The PRC's Pudong area is expected to have internationally comparable and frontline IT capability to enable it to emerge as a leading financial and capital market center in the region. These are just a few examples: other countries such as Indonesia, Pakistan, Philippines, Sri Lanka, and Thailand are also establishing IT enclaves.

Export Performance by Product: Malaysia (1994–1998)



a Technology intensive manufactures
b Resource intensive manufactures
c Labor intensive manufactures
d Primary products
e Human capital intensive manufactures

Given the size of Asian populations, especially in the PRC and India, the potential market for IT products in the region is vast. As noted above, some countries in the region are also emerging as leading producers of IT hardware, software, service-providers, and programmers. There is also a strong awareness about IT's potential benefits. The region is therefore well placed for rapid self-sustaining growth in the IT industry in the coming years.

Growth Conditions for the IT Industry

IT's development during the last three decades is a history of invention and innovation. Stories of entrepreneurs starting out in a backyard garage with a few hundred dollars' worth of capital are by now a staple of industrial development folklore. More substantively, however, the conditions that characterized the growth of IT drew upon individuals, and contemporary institutions and processes. Identifying these conditions is important for the future development of IT, its diffusion in other sectors, and its replication in DMCs.

The most important factor in the development of IT has been *human resources*. An adequate pool of professionals qualified in science and mathematics, adept at problem solving, often working in multidisciplinary teams, made up the core. Their skills and knowledge enabled them to create and refine products in a constant stream.

The *organizational structure* of IT enterprises complemented the human resources. These enterprises put a premium on speed, creativity, and innovation. They eschewed anonymous bureaucratic structures. They opted for facilitating rules and regulations so that the required environment for creativity could be ensured. A large number of such minimalist organizations working together and independently focused solely on the generation of IT products established an industry ethos.

Human resources and these enterprises were in turn supported by *social institutions* that ensured due rewards, resolved disputes, and protected against intellectual-property theft. Products could be certified and patented, and standards could be established and enforced. Bound within this larger institutional framework, competitive spirit could be let loose. This lent legitimacy to efforts and diligence, and made it easier for investors to see the risks they were taking.

Resources had to be mobilized and invested in buildings, machines, equipment, transport, and communications. However, given the nature of IT, it was the telecommunications infrastructure that ensured connectivity, networking, and scale economies. Without it, IT could not have actualized its potential.

Given that IT products were new inventions, the IT industry held out the promise of high returns and thus attracted disproportionately large amounts of venture capital, as can be seen from the movement of technology stock prices during the last few years.

To some extent, these conditions are required for any major economic initiative to take root and succeed. What makes these special in the context of IT is their symbiotic relationship, and the speed at which they have engendered change in each other. More importantly, identifying these conditions helps to recreate them in other locations in the future.

Such regions are of immense importance for development planners and public policy.

Public Policies for IT

IT is still in its infancy. For it to grow and diffuse widely, IT will require supportive multilateral and domestic public policies. The overarching goal of public policy in DMCs will be to create the conditions that promote the development of the IT industry itself, while encouraging the rapid diffusion and application of IT in the rest of the economy.

It must also be borne in mind that the rate of technological advance has risen with increasingly powerful computers used to accelerate innovations in products and processes. This is likely to lead to a widening of productivity differentials among countries if efforts are not made by those lagging behind. The lack of financial resources is a major obstacle to the introduction of appropriate policies for improving access to IT and its applications in developing economies. Hence, Japan's commitment to earmark $15 billion for IT's development at the Okinawa Summit is an important step.

Domestic public policy will, at the minimum, have to ensure that sound macroeconomic policies encouraging the growth and dynamism of a competitive private sector—the primary driver of IT—remain in place. The impact of IT on the rest of the economy has substantially raised the rewards for the right economic policies, as well as the risks of widening the digital divide when the wrong policies are implemented. Given its systems technology nature, the full benefits of IT applications are only felt when they are adopted *en masse* and quickly. Hence, an open and outward-looking policy stance combined with the maintenance of macroeconomic balances are public policy requirements for IT's development and diffusion.

Policies for IT Diffusion

Enable the telecommunications infrastructure to grow. IT cannot grow in the absence of a dynamic telecommunications sector. In many DMCs, telecommunications penetration levels are low and future expansion prospects remain uncertain. As the table above implies, the region will require hundreds of billions of dollars to bring the telecommunications infrastructure to a par with the NIEs. Therefore, public sector restrictions on the development of the telecommunications industry should be removed. Public policy should also assist in mobilizing private resources for the telecommunications industry both from within the country as well as abroad. Foreign direct investment can also be helpful in bringing in the necessary technologies, along with financial resources.

Develop human resources. This is central to the development of IT and the diffusion of applications, especially in those developing economies where large sections of the population have not had basic education. Providing basic education and skills will continue to remain a public sector responsibility. Privately owned and run computer schools and Internet cafes should be encouraged to provide people with easy and economical access to IT. In public services, arrangements for acquiring computer literacy

should be established and incentives provided. In addition, it is important to develop basic science and technology capabilities to understand, adopt, and adapt IT in sector-specific applications.

Encourage private enterprise participation. As mentioned above, the private sector has throughout the world been the primary driver of IT development and adoption. Appropriate fiscal incentives could be provided for encouraging the private sector to promote IT. The case for policy support is reinforced because of significant positive externalities and spillover effects from the adoption of IT in the rest of the economy.

Provide adequate safety nets. These are required to assist those who have been adversely affected by IT's diffusion. Public policy can include assisting enterprises to make a fresh start in an emerging and expanding industry, retraining and re-skilling people who have been thrown out of work, and making available the financial and other resources.

Establish good governance. Consistency in policy making and greater transparency will support the growth of IT and maximize its beneficial impact. Moreover, IT-supportive regimes prefer an open and yet cohesive development environment. This implies an effective use of information and participatory processes to catalyze consensus and common self-interest. Policy implementation needs to be quick, decisive, and even-handed.

Policies for IT Development

Support higher education in science and mathematics. Development of IT can hardly take place without adequate numbers of trained and qualified science and mathematics professionals. A country's education policy, especially at the higher levels, needs to be supportive of these subjects. Appropriate selection systems that promote merit and identify talent have to be implemented.

Promote R&D. Public policy has to guide R&D by developing beneficial linkages between research institutions and industries and by providing incentives for specific areas of R&D. An interconnected system of research institutions and laboratories, perhaps in the form of science parks, may be part of this process. An advantage of these parks is that the research efforts stay closer to the applied problems of the IT industry. Public policies can support these investments through both provision of infrastructure and operating grants.

Safeguard intellectual property rights. With the spread of IT, services are likely to constitute an increasing share of national output. Intellectual property is now even more valuable and hence is subject to legal and proprietary claims. Maintenance and support of IT will require appropriate regulatory, supervisory, and monitoring systems including strengthened laws on copyright and patent rights.

Ensure standardization, regulation, and quality assurance. The widespread applicability of IT products, whether hardware or software, hinges upon

their compatibility with each other. To maintain this compatibility, it is important to devise or subscribe to industry standards or protocols. Regulations for quality assurance have to be established and rigorously followed.

Conclusions

Some of the above public policy actions to spur on IT-driven developments can be posited a priori. However, it is much harder to discuss the interface between the old and the new economies outside its specific country context; hence the need to review closely the IT policy of each DMC, identify the areas of competitive advantage, and establish a medium-term IT plan.

As discussed above, the Asian and Pacific region has inherent potential for rapid and self-sustaining IT growth. Better provision of international public goods and services will help fully exploit the region's IT potential and contribute to raising welfare levels. This includes: coordination of IT regulatory practices and IT standards; standardization of hardware, software, and communications components; mobilization of necessary resources to build the region's info-structure through wider access to education, health care, employment opportunities; and facilitating cross-border movement of goods, services, and resources in the region.

ADB has already taken steps to ensure that some of the positive impacts of IT are captured in its programs and sector projects. Further, ADB can play an important role in improving the provision of international public goods and services in the region. This will also contribute directly to not only bridging the digital divide but also address the important issue of reducing poverty in the region by spurring on economic growth.

To conclude, IT has become the focus of attention since its inclusion in the global development agenda following the Okinawa Summit. DMCs, while contributing to IT's emergence, are in danger of being stranded on the wrong side of the digital divide. Given IT's significant productivity- and growth-enhancing impacts, as seen in some of the NIEs, the potential for raising welfare levels in DMCs is substantial. However, domestic and multilateral policy for promoting the growth of IT in developing economies will need to have a dual focus: to promote the growth and spread of IT, and, at the same time, to prevent the worsening of inequity both within and across economies.

SUMMARY TABLES

Table 1. Growth Rate of GDP
(percent per annum)

Economy	1997	1998	1999	2000	2001
Newly Industrialized Economies	5.8	-2.6	7.4	7.9	6.6
Hong Kong, China	5.0	-5.3	3.1	8.5	8.8
Korea	5.0	-6.7	10.7	8.3	6.0
Singapore	8.4	0.4	5.4	8.0	6.0
Taipei,China	6.7	4.6	5.4	6.8	6.3
People's Rep. of China	8.8	7.8	7.1	7.5	7.2
Central Asian Republics	3.4	0.8	2.8	4.1	–
Kazakhstan	1.7	-1.9	1.7	5.0	–
Kyrgyz Republic	9.9	1.8	3.6	2.5	–
Tajikistan	1.7	5.3	3.7	4.0	–
Uzbekistan	5.2	4.4	4.4	3.0	–
Southeast Asia	3.5	-8.5	2.9	4.7	5.2
Indonesia	4.7	-13.2	0.2	3.5	5.0
Malaysia	7.5	-7.5	5.4	7.8	7.0
Philippines	5.2	-0.5	3.2	3.8	4.3
Thailand	-1.7	-10.2	4.2	4.5	4.6
Viet Nam	8.2	4.4	4.8	6.0	6.5
South Asia	4.7	5.8	5.6	6.5	6.6
Bangladesh	5.4	5.2	4.9	5.5	5.7
India	5.0	6.8	6.4	7.0	7.0
Pakistan	1.9	2.0	3.1	4.5	5.0
Papua New Guinea	-3.9	-3.8	4.2	3.4	2.7
PDMCs	-1.5	-1.0	4.2	-9.2	–
Average for DMCs	5.9	1.0	6.1	6.9	6.5

Table 2. Inflation Rates
(percent per annum)

Economy	1997	1998	1999	2000	2001
Newly Industrialized Economies	3.5	4.3	-0.2	1.0	2.3
Hong Kong, China	5.9	2.8	-4.0	-3.5	2.1
Korea	4.5	7.5	0.8	2.3	2.6
Singapore	2.0	-0.3	0.4	1.5	2.0
Taipei,China	0.9	1.7	0.2	1.4	2.2
People's Rep. of China	2.8	-0.8	-1.4	1.0	2.0
Central Asian Republics	21.2	11.5	22.0	12.5	–
Kazakhstan	11.3	1.9	17.8	8.5	–
Kyrgyz Republic	14.7	18.3	39.9	–	–
Tajikistan	159.8	2.7	24.0	15.0	–
Uzbekistan	27.6	26.1	26.0	20.0	–
Southeast Asia	5.4	25.5	8.8	4.3	4.7
Indonesia	6.2	58.5	20.5	6.0	6.0
Malaysia	2.7	5.3	2.8	2.2	2.8
Philippines	5.9	9.8	6.6	6.5	6.0
Thailand	5.6	8.1	0.3	2.5	3.5
Viet Nam	3.6	9.2	-0.2	2.5	5.0
South Asia	5.3	6.3	4.1	6.3	5.1
Bangladesh	2.6	7.0	9.0	3.8	7.0
India	4.4	5.9	3.3	7.0	5.0
Pakistan	11.8	7.8	5.7	3.6	4.5
Papua New Guinea	3.9	13.6	14.9	12.5	5.0
PDMCs	4.0	5.8	2.5	4.4	–
Average for DMCs	4.3	7.1	2.2	2.7	3.3

Table 3. Growth Rate of Merchandise Exports
(percent per annum)

Economy	1997	1998	1999	2000	2001
Newly Industrialized Economies					
Hong Kong, China	4.0	-8.5	-0.6	12.4	10.0
Korea	6.7	-4.7	10.1	19.2	8.7
Singapore	-0.2	-12.1	4.6	3.5	5.3
Taipei,China	5.4	-9.5	9.9	11.1	8.4
People's Rep. of China	21.0	0.5	6.2	20.6	10.6
Central Asian Republics					
Kazakhstan	9.6	-14.9	2.0	5.0	–
Kyrgyz Republic	18.8	-15.2	-13.6	–	–
Tajikistan	-3.1	-21.4	15.0	–	–
Uzbekistan	4.5	-21.8	-10.0	8.5	–
Southeast Asia					
Indonesia	12.2	-10.5	1.6	11.3	6.8
Malaysia	0.9	-7.3	15.6	18.9	13.8
Philippines	22.8	16.9	18.8	14.0	14.0
Thailand	3.7	-6.8	7.4	6.0	8.0
Viet Nam	22.2	3.9	24.1	12.0	10.0
South Asia					
Bangladesh	14.0	16.8	2.7	8.3	11.1
India	4.5	-3.9	11.6	13.0	11.0
Pakistan	-2.6	4.2	-10.7	8.7	11.0
Papua New Guinea	-16.0	-15.4	8.1	11.8	1.0

Table 4. Growth Rate of Merchandise Imports
(percent per annum)

Economy	1997	1998	1999	2000	2001
Newly Industrialized Economies					
Hong Kong, China	5.1	-12.3	-3.2	13.5	11.0
Korea	-2.2	-36.2	29.0	38.0	12.0
Singapore	0.7	-23.1	8.9	7.9	8.8
Taipei,China	10.1	-7.4	6.0	9.5	8.6
People's Rep. of China	2.5	-1.5	18.2	24.9	15.0
Central Asian Republics					
Kazakhstan	8.3	-7.0	-15.4	7.0	–
Kyrgyz Republic	-17.5	17.0	-27.6	–	–
Tajikistan	3.0	-9.7	-7.0	–	–
Uzbekistan	-11.2	-25.2	10.0	8.2	–
Southeast Asia					
Indonesia	4.5	-30.9	-3.8	10.1	13.3
Malaysia	1.7	-26.8	12.6	26.5	22.0
Philippines	14.0	-18.8	4.1	14.0	16.0
Thailand	-13.4	-33.8	18.0	14.3	17.0
Viet Nam	-1.6	-2.3	1.1	16.0	17.0
South Asia					
Bangladesh	3.1	5.1	6.6	6.8	7.8
India	4.6	-7.1	16.5	15.0	9.0
Pakistan	-6.4	-8.4	-6.7	8.0	3.6
Papua New Guinea	10.1	-27.7	5.6	11.9	13.4

Table 5. Balance of Payments on Current Account
(percent of GDP)

Economy	1997	1998	1999	2000	2001
Newly Industrialized Economies					
Hong Kong, China	-3.9	1.9	5.8	3.3	1.8
Korea	-1.7	12.8	6.1	1.7	0.4
Singapore	17.9	25.4	25.3	22.6	19.7
Taipei,China	2.4	1.3	2.0	1.3	0.8
People's Rep. of China	4.1	3.1	1.6	1.5	1.3
Central Asian Republics					
Kazakhstan	-3.6	-5.4	-1.1	-1.8	–
Kyrgyz Republic	-7.8	-22.6	-15.1	–	–
Tajikistan	-5.4	-8.8	-2.8	–	–
Uzbekistan	-4.0	-0.6	-1.3	-1.0	–
Southeast Asia					
Indonesia	-2.4	4.1	4.0	3.5	1.0
Malaysia	-5.9	13.0	15.8	10.8	7.7
Philippines	-5.3	2.4	9.4	6.5	5.6
Thailand	-0.9	12.8	10.0	6.3	4.0
Viet Nam	-6.5	-4.3	4.0	2.1	-1.6
South Asia					
Bangladesh	-2.2	-1.1	-1.4	-1.1	-1.2
India	-1.3	-1.0	-0.9	-1.2	-1.0
Pakistan	-6.1	-3.0	-3.8	-2.4	-2.0
Papua New Guinea	-5.0	0.5	1.4	-0.4	-2.2

STATISTICAL NOTES

Summary tables for 14 selected developing member countries and two subregions of the Asian Development Bank (ADB) are presented for output, inflation, and components of the balance of payments. These tables contain historical information from 1997 to 1999 and projections for 2000 to 2001. Most historical data are derived from the 2000 issue of the ADB Key Indicators of Developing Asian and Pacific Countries (ADB KI), official statistical sites on the internet, and secondary sources. Updated statistical publications from the International Monetary Fund (IMF), World Bank and the United Nations are also used. Projections for 2000 and 2001 are staff estimates based on available quarterly data. Data refer to calendar year, except for Bangladesh, India, and Pakistan, where fiscal year data are reported.

Subregional averages are presented for output growth and inflation. These averages are weighted arithmetic means of the country figures, with three-year moving averages of nominal GDP in US$ as weights. This approach is used to temper the huge fluctuations in exchange rates observed in 1998. This weighting system thus assigns a more stable share to the crisis-affected countries as compared to contemporaneous nominal GDP in US$.

Growth rates of GDP are valued at constant market prices except for India and Pakistan where GDP at constant factor cost is used. For Papua New Guinea, the growth rate is based on GDP at constant purchaser's value.

Inflation rates are generally based on the consumer price index and reflect period averages except for the Central Asian republics and Viet Nam with end-of-period inflation rates. The inflation rate for Hong Kong, China is based on the composite consumer price index, while for India, it is based on the wholesale price index.

Growth rates of merchandise exports/imports are from the balance of payments accounts of ADB KI 2000, except for Bangladesh, PRC, India, and Papua New Guinea for which data are from official sources. These figures are on a free-on-board basis.

Current account balances as percent of GDP are the sum of the balance of trade, net trade in services and factor incomes, and current official and private transfers. In the case of Bangladesh, the current account does not include official transfers. The data are from the ADB KI 2000 with the exception of Bangladesh, PRC, India, and Papua New Guinea for which data are from official sources.

Tables and figures for Part I are generated using data obtained from the following sources: ADB KI 2000; Asian Development Outlook (various issues); Asian Recovery Information Center (ARIC) website; Datastream database; IMF World Economic Outlook, May 2000; J.P. Morgan, World Financial Markets, Third Quarter 2000; US Bureau of Labor Statistics; and Bank for International Settlements (BIS) Database. For the chart on Euro-area interest rates, the Bundesbank rate is used as a proxy for the Euro rate through 1998.

Individual country text-charts for Part II show trends in technology development, external vulnerability, and fiscal position; and a decomposition of GDP growth by demand components. What follows describes the concepts used for these charts.

Technology exports are grouped as (1) low technology consisting of textiles, clothing, toys, and basic metals; (2) medium technology consisting of automotive, industrial equipment, and basic chemicals; and (3) high technology consisting of refined chemicals, electronics and semiconductors, precision instruments, and aerospace. The shares of technology exports do not add up to 100 as they exclude nonmanufactured

exports. Basic data are taken from the Infobase contained in the United Nations Conference on Trade and Development/World Trade Organization (UNCTAD/WTO) website: www.intracen.org.

Ratios of international reserves to short-term debt use international reserves data from the ADB Statistical Database System and short-term debt figures from the BIS. Short-term debt consists of government liabilities to banks, debt securities issued abroad, and nonbank trade credits, all due within one year.

Fiscal balances as a percent of GDP are from ADB KI 2000 for historical years and are staff estimates for projection years. For the individual country charts, fiscal balance includes net lending and official grants.

Contributions of demand components to GDP growth are computed as the product of the share of the demand component from the previous corresponding quarter, and the real growth rate of this component this quarter. Basic data are from online websites which include ARIC; Central Bureau of Statistics, Indonesia; Bank of Korea; Department of Statistics, Malaysia; National Economic and Social Development Board of Thailand; and National Statistical Coordination Board of the Philippines; and the official publications of the Office of the Director-General of Budget, Accounting and Statistics, Executive Yuan, Republic of China, *National Income in Taiwan Area of the Republic of China, 1999.*

Charts and the table for the theme chapter show indicators of technology developments. The basic data are obtained from the Datastream database and the internet site http://www.isoc.org.