Information and Communication Technology in Developing Countries of Asia[1]

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This paper reviews the development of information and communication technology (ICT) in the recent past and focuses on the pattern of its growth in Asian countries[3]. It tries to assess ICT's development potential for developing countries of the region where the bulk of the world's poor reside and to capture some of the challenges ICT now faces there.

Growth and Impact of the ICT Industry

Developments in ICT have changed the way economic activities are organised. The impact can be traced in two ways: first, how the ICT industry itself has changed during the last few years, and, second, how ICT has impacted on other economic activities such as manufacturing and services.

The ICT Industry

The beginnings of the ICT industry trace to the birth of the internet in the late 1960s and the appearance of the personal computer (PC) in the 1970s. Its development as currently understood actually picked up momentum in the early 1990s, however, when, assisted by communication technology, the PC and web–based technology joined to emerge as a powerful tool for business and development. Since then, ICT has integrated computing, communications and graphics through digitalisation. It has thrived on web sites with the use of broadband optical–fibre lines. It has already made headway into the wireless mode and is becoming more and more personalised with greater use of personal digital aides (PDA). The pace of technological change has accelerated, driven by both hardware and software innovations (Gates, 1996). There is no reason to believe that we have come to the end of this process. Indeed, the changes are so deep–seated that we are not even fully aware of their full implications.

Qualitatively, an important change made possible by ICT is the further separation of product development from the production process (Ernst and Guerrieri, 1998). This is not entirely new; it began with the basic reorganisation of work with the division of labour (Smith, 1776). The Industrial Revolution accelerated it by imparting greater efficiency and productivity under the factory system[4]. ICT has further refined traditional production methods by shifting more value added to product development than to production itself (Talluri *et al.*, 1999). It pays much more to plan the product, design it, establish logistics for its manufacture, monitor its quality and manage the brand image than actually to produce it. ICT has accelerated this process beyond recognition and shortened the product–development period so much that it now is virtually "concurrent engineering". Network externalities have been the principal conduit through which ICT has brought about this transformation (Katz and Shapiro, 1985). The process has yielded the well–known economies of scale (large inputs of resources generating proportionately larger outputs) as well as economies of scope (manufacturing different products by deploying common resources). The linear production system of sequential steps has been rearranged such that different parts get outsourced to different places, often thousands of miles away in different countries, and transported to an assembly point for just–in–time delivery. This process is known as supply–chain management (SCM). Final assembly often responds to customer–demanded configurations.

The SCM process has totally altered the production dynamics in the ICT industry. Generally, the emphasis on product development has increased in relation to actual production. Within the production cycle, value added has shifted more to specific parts that contain greater technical complexity, like chips and software, as opposed to the assembly of the whole product — the so–called "Wintel" effect (Borrus and Zysman, 1997). This contrasts with industries in which whole products or brands carry the value addition, e.g. automobiles or wristwatches.

The complexities of this outsourced production system — computer–aided–design (CAD) and computer–aided–management (CAM), product design, specification and material content and movement through time and space — are all co–ordinated by a closely monitored information system. The logistics of this manufacturing system, impossible without ICT, have emerged as a task in itself, known as electronic manufacturing services (EMS). EMS involves a group of specialised companies whose scope includes order receiving, material procurement, SCM, design and prototype production or testing, and management of the distribution of finished goods (Ohki, 2001). These changes have altered the traditional roles of original equipment manufacturers (OEM), original design manufacturers (ODM) and contract manufacturers. Many mature industries now comprise low value–adding processes.

These qualitative changes have spread beyond isolated cases to become the norm in the entire ICT industry and especially the PC industry. The full scale of their impact appears more vividly with a view of the rate at which ICT has grown in recent years.

Global ICT Growth

Data on the growth of the ICT industry worldwide are provided in the Appendix. Table 1 gives selected highlights for Asia–Pacific sub–regions and country groupings. The data show the IT sector on an upward trend for all the countries and all the sub–regions surveyed, although its growth has been highly uneven. The Newly Industrialised Economies (NIEs) have 287 PCs for every 1 000 persons; almost 30 per cent of their combined population has access to PCs. The sub–regions of Southeast Asia and South Asia, and the People's Republic of China (PRC), lie far behind the more digitalised economies, attaining less than one–tenth of the PC penetration in the NIEs. The same holds for the measures of internet hosts and users. These numbers are alarming, especially for the Pacific sub–region, the PRC and South Asia, where not even one internet host per 10 000 persons is available. In terms of internet users, not even one per cent of the population of the Pacific sub–region uses the internet and only a little above one per cent of South Asia's population does so. This indicates limited outreach and how a large proportion of the population cannot take advantage of ICT, making it hard for the digitally backward and developing economies to catch up.

Table 1. **Selected IT Indicators**

	Personal Computers per 1 000 people 1997-2000	Per 10 000 people	
		Internet Hosts 1998-2000	Internet Users 1998-2000
Newly Industrialised Economies	287	190.6	1 820
People's Republic of China	11	0.4	88
Southeast Asia	25	7.2	227
South Asia	3	0.2	11
Central Asian Republics	n.a.	4.6	25
The Pacific	n.a.	0.6	3
Industrial Countries	375	1 113.6	2 578

Notes: The following countries were included for the computation of the sub-regional averages: *a) Newly Industrialised Economies*: Hong Kong, China, Republic of Korea, Singapore and Taipei,China (only for the data on Internet Users); *b) Southeast Asia*: Indonesia, Malaysia, Philippines, Thailand and Viet Nam; *c) South Asia*: Bangladesh, India and Pakistan; *d) Central Asian Republics* (CARs): Kazakhstan and Kyrgyz Republic; *e) The Pacific*: Papua New Guinea; and *f) Industrial Countries*: Japan and the United States.

Sources: World Bank, *World Development Report* (various years) and *World Development Indicators* database; ITU Telecommunication Indicators from website (www.itu.int/ti/industryoverview/index.htm).

Impact of ICT on Other Industries and Services

ICT is a general–purpose technology and thus has wide applicability in various manufacturing and services sectors. It has strong spread effects and extensive linkages with the rest of the economy. Its potential forward linkages extend to custom–made configuration while its backward linkages extend to material sciences. It thus has the potential to affect virtually all sectors of the economy by imbuing greater information and development content in products and processes. More importantly, it has spawned new products and made existing products more versatile. One can argue that it is this use of ICT in other larger sectors of the economy that determines its overall productivity impact (Kraemer and Dedrick, 2001). CAD/CAM applications and SCM systems initially developed for ICT are now permeating other industries. Product development time has been drastically reduced, sometimes by as much as two–thirds. Once developed, product components can be manufactured virtually anywhere. This results in at least two basic changes. It facilitates the process of disintermediation and SCM, with attendant implications for inventory management, etc. It also liberates the production process from spatial constraints and enables the production of different components in different regions, which in turn speeds up the process of globalisation (ADB, 2001).

Given the pace of changes in the industry and the rush to catch up, "first movers" gain tremendous benefits. This works as a major incentive to innovate, keep others out and stay ahead of the pack. On the other hand, as products mature, their production gets relocated to low–cost areas open to competition.

Given easier access to information and its processing, the market as an institution becomes more competitive and efficient. An important source of market failure, lack of information, begins to weaken. As a result, new forms of economic activity have emerged, e.g. business–to–business (B2B) and business–to–consumer (B2C) transactions. The entire field of e–commerce is changing the traditional form of market organisation. All these processes contribute to reducing resource intensity and production costs.

An important implication is that those not capable of taking advantage of ICT, or not keeping pace with the unfolding changes, are in danger of being left behind. As the frontier shifts forward and leaders pull ahead, the entire field of slower competitors is left behind. ICT in this sense has emerged to become yet another factor dividing the developed and developing countries.

ICT Development in Asia

The Asian and Pacific economies have played an important and active role in the development of ICT worldwide, especially in the PC industry. In a succession of waves, the industry has spread fairly widely throughout much of developing Asia. The surge began in Japan, the Republic of Korea and Taipei,China, which have been among the leaders. These economies have made significant contributions to the global

supply of ICT products and components. Hong Kong, the People's Republic of China and Singapore have added further to the spread of ICT in the region and the world through their contributions in trading and manufacturing. Subsequently Malaysia, the Philippines and Thailand have joined through manufacturing and packaging.

During the last two to three years (rather long for the ICT industry), the large economies of the PRC and India have joined in ICT development. The PRC is poised to emerge as a major production hub for ICT products in the coming years, while India contributes through software development for overseas firms, especially those in the United States.

The cumulative effect of these developments has been tremendous growth in the whole range of ICT–related economic activities in Asian economies, *viz*. manufacturing, packaging, exports and services related to ICT. E–commerce, both B2B and B2C, has increased manyfold. Asian countries have been among the principal suppliers of ICT products to the United States and the rest of the world. Indeed, the growth of electronics exports from Asian countries has been so large that they have become excessively dependent on them. With the slowdown in the US economy, especially in the technology sector, fears have arisen that the growth prospects of Asian economies are being impacted adversely.

Singapore

Notwithstanding the general spread of ICT in developing Asian countries, many inter–country differences mask distinctive national features. Singapore, "the intelligent island", is one of the most developed countries in the world. It has made a systematic effort since the early 1980s to adopt and use ICT innovations. Its ICT infrastructure is well established, and skills and educational standards are very high — as is its use of PCs and the internet. The number of PCs per 1 000 persons increased from 332 in 1997 to 483 in 2000, an annual growth rate of more than 13 per cent. Similarly, the numbers of internet hosts and users jumped between 1998 and 2000 by about 250 per cent and 26 per cent, respectively. The percentage share of ICT–related goods (SITC 75–77) in total exports reached the high 50s during the late 1990s.

Its style and efficacy of corporate governance make Singapore an attractive regional centre for Western as well as Asian corporations. It uses networks (e.g. Enet and TradeNet) for promoting trade and supply–chain management. As a result, Singapore has been able to blend a full range of market institutions with its keen interest in ICT and has emerged as a major manufacturing and commercial hub for high–end ICT products. The country is currently pursuing a new development plan known as the ICT21 Masterplan, which, among other things, addresses the following: full liberalisation of the telecommunication industry; information and communication industry development; improving outreach; human–resource development; promoting e–government; and developing the private sector. Given Singapore's significance as a regional hub, the medium–term future of ICT there will be greatly affected by the full economic recovery of the crisis–affected economies of the region.

Malaysia

Malaysia is a prominent centre of ICT manufacturing, and electronics constitute a big share of its total exports. Exports of ICT–related goods (SITC 75–77) take about 50 per cent of its total exports. The government attaches high priority to ICT. Unlike Singapore, Malaysia is large geographically. The government's approach has been to focus on the development of a pre–selected area known as the multimedia super corridor. Within it, cyber cities are being developed to function as nodal points for ICT development. With 105 PCs per 1 000 persons and about 1 500 internet users per 10 000 persons, its current level of ICT penetration is somewhat limited. Much of ICT use tends to concentrate in export–related economic activities. The ongoing slowdown of the US economy has temporarily dampened ICT growth, but the commitment of the government to promote ICT use remains strong.

Thailand

In comparison with Singapore and Malaysia, Thailand has a relatively less–developed ICT sector, especially outside the urban metropolis of Bangkok. With 24 PCs per 1 000 persons and 266 internet users per 10 000 persons, the use of PCs and internet access are available to only a small segment of society. Aspirations for ICT development are high however, and the country produces significant amounts of PC components. The Government has launched the development of Phuket as Thailand's cyber island. That the economy is still to recover fully from the 1997 Asian economic crisis constrains further ICT development to some extent, and inadequate numbers of high–level scientific and technical personnel also hamper progress.

Philippines

The ICT industry has a significant presence in the Philippines. Many of the ICT–related manufacturing activities are relocated production facilities of Japanese firms. SITC 75–77 goods constitute a huge part of Philippine exports (69 per cent of total exports in 1998), and most of these go to the United States. The country has abundant educated and skilled personnel, but their potential has not been fully used for ICT development. There are 20 PCs per 1 000 persons and about 265 internet users per 10 000. The availability of ICT–related infrastructure is limited and confined to Metro Manila and its neighbourhood.

People's Republic of China

The PRC started slowly in ICT but during the last five years has picked up a tremendous pace. There are 16 PCs per 1 000 persons and about the same number of internet users. The PRC is now poised to emerge as one of the largest manufacturers

of ICT products in the region. Much of the ICT investment comes from Taipei,China as relocated production facilities. SITC 75–77 goods constitute about 20 per cent of total exports. Although the PRC's major strength has resided largely in manufacturing, expectations are that it will soon start competing in the software industry. In the medium term, the PRC is expected to start impacting the world software market much as it presently does in ICT manufacturing.

India

India's entry into ICT and its role in the sector differ from the other Asian countries. From the early 1950s, India laid emphasis on training high–level scientific and technical personnel across a broad range of subjects. When the PC made its entry and the declining prices of hardware made access to computing possible for educated professionals, a window of opportunity opened for the growth of the software industry. Highly trained scientific and technical personnel from India had been steadily migrating to the United States throughout the 1960s and 1970s, and many of them were engaged in the development of computers, computer science and the communications industry. Their presence in the ICT industry, especially among the top professionals in the United States, worked as a shot in the arm. They provided high–level skills in bulk and led the industry to India, especially during the 1990s when it was growing fast. The Indian software industry discovered a reservoir of scientific and technical personnel at competitive prices to feed its rapid growth.

In the initial stages, India only supplied qualified personnel to do jobs on site. With the maturity of its software industry, the situation began to change, however. Several Indian firms were set up to supply software. Major ICT producers soon realised that the potential of the technical know–how available could be tapped more effectively by setting up subsidiary software centres in India. Texas Instruments, encouraged by its own Indian employees in the United States, established its first major centre in India in the early 1980s. India in 2000 accounted for about 20 per cent of the world custom–software market (estimated at about $500 billion). Almost all the major software producers in the world have a presence in the country, and Indian professionals work in the industry worldwide, especially in the United States. Some 40 per cent of the Fortune 500 corporations are clients of the Indian software industry (Giovanetti *et al.*, 2001).

In terms of the industry benchmark standard, more than 25 per cent of the Indian firms engaged in this business meet the requirements of ISO 9000. Of the 19 companies worldwide that have CMM–5 level capability (capability maturity model), 12 are Indian firms (Giovanetti *et. al*., 2001). That this standard is available at much lower prices (ranging from less than one–tenth to about one–third of US price levels), makes the Indian software industry very competitive. The value of software exports now exceeds $4 billion per annum. Yet there are also downsides that hamper Indian ICT growth. The limited nature of the country's telecom infrastructure underlies weak PC and internet penetration. India has only 5 PCs per 1 000 persons and 50 internet users per 10 000.

Challenge for ICT in Developing Asia

In addition to the major countries treated separately above, ICT development has also taken place in countries like Indonesia, Sri Lanka, and Viet Nam. Generally, healthy growth of ICT in Asian developing countries was much in evidence up to the first half of 2000. Yet some challenges have surfaced since then.

Economic Environment

Fuelled by the expansion of ICT, the US economy grew beyond its long–term potential through much of the 1990s, and economists became concerned about this unprecedented growth. Apprehending that it could not continue indefinitely, policymakers sought to ensure a soft landing for the economy[5]. Oil price hikes in the third quarter of 2000 also emerged as an additional constraint. The Federal Reserve repeatedly increased interest rates to slow the economy gradually, but when the economy responded in the fourth quarter of 2000, it slowed faster than expected. GDP growth in that quarter and the revised figures for the first quarter of 2001 showed an unexpected, sharp decline (ADB, 2001).

An equally strong performance of high–technology stocks worldwide accompanied exceptionally high long–run US growth. By mid–June 2000 the corrective process had set in. Since then the US stock market has gone through huge corrections and the leading technology stocks are currently at about one–third of their peak values. The long–term implications of the current scenario are not clear, although by some accounts the slowdown has already been longer than anticipated. Much depends upon how soon the US economy, which is also the leading ICT user in the world, turns around. The sudden slowdown caused ICT inventories to build up, although it seems that they are now being gradually brought down. Corporate profits of many ICT firms declined in 2000, which is likely to squeeze out fresh investments for the moment, especially for capital goods. Consumer spending in the US has somehow continued to be more robust than expected.

The recent issue of the IMF's *World Economic Outlook* (IMF, 2001*a*) reviews the impact of global technology corrections on the real economy. In an empirical exercise, it measures the effect of changes in stock–market valuations on consumption through the wealth effect and on investment through the cost of capital. It reports that an increase of one US dollar in technology stocks raises consumption by four per cent. Similar results are obtained for investment through a virtuous cycle of rising investment in ICT leading to higher productivity, hence higher stock prices and increased access to funding for new economic activities. It concludes that the downturn in stock prices will correspondingly dampen investment in ICT.

The results do not seem to be significant for Asia however (IMF, 2001*a*). One possible reason could be that the exercise focuses on the valuation of publicly listed stocks and not on the value of ICT production. Moreover, it does not include private manufacturers that are a significant part of the Asian ICT production system. That the recovery of the Japanese economy continues to be fragile does not help much to improve

the prospects for Asian economies. Combined with the slowing of the US economy, it puts a lot of pressure on their immediate and short–run outlook. Apart from being the second largest economy of the world, Japan has a pivotal role in the ICT industry. Hence, the performance of the Japanese economy has special significance for ICT in general and on the development of ICT in Asian countries in particular. The prospects of a Japanese turnaround do not yet seem very encouraging, although there are high expectations from the new government.

Asia's Dependence on Electronic Exports

To the extent that technology stocks around the world tend to move together because of their inter–linkages and inter–dependence, technology stocks in developing countries too are now at lower levels. Given that the share of electronics in total exports of many East Asian countries varies from about one–third in Korea to about two–thirds for the Philippines and Malaysia, the US economic slowdown has affected their exports and overall GDP growth. This is certainly slowing demand for ICT goods and services, although the precise extent is not clear. India, for example, has adjusted the growth rate of its software exports from 60 per cent to about 40 per cent, a decline of one–third, and more recently from 40 per cent to 25 per cent. Similarly, ICT manufacturing countries are also expected to downgrade their growth rates anywhere from about one–third to about half of the earlier targets.

Another feature likely to affect ICT in Asia relates to the emergence of the PRC as the major producer of ICT goods. This might lead to greater competition for Southeast Asian countries. The immediate task of these economies is to cope with the slowdown of the US economy, but the medium–term risk, and the relatively more important one, is to adjust to the emergence of the PRC as a major ICT producer and competitor. That structural reforms are proceeding more slowly than expected in some of the East Asian countries, namely Indonesia, the Philippines and Thailand, could make things worse. Similarly, the presence of unresolved domestic political issues and policy emphases in Indonesia, the Philippines and Thailand may further thwart the return of investor confidence in these economies.

Potential of ICT within Asia

Asian countries have played an important role in the development of ICT. This sector is a powerful instrument of development and could be used to push them to a higher growth trajectory for years to come. Although the ICT industry in Asia has grown rapidly and performed as a tremendous source of supply for the rest of the world, its potential scope for further growth within the region is almost open–ended.

Many countries have been left out of the ICT revolution, and even among those that have done well, huge pockets of population remain outside the ambit of ICT. In the poorer countries of Asia, better access to ICT faces multiple challenges. In the absence of specific efforts to bridge the gap, prospects for economic development in

these communities will be dim. The bottom line is that the poorer populations and inadequately equipped areas tend to lie beyond the reach of ICT. Hence, there is room for public policies to level the playing field. In the extreme case of the least–developed regions, ICT hardly has any role in the development process in the absence of basic services like water, health, literacy and housing. The debate revolves around whether ICT renders development of such regions more or less difficult. Given that Asia accounts for more than half of the world population and has as many as 900 milion living on less than one dollar a day, the issue has much significance.

This problem is popularly known as the *digital divide*. National and international policymakers have recognised and acknowledged the challenge of this negative fall–out effect of ICT. The G–8 group deliberated on the digital divide at its Okinawa Summit in 2000 (www.jetro.org/newyork/focusnewsletter/focus9.html). It set up a taskforce (Dot Force) to develop a plan to support the future development of ICT in the poorer countries, and Japan has earmarked a fund of $15 billion for the purpose[6].

Amidst the present global economic slowdown and uncertain prospects, one wonders whether the funds earmarked at the Okinawa Summit can be effectively deployed and provide the requisite shot in the arm for the ICT industry. Can we take advantage of Asia as the "world manufacturing centre of ICT"? (Ueki, 2001) Can the resources earmarked in Okinawa help developing countries ride out of the US slowdown without undue damage? These questions are significant because, although Asia has gained from the production of ICT hardware, it has generally not made much use of ICT to boost productivity (Kraemer and Dedrick, 2001).

Policy Requirements

Both domestic and regional policies are needed to ensure greater application of ICT within Asian economies, especially in the poorer and inadequately serviced regions. Given that different countries of the region have expertise in different parts of this new technology, greater application of ICT provides an opportunity for greater economic co–operation within Asia. The important question is to what extent the domestic demand for ICT products and services in the region can sustain the momentum.

The most basic problems and challenges that public policymakers must address to enhance IT diffusion and development are the lack of financial resources for large–scale IT–related projects, the maintenance of a stable macroeconomic environment and the adoption of appropriate sector policies to speed the creation of necessary infrastructure (ADB, 2000). The need for the continuous development of IT is highly relevant in this ever–changing technological world. The challenge of forging ahead, or at least catching up with the leaders, is important. Four sets of policies are important to ensure that the developing countries of Asia will not be left behind (ADB, 2000). First, stronger higher education in science and mathematics should follow basic

education in science and technology. This will create a pool of highly qualified and skilled IT professionals that will serve as foundation for the region's or a country's IT sector. Second, it is important to promote R&D within each country and in the region as a whole. Third, protection of intellectual property rights is another important prerequisite for development. It must be implemented well to encourage further inventions and innovations. Finally, standardisation, regulation, and quality assurance must be imposed. These factors will keep competition in place.

Stronger economies like Korea and Taipei,China as well as Hong Kong, the PRC and Singapore, which have strong research and development bases and are regional hubs for exports, have a greater potential for moving up the value chain. The ASEAN countries, however, will have to strengthen their research and development, infrastructure and investments in human resources to stay in competition (Ueki, 2001).

Concluding Observations

This brief paper introduces the development of ICT in Asia. It describes certain features of the industry, especially the way organisational arrangements of ICT have evolved. Two particular points are noted — first, the value–chain pattern focused on individual components or parts of a PC and, second, the growing separation of product development from production processes. Led by Japan, the Republic of Korea and Taipei,China, Asian countries have contributed substantially to the way ICT has spread around the world, especially in relation to the division of labour, specialisation and mass production techniques. Malaysia, Thailand, and the Philippines have played an important role in furthering this process. India has contributed predominantly to the global software industry. The PRC is now emerging as the major hub for production of ICT hardware and is expected soon to make significant inroads into the software industry. In this sense, ICT has enabled many Asian countries to take up new technologies.

Nevertheless, even bigger chunks of population live beyond the reach of ICT in Asia due to lack of infrastructure, low levels of human–resource development and paucity of resources. So far, Asian countries have developed ICT for export markets. They have not used it extensively in the cause of rapid economic development and poverty reduction through higher levels of productivity. They have yet to fulfil the real potential of ICT.

It remains in question whether the current slowdown in technology stocks and consequent lower demand in the leading export markets will provide an opportunity to view the vast hinterlands of Asia as potential grounds for expansion of ICT. The resolution of the G–8 Okinawa Summit and Japan's commitment of financial resources for bridging the digital divide could hold some hopes. Can Asian countries get together and harness their internally available technology for the next round of development and poverty reduction?

Notes

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3. The paper has benefited in a large measure from the recent work on the subject edited by Kagami and Tsuji (2001).

4. Becker and Murphy (1993) make an interesting point in this regard. They point out that co–ordination costs determine the extent of the division of labour and specialisation. In view of the modern production techniques spurred on by ICT, this point assumes even greater significance than they perhaps originally intended.

5. Predictions (possibly also preparations) for a soft landing of the US economy have been around for many years (see, for example, various issues of the IMF's *World Economic Outlook*).

6. For a discussion of official development assistance in the context of ICT (so–called eODA) and illustrative initiatives to close the digital divide, see Shinohara (2000) and the World Economic Forum at www.weforum.org/digitaldivide.

Appendix

Table A1. **IT Indicators in Selected Countries: Telephones**

	Per 1 000 people									
	Telephone main lines					Mobile telephones				
	1996	1997	1998	1999	2000	1996	1997	1998	1999	2000
Newly Industrialised Economies										
Hong Kong, China	547	556	561	576	581	216	343	475	636	636
Korea, Republic of	430	444	433	438	464	70	150	302	500	567
Singapore	433	451	460	482	485	141	273	346	419	684
Taipei,China	465	500	524	545	568	45	69	216	522	803
People's Republic of China	44	56	70	86	86	6	10	19	34	67
Southeast Asia										
Indonesia	21	25	27	29	31	3	5	5	11	17
Malaysia	178	195	202	203	211	74	113	99	137	155
Philippines	26	29	34	39	40	13	18	22	38	84
Thailand	70	80	84	86	86	28	33	32	38	44
Viet Nam	16	17	22	27	27	1	2	2	4	4
South Asia										
Bangladesh	3	3	3	3	3	0	0	1	1	1
India	15	19	22	27	32	0	1	1	2	4
Pakistan	18	20	21	22	22	0	1	1	2	2
Central Asian Republics										
Kazakhstan	116	110	109	108	108	0	1	2	3	3
Kyrgyz Republic	75	76	76	76	76	n.a.	0	0	1	1
The Pacific										
Papua New Guinea	11	13	13	13	13	1	1	1	2	2
Industrial Countries										
Japan	509	521	534	558	558	214	304	374	449	526
United States	622	644	661	664	673	165	206	256	312	400

Sources: World Bank, *World Development Report* (various years), World Development Indicators database, and ITU Telecommunication Indicators, website (www.itu.int/ti/industryoverview/index.htm)

Table A2. **IT Indicators in Selected Countries: PCs and Internet Penetration**

	Per 1 000 people				Per 10 000 people					
	Personal computers				Internet Hosts			Internet Users		
	1997	1998	1999	2000	1998	1999	2000	1998	1999	2000
Newly Industrialised Economies										
Hong Kong, China	229	256	291	347	123.78	166.89	336.90	1 495	2 519	3 359
Korea, Republic of	151	169	183	190	40.15	60.99	84.10	668	1 468	4 025
Singapore	332	375	437	483	140.76	269.75	492.30	2 371	2 946	2 987
Taipei,China	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1 373	2 051	2 813
People's Republic of China	6	9	12	16	0.14	0.57	0.55	17	70	176
Southeast Asia										
Indonesia	8	8	9	10	0.75	1.01	1.26	15	19	68
Malaysia	46	60	69	105	22.00	27.03	29.34	368	687	1 505
Philippines	13	15	17	20	1.26	1.66	2.58	21	67	266
Thailand	20	22	23	24	3.40	6.60	10.47	33	67	266
Viet Nam	5	6	9	9	0.00	0.02	0.02	1	13	13
South Asia										
Bangladesh	0	1	1	1	0.00	0.00	0.00	0	2	4
India	2	3	3	5	0.13	0.23	0.35	5	20	49
Pakistan	4	4	4	4	0.24	0.35	0.46	5	6	6
Central Asian Republics										
Kazakhstan	n.a.	n.a.	n.a.	n.a.	0.90	2.31	4.55	12	43	43
Kyrgyz Republic	n.a.	n.a.	n.a.	n.a.	3.29	7.57	8.76	8	21	21
The Pacific										
Papua New Guinea	n.a.	n.a.	n.a.	n.a.	0.26	0.72	0.92	0	4	4
Industrial Countries										
Japan	202	238	287	315	133.41	208.41	365.65	1 323	1 447	3 044
United States	407	456	511	585	1 120.69	1 925.14	2 928.32	2 205	3 982	3 466

Sources: See Table A1.

Table A3. **Other Indicators of the Status of IT in Selected Countries**

	Per million people			High-technology exports % of mfg. exports			
	Scientists & engineers in R&D						
	1981-95	1985-95	1987-97	1996	1997	1998	1999
Newly Industrialised Economies							
Hong Kong, China	n.a.	98	n.a.	19	21	21	21
Korea, Republic of	2 636	2 636	2 193	24	27	27	32
Singapore	2 512	2 728	2 318	56	57	59	61
Taipei,China	n.a.	n.a.	3 532	n.a.	n.a.	n.a.	n.a.
People's Republic of China	537	350	454	12	13	16	17
Southeast Asia							
Indonesia	181	n.a.	182	9	12	10	10
Malaysia	87	87	93	44	49	55	59
Philippines	90	157	157	58	67	72	59
Thailand	173	119	103	29	31	34	32
Viet Nam	334	308	n.a.	n.a.	n.a.	n.a.	n.a.
South Asia							
Bangladesh	n.a.	n.a.	52	0	0	0	n.a.
India	151	149	149	7	7	6	n.a.
Pakistan	54	54	72	0	0	0	0
Central Asian Republics							
Kazakhstan	n.a.	n.a.	n.a.	n.a.	n.a.	8	n.a.
Kyrgyz Republic	n.a.	703	584	18	n.a.	n.a.	6
The Pacific							
Papua New Guinea	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Industrial Countries							
Japan	5 677	6 309	4 909	26	26	26	27
United States	3 732	3 732	3 676	32	32	34	35

Sources: See Table A1.

Table A4. **Total Office Machines and Telecom Equipment Trade in Per Cent of GDP, Selected Countries, 1996-99**

	1996	1997	1998	1999
Newly Industrialised Economies				
Hong Kong, China	49.41	49.74	48.94	51.58
Korea, Republic of	9.77	11.47	15.26	16.62
Singapore	119.30	115.97	114.18	120.76
Taipei,China	19.41	21.57	23.35	25.60
People's Republic of China	3.79	4.23	4.91	6.12
Southeast Asia				
Indonesia	2.42	2.43	3.30	n.a.
Malaysia	58.43	60.17	77.52	88.27
Philippines	23.36	32.20	46.96	45.60
Thailand	13.24	16.59	19.93	20.08
Industrial Countries				
Japan	2.98	3.25	2.23	3.11
United States	3.14	16.15	1.30	3.25

Notes: Total trade is defined as exports plus imports.

Sources: WTO (2000) and IMF, (2001*b*) *International Financial Statistics* CD-ROM 2001

Table A5. **Exports of Office Machines and Telecom Equipment in Per Cent of GDP, Selected Countries, 1996-99**

	1996	1997	1998	1999
Newly Industrialised Economies				
Hong Kong, China	22.44	22.01	22.51	24.18
Korea, Republic of	6.13	7.11	10.04	10.55
Singapore	70.62	68.08	69.37	71.13
Taipei,China	12.70	13.79	14.46	15.63
People's Republic of China	2.09	2.38	2.63	3.04
Southeast Asia				
Indonesia	1.36	1.34	2.50	2.17
Malaysia	34.77	36.20	47.69	56.22
Philippines	12.14	17.25	28.44	30.12
Thailand	7.30	9.39	12.76	12.24
Industrial Countries				
Japan	2.04	2.26	2.23	2.10
United States	1.34	14.32	1.30	1.35

Sources: See Table A4.

Table A6. **Imports of Office Machines and Telecom Equipment in Per Cent of GDP, Selected Countries, 1996-99**

	1996	1997	1998	1999
Newly Industrialised Economies				
Hong Kong, China	26.97	27.73	26.44	27.41
Korea (Republic of)	3.65	4.36	5.23	6.08
Singapore	48.68	47.88	44.80	49.63
Taipei,China	6.71	7.78	8.89	9.98
People's Republic of China	1.70	1.85	2.29	3.08
Southeast Asia				
Indonesia	1.06	1.09	0.80	n.a.
Malaysia	23.66	23.98	29.82	32.05
Philippines	11.22	14.96	18.52	15.47
Thailand	5.94	7.21	7.17	7.85
Industrial Countries				
Japan	0.94	0.99	0.00	1.01
United States	1.80	1.83	0.00	1.90

Sources: See Table A4.

Table A7. **Exports of Office Machines and Telecom Equipment in Per Cent of Total World Merchandise Exports, Selected Countries, 1996-99**

	1996	1997	1998	1999
Newly Industrialised Economies				
Hong Kong, China	19.12	20.01	20.95	22.03
Korea, Republic of	24.57	24.87	24.05	29.65
Singapore	51.57	51.70	52.37	52.84
Taipei,China	30.68	33.05	34.95	37.07
People's Republic of China	11.39	11.75	13.80	15.44
Southeast Asia				
Indonesia	6.20	5.41	4.82	6.12
Malaysia	44.69	46.12	47.22	52.42
Philippines	49.27	56.68	63.14	63.00
Thailand	23.82	24.66	26.27	26.07
Industrial Countries				
Japan	22.86	22.58	21.92	22.30
United States	16.74	172.62	16.69	18.08

Source: See Table A4.

Table A8. **Imports of Office Machines and Telecom Equipment in Per Cent of Total World Merchandise Imports, Selected Countries, 1996-99**

	1996	1997	1998	1999
Newly Industrialised Economies				
Hong Kong, China	20.66	22.24	23.04	24.10
Korea, Republic of	12.61	14.37	17.77	20.65
Singapore	33.84	34.32	36.62	38.07
Taipei,China	18.53	19.82	22.64	26.00
People's Republic of China	10.04	11.74	15.71	18.39
Southeast Asia				
Indonesia	5.60	5.63	2.75	n.a.
Malaysia	30.38	30.43	37.11	38.84
Philippines	27.24	31.85	38.45	36.44
Thailand	14.94	17.28	18.70	19.40
Industrial Countries				
Japan	12.42	12.37	13.03	14.15
United States	17.11	16.88	16.51	16.70

Source: WTO (2000).

Table A9. **Growth Rates of SITC 75-77 Exports by Sub-Region**
(Per cent per year)

	SITC				Year Range
	75	76	77	75-77	
Newly Industrialised Economies	6.6	-28.4	-8.0	-9.0	1995-1998
People's Republic of China	123.4	19.7	38.4	49.4	1995-1998
Southeast Asia	78.1	-34.1	46.7	24.6	1995-1998
South Asia	0.5	-21.0	5.2	-0.7	1995-1997
Central Asian Republics	0.0	400.0	31.3	46.7	1995-1996
Industrial Countries	-2.6	-3.7	-8.0	-5.6	1995-1998

Note: The following countries comprise the various regions in the estimation of growth rates: *NIEs:* Hong Kong, China, Republic of Korea and Singapore; *Southeast Asia:* Indonesia, Malaysia, and Philippines; *South Asia:* India; *Central Asian Republics:* Kyrgyzstan; and *Industrial Countries:* Japan and the United States.

Sources: IMF (1998) and IMF (2000).

Table A10. **Growth Rates of SITC 75-77 Imports by Sub-Region**
(Per cent per year)

	SITC				Year Range
	75	76	77	75-77	
Newly Industrialised Economies	2.2	-31.0	-11.8	-13.7	1995-1998
People's Republic of China	86.8	-7.0	55.0	36.1	1995-1998
Southeast Asia	53.7	-51.5	7.4	1.7	1995-1998
South Asia	31.1	-7.1	-9.4	-1.5	1995-1997
Central Asian Republics	172.0	186.5	292.2	258.3	1995-1996
Industrial Countries	11.5	10.9	-2.3	5.3	1995-1998

Note: For the country composition of the various regions, see note to Table A9.

Sources: See Table A9.

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