Financing Information Technology Diffusion in Low–income Asian Developing Countries

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Introduction

How to adopt information technology (IT) successfully in low–income developing countries (LIDCs) is one of the most pressing current developmental issues. Since IT became commercial in the early 1990s, it has diffused rapidly in developed countries but generally slowly in developing ones. This led to a widening IT gap, the so–called *digital divide* between the two groups. The IT gap among developing countries is also increasing. The more advanced, such as the Newly Industrialised Economies (NIEs), Brazil, Chile, Estonia and Malaysia, have made enormous progress toward a digital economy, but many of the rest of the developing nations remain much more backward.

The world has an estimated 350 million internet users. Over 90 per cent of them are in industrial countries, although developing countries comprise about 85 per cent of the world population[2]. Further, while internet use is not limited to certain groups of individuals (in terms of ages and sexes) in industrial countries, the internet users in developing countries are mostly young, male, urban individuals in the middle and upper income groups. In LIDCs, IT has not been effectively adopted by many micro–enterprises, agro–industries, small traders, farming/livestock households, public offices, schools, health centres, etc., particularly in rural areas.

National economies are increasingly tightly tied together globally by ultra high–speed information networks. In these circumstances, problems created by the digital divide include a vicious cycle. Lack of IT leads to lower productivity growth, loss of business opportunities and lower incomes[3], which in turn impede use of the latest technologies, including IT. An individual (or a country) that lags behind finds it difficult to catch up with the state–of–art IT because of this vicious cycle and the rapid progress in IT. It is therefore essential to expedite the diffusion of IT in LIDCs. The access of low–income individuals to IT will enable them to participate more actively in the development process. This paper identifies the primary bottlenecks to IT in LIDCs and discusses how to mobilise their financial resources to deal with them.

Technology Revolutions, Information, and Growth

Revolutions in Technology

Although tremendous technological advances took place over the past 100 years in several sectors, such as transport, communications, electrification and medicine, recent ones are much more comprehensive and powerful. Their salient characteristics involve convergence and interaction of many strands of technological change, with social consequences far more profound and far more difficult to foresee. They fall into three basic categories or strings of technical changes: in materials, in biotechnology and in information (Hallberg and Bond, 2000). Research has discovered many new, innovative materials. Transport enjoys lighter materials for fuel efficiency; health care takes advantage of dynamic images and intelligent prosthetics; and the energy sector benefits from many new materials as well. Biotechnological advances dominate in health applications (therapeutics and diagnostics) and are spreading quickly to other areas. Marine biotechnology leads to better disease prevention and reproduction control of fish, while biotechnological applications in agriculture increase productivity, improve animal health and diversify products. Bioremediation technology in the environment field provides new methods for waste and water treatment, waste–site cleanup and forest restoration. The revolution in IT has itself been brought forth by a company of innovations in telecommunications and informatics, made possible by cheaper new lightweight materials (e.g. optical fibres) transmitting information faster. Information flows faster and less expensively throughout the globe, but it will take substantial time to reach full digitalisation given the youth of IT.

Information and Economic Growth

Among the three strings of technological advance, IT is much more powerful than the others in deciding the magnitude and quality of economic production. Information, together with capital and labour, is a critical, essential production factor. It is a major contributor to labour productivity and total factor productivity. An increase in information content has significantly changed the concept of production, signifying the importance of timely information flows. Firms failing to incorporate new information can be left behind in gaining productivity and competitiveness, given that the scope of the impact of new information technology is much broader than that of other technologies. While they impact on limited sectors, IT does so across the board. IT also significantly changes corporate behaviour and organisation structure, which should increase productivity (Brynjolfsson and Hitt, 2000).

Many of the early studies on the role of information technology in productivity, which generally used economy or sector data, found little evidence of significance. See, for example, Roach (1987), Berndt and Morrison (1995), and Morrison (1996).

Since the mid–1990s, however, analyses at the firm level have begun to find positive effects of information technology on firms' productivity. Using data from over 300 large firms for 1988–1992, Brynjolfsson and Hitt (1995, 1996) and Lichtenberg (1995) found a clear, positive relationship between firm–level IT investment and multifactor productivity, despite a great deal of individual variation in firms' success with information technology. Many other studies also suggest that information technology contributed to substantial increases in output and productivity (Greenan and Mairesse, 1996; Kelley, 1994; Muhkopadhyay *et al.*, 1997). Brynjolfsson and Hitt (2000) examined the mechanism for productivity gains. Jorgenson (2001) made an attempt to explain why the US real GDP rose at such a high annual rate of over four per cent in the second half of the 1990s, a remarkable step–up from about 2.4 per cent during the first six years of the decade. Both a rebound in the growth of average labour productivity (ALP) and labour hours drove the rapid growth. Table 1 shows this, along with a breakdown of contributions to ALP growth. Information technology was clearly a large contributor in 1995–99. IT capital contributed significantly to rapid capital deepening, and IT was a major factor in the growth of total factor productivity. The contribution of labour quality actually declined in the second half of the decade.

Table 1. **Sources of US Real GDP and Average Labour Productivity Growth, 1973–99**
(Average annual rates of growth, in per cent)

	1973-90	1990-95	1995-99
Gross domestic product	2.86	2.36	4.08
Hours worked	1.59	1.17	1.98
Average labour productivity	1.26	1.19	2.11
Contribution of capital deepening	0.79	0.64	1.24
Information technology	0.35	0.43	0.89
Non-Information technology	0.44	0.21	0.35
Contribution of labour quality	0.22	0.32	0.12
Total factor productivity	0.25	0.24	0.75
Information technology	0.19	0.25	0.50
Non-Information technology	0.06	-0.01	0.25

Source: Jorgenson (2001).

An important related development was the continuing sharp increase in the income shares of the IT–related sector (hardware, software, and communication equipment), which picked up from 3.3 per cent in 1974–90 to 5.3 per cent in 1991–95 and further to 6.3 per cent in 1996–99 (Table 2). The shares of other capital and labour hours, in contrast, fell continuously. These trends match the much higher growth rates of IT inputs to production than of inputs of other capital and labour hours. Hardware and software IT inputs grew by 35.9 per cent and 13.0 per cent, respectively, in 1996–99, compared with 2.8 per cent and 2.2 per cent for other capital and labour hours.

Table 2. **Income Shares of IT and Other Factors in US Non-farm Business Output, 1974–99**
(Per cent)

	1974-90	1991-95	1996-99
Information Technology	3.3	5.3	6.3
Hardware	1.0	1.4	1.8
Software	0.8	2.0	2.5
Communication equipment	1.5	1.9	2.0
Other capital	27.9	26.8	26.7
Labour hours	68.9	67.9	66.9

Source: Oliner and Sicher (2000).

In Korea, the IT industry (IT services, hardware and software) expanded much faster than GDP in the 1990s (Cho, 2000). Table 3 gives the relevant statistical information. With this fast IT growth, the IT industry's share in GDP doubled, from 3.7 per cent in 1991 to 7.6 per cent in 1999. Total factor productivity (TFP) in the IT industry grew by 14.3 per cent per annum from 1994 to 1997, a rate much higher than in other industries, where it ranged between only 1 and 2 per cent. In the crisis period (1998 and 1999), high IT TFP growth continued (14.6 per cent in 1998 and 32.2 per cent in 1999), while other industries showed negative TFP growth. Cho (2000) concludes that the high TFP growth of the IT industry does not seem to have diffused to other industries yet, but it will increasingly and positively affect them as the IT capital stock increases. The IT capital stock remained at only 5.2 per cent of total capital stock in 1999.

Table 3. **Growth of IT Industry in the Republic of Korea**
(Per cent)

	1991	1994	1997	1998	1999	2000 January-June	1991-99 average
Real GDP Growth Rate	9.2	8.3	5.0	-6.7	10.7	11.1	5.9
Growth rate of IT industry	10.7	26.4	30.5	20.7	41.1	41.2	23.9
Contribution of IT industry to real GDP growth	0.3	1.0	1.9	1.5 – 1.7	4.1	5.1	About 1.5
Share of IT industry in nominal GDP	3.7	4.7	5.6	6.3	7.6	n.a.	5.6

Source: Cho (2000).

IT Diffusion in Asian and Pacific Developing Countries

Appendix Table A1 provides information on IT diffusion in selected Asian and Pacific economies and the United States. It is clear that the degree of IT diffusion has a strong positive correlation with the level of income per capita among these countries. The NIEs are in a position comparable to developed countries such as the United States, while the People's Republic of China (PRC), Malaysia and Thailand are in a much more advanced stage than the other developing countries in Southeast Asia, South Asia, Central Asia and the Pacific. For example, internet users per 1 000 people are: 260–420 in the NIEs, 69 in Malaysia, 17 in Thailand, 14 in the PRC, nine in Pakistan, seven in the Philippines, five in India and Kazakhstan, four in Sri Lanka, two in Indonesia, Kyrgyz, Nepal and Viet Nam and less than one in Bangladesh and Papua New Guinea. IT is beyond the reach of many micro–enterprises, agro–industries, traders, schools, health centres and governmental offices in rural areas in Asian LIDCs.

IT will become increasingly important to Asia and Pacific developing countries in determining productivity growth and industrial competitiveness. A critical question involves whether the new technology will benefit the LIDCs and the other countries to an equal degree, or widen the income disparity between the two groups. The large digital gap between them suggests a gloomy answer. The gap will become even wider unless a well designed long–term strategy for diffusing IT is urgently implemented. Internally within a country, the latest IT is used by only a limited group of citizens, namely young urban individuals at middle or higher income levels. Individuals who do not have satisfactory access to IT will suffer in terms of lower competitiveness and skills, and thus lower incomes.

Required Measures for IT Diffusion and Financing Options

Broadly–defined, IT services include the following:

— Facility–based telecommunications services such as local and long–distance call and wireless telephone service; as well as special telecommunications services[4], including internet phone, call–back, and voice resale;

— Value–added telecommunication services (e.g. PC communications and data services); and

— Broadcasting services such as TV and radio, CATV and satellite broadcasting.

This paper accords priority to the second and third, particularly the third, which has broader economic implications than the others. An array of barriers impedes the access of the low–income population to IT. Receiving information requires information producers (e.g. data services and consulting), information disseminators, physical infrastructures to convey information, equipment (e.g. PCs and monitors) to display it, literacy of recipients to read/understand it and ultimate application of the information to productive activities. The first two of these are beyond the scope of this paper and the fourth (equipment) is not a major problem.

Physical Infrastructures

A major barrier is the poor condition or limited availability of physical infrastructures in LIDCS. Existing telecommunications networks are often limited to urban areas only, and even these offer poor services in contrast with the ultra high–speed systems present in IT–advanced countries. Modernising existing infrastructures as well as building new ones in rural and remote areas are thus the key issues. The following considerations are important in augmenting IT infrastructures:

— They should be financially sustainable;

— Systems should meet satisfactory equity criteria; and

— Maximum use of the infrastructures must be ensured.

IT services generally are provided through telephone lines, and it is essential to build or improve these facilities in underdeveloped areas. Telecommunication line construction in remote areas, however, although responding to the equity consideration, will not ensure maximum use and will not be financially sustainable, with costs much higher than collectable service charges, given the low demand in such areas. Cheaper, complementary methods should therefore be identified as basic infrastructures are developed step by step. One would be to use satellites, which should cover as many areas as possible to ensure economies of scale and financial sustainability. Many countries use satellites as a major telecommunications infrastructure; they are particularly popular in Eastern European countries. Cellular–phone services, which do not require wires, offer another method. Wireless telecommunication services are rapidly replacing wired ones and are leading in the telecommunication markets. In the Republic of Korea, production of wireless telecom services has exceeded the wired telecom services since 1998 (Table 4).

Table 4. **Production of Wired and Wireless Telecom Services in the Republic of Korea**
(In billion won; percentages in parentheses)

	1997	1998	1999	2000[a]
Wired	6 403	6 124	6 254	7 480
	(57.0)	(48.5)	(39.2)	(39.5)
Wireless	4 837	6 498	9 701	11 455
	(43.0)	(51.5)	(60.8)	(60.5)
Total	11 240	12 622	15 955	18 935
	(100.0)	(100.0)	(100.0)	(100.0)

a. Preliminary.

Source: Hong (2001).

The next issue concerns how to distribute efficiently the information/data received from the infrastructures. Individual receiving is too costly in remote areas. An alternative uses a collective method — a telecentre. A telecentre provides the public with access to information and communication technologies for personal, educational, social and commercial/economic purposes. The first telecentre was established in the mid–1980s in a Swedish rural agricultural community[5]. It became a powerful concept to bring the latest technologies to remote communities traditionally neglected by the market.

The telecentres contributed to an equitable expansion of the telecommunications network and offered rural communities the chance to adopt information and communications technologies to their benefit, strengthening social ties within the community and economic ties with the outside world. Since then, the concept has spread rapidly around the world. Governments, development institutions, non–profit organisations and entrepreneurs operate them, in different forms to accommodate local conditions and opportunities. Telecentres have brought a visible and identifiable change in the skills and capacities of people and institutions in communities (Fuchs, 2000). Although their objectives, sizes and configurations can vary, the key characteristics of telecentres include (Shakeel, 2000):

— Geographic location — rural, urban or peri–urban;

— Physical location — in schools, public libraries, government offices or community centres;

— Services rendered — email, internet, phone and fax (common configurations range from phone shops providing public phone access to Multipurpose Community Telecentres (MCTs) rendering voice and data connectivity together with public services such as tele–education);

— Business models — subsidised public, cost recovery or profit making; and

— Partners — national or local governments, universities, NGOs or commercial groups.

Developing infrastructures is costly and requires heavy funding, which cannot be borne by individuals in rural communities. The problem relates not only to the costs themselves but also to financial sustainability of the infrastructures. Except in special cases, therefore, the local or national government must be involved in the construction of the projects with a notion that IT should be a universal service to all inhabitants of the country — a public–goods concept. International donors may co–finance the projects to bridge the funding gap.

If the circumstances allow the participation of private companies in developing the infrastructures, arranging co–financing with the provision of certain risk–hedging formulas should encourage their participation. Necessary legal/regulatory arrangements should facilitate efficient and effective private–sector operation and provide some incentives; for example, companies diffusing IT in IT–underdeveloped areas might be given priority to receive licenses to run commercial telecommunications services in other, profitable areas. Other measures that can encourage private participation include privatisation of state–owned enterprises[6] to increase market competition and economic efficiency; de–monopolisation of niche sectors (*e.g.* cellular phones); foreign participation; government guarantees; supports for financing arrangements; and policy and institutional reforms.

In the aftermath of the Asian crisis, private participation in infrastructure projects has been very cautious due to the underlying high macro uncertainties and foreign exchange risks. A well–designed policy is therefore required to attract foreign and domestic private investors. Various forms of public–private partnerships have been developed: build–operate–transfer (BOT), build–own–operate (BOO), build–own–operate–transfer (BOOT) and concessions. The appropriate mode depends on the character of the project. To promote private investment in infrastructure, competition, transparent tendering, effective regulation, long–term domestic financing sources and risk mitigation are most important (O'Sullivan, 2000). Natural monopoly should be reduced and competition promoted. Unbundling of infrastructure sectors is an important technique to this end, because many parts of networks can support competition. Establishing contestable environments is also essential, through effective competitive bidding for the sale or lease of assets and licensing or franchising of services, etc. (Box 1).

Box 1. **Unbundling of Hungarian Telecom Services**

In the early 1990s, Hungarian Telecoms Services were unbundled into cellular and regional concessions to provide local telecom services. The main telecom operator, Hungarian Telecom Corporation (HTC), remained responsible for the remaining regional areas as well as long–distance and international markets. A cellular company was awarded an exclusive concession in 1990 to develop a nation–wide analogue cellular network. By December 1993 the company had 40 000 customers, 10 000 more than originally expected. The venture's success encouraged the government to open the sector to competition, and in late 1993 two 15–year licenses were awarded to install nation–wide digital cellular systems. In 1994, the government awarded concessions to provide local telecom services in 23 regions. HTC provided interconnection services, but the regional licensees developed services within each area. This approach to harnessing private participation led to rapid entry of capital and technology. In one region (Pápa), telephone penetration was expected to increase by a factor of over three within five years (IFC, 1994).

Governments should play a very important role in reducing risks involved in infrastructure projects[7]. Table 5 presents a summary of various risks and mitigation measures. Governments in developing countries often must accept commercial risks, including foreign–exchange risk and demand risk. In developing countries in general, private funding of infrastructure requires a large amount of foreign financing. It involves high risks of currency mismatches and exchange–rate fluctuations, given that income is in local currency but the foreign financing generates debt servicing in foreign currency. During the Asian crisis, the depreciation of crisis–country currencies ranged from 50 per cent to 80 per cent, an unbearable level for foreign investors who want to remit their financial returns. Some governments provided guarantees against both foreign–exchange and demand risks. Yet the provision of guarantees involves negative impacts, including substantial contingent liabilities for governments that add to fiscal debt and foreign–exchange constraints, because the telecommunications sector does not directly generate foreign–exchange income.

Table 5. **Managing Project Risks as Seen from the Lender's Perspective**

Type of Risk	Risk Controllers	Risk Mitigation/Covering Measures
Commercial Risks		
Project-Specific		
Project concept and costs	Sponsor	Lessons from similar projects; careful cost review
Project supplies	Supplier	Supply contract: government guarantee
Demand (multiple users: toll road)	None	Independent survey: government guarantee
Demand (single purchase: power)	Purchaser	Take-or-pay contract; revolving letter of credit from purchaser
Sponsor Commitment	Sponsor	Equity commitments
Contractor/operator commitment	Contractor/operator	Insurance arrangements; penalty arrangements
Non Project-Specific		
Currency/interest risk	Basically host government	Hedging; sponsor guarantees to cover cost-overruns; use local financing; government agreement to link project tariff to debt service costs
Inflation	Basically host government	Use inflation index for estimating the tariff level.
Non-Commercial Risks		
Project-Specific		
Regulatory	Host government	Detailed concession agreement
Expropriation	Host government	Concession terms
Obligations of SOEs	SOE/government	Contracts; government guarantees
Non Project-Specific		
Country risk (e.g. Forex availability)	Host government	Government guarantee; project revenues paid directly to an offshore escrow account
Political	Government or none	Insurance; buy-out clauses
Legal	Host government	Use neutral-country contract law
Force majeure (e.g. earthquake)	None	Insurance

Source: IFC (1994) and the author.

The development of domestic financial markets is important to secure long–term domestic resources. The volume of funds raised in domestic financial markets, although still small, is growing in the Asian region. If private investors can mobilise resources from local capital markets, foreign–exchange risks and currency mismatches will be reduced. This local funding in return stimulates development of domestic capital markets.

Local financing can be sought through three channels. First, companies already engaged in IT infrastructures might raise funds through issuing equity on the domestic stock market. Telecommunications companies have been active equity issuers in many countries, such as Thailand and Argentina (IFC, 1994). A second source is debt financing provided by local commercial and development banks. Most projects have local financing requirements and local banks can extend credit if necessary, but the room for commercial banks to provide long–term project financing is generally very limited. Local bond markets provide a major source of funding for development banks and, more generally, bond issuance is the third channel for raising funds to finance IT infrastructure. Although the importance of domestic bond markets has been well recognised and significant development efforts have been made in several countries (particularly the crisis economies) since the outbreak of the Asian crisis, Asian bond markets still remain underdeveloped (Kim, 2000). Development of local bond markets is particularly important to IT project financing, which requires large–scale, long–term resources. Developing bond markets need a range of policy reforms that include creating a benchmark yield curve, improving corporate governance, strengthening the role of institutional investors and reforming regulatory and supervisory frameworks. Private placement of bonds should also be encouraged.

Education and Training

Education and training in IT cannot be separated from general education and training in developing countries because basic literacy and primary–level knowledge form an essential minimum requirement for understanding and using available information. A major problem faced by low–income Asian and Pacific developing countries lies in low literacy rates that block any policy action to diffuse IT. Appendix Table A2, which provides basic education indicators in those countries, shows that Afghanistan, Bangladesh, Bhutan, India, Lao People’s Democratic Republic, Nepal, and Pakistan have particularly pressing situations. Male adult literacy ranges from 41 per cent (Nepal) to 69 per cent (Lao People’s Democratic Republic), and female adult literacy rates are far lower.

Apart from low adult literacy, another discouraging factor is poor education of children in these countries, as revealed by low primary–school enrolment rates and high dropout rates. It is therefore crucial to improve adult literacy as well as children’s school enrolment rates to keep pace with recent developments. It also is important to include IT training as a major educational subject, so that children can start to learn IT at early ages, which is now popular in IT–advanced countries. For children to miss IT education and be excluded from job markets will perpetuate poverty. Given that advanced IT work requires education higher than just the primary level, secondary and tertiary education are also important. Here again, the situation in Asian and Pacific developing countries is not encouraging (Appendix Table A3). Training for schoolteachers, particularly elementary and secondary teachers, is also essential.

Given that primary education is generally the government’s responsibility, it is important to increase fiscal resources for primary education. This issue has been examined by many studies. Taxes, bond issuance, collection of education fees and international assistance are among the common methods to finance primary schooling in developing countries. Two issues connected with strengthening primary education are particularly important in LIDCs in Asia. One concerns the empowerment of local governments to provide education to children in their jurisdictions. The other involves augmenting their fiscal capability. Given that a local government understands local educational problems and needs well and is in a better position to find proper solutions, it would be desirable for local governments to bear the principal responsibility for designing and providing primary education. If the central or middle–level government (e.g. a state government) is responsible for the provision, it should hand over it to local governments. Fiscal strengthening of local governments then becomes crucial to enable them to provide adequate education services. There should be proper arrangements on fiscal decentralisation and intergovernmental fiscal transfers to this end.

Donation of relevant resources by business corporations, particularly those benefiting from IT, should be encouraged[8]. A special–purpose corporate income tax whose revenue would be used solely for IT education and training can also be collected, because companies benefit most from an IT–trained labour force. It is also essential to reprioritise fiscal expenditures to allocate more financial resources to education in IT skills.

Collection of Information and Application to Productive Activities

Another important objective is to understand community needs, disseminate necessary information and guide communities in applying the information to productive activities. The needs and interests of community members should first be clearly comprehended, so that the IT network can supply meaningful information and data. Next, based on this understanding, the most relevant information should be produced and disseminated to the needy. Last, communities (*e.g.* those producing cash crops, fishery, livestock and horticulture) must be helped to learn how best to apply the information for their production and trade. These three different facets can be managed by a single organisation or separately by different ones, but public agencies should guide the application of the information to various purposes, given that it requires research not financially lucrative to the private sector. The first and second activities should preferably be undertaken by private organisations charging fees for cost recovery. In principle, these activities should have commercial motivations. Commercially oriented organisations receiving fees can survey the needs and interests of communities and produce and disseminate necessary information to them. The information should cover demand and supply situations, price levels and trading conditions. As noted, however, experts with sufficient knowledge and practical experience should provide the guidance for applications, given the information’s paramount importance for the medium–term production activities of its recipients. Horticulture in Korea follows such a pattern.

Need for Fiscal Reprioritisation

Responsibilities of the Government

Government should assume the primary responsibility for providing a favourable environment and basis for diffusion and development of IT in LIDCs where the private sector is financially weak. It should address several important policy issues. The first is to reprioritise budget allocations to make fiscal expenditure policy play a major role in promoting IT adoption in the national economy. The basic current fiscal framework in LIDCs was designed in the "Industrial Age" and retains an old expenditure structure not consistent with the "Information Age." Fiscal policy for industry, infrastructure, education, health, poverty, employment and civil administration should include an IT component as an essential parameter. For example, IT access should be made available in all education and health facilities. Fiscal policy should also accord priority to constructing IT–related infrastructures. If a conflict arises between IT–related expenditures and others, the first should receive a higher priority in principle, taking into account the tremendously important role of IT as a fundamental production factor. Further, the administrative system should be based on IT and open to the public to ensure its transparency as well as enhance its convenience.

To strengthen the resources of government, it is crucial to eradicate corruption and minimise government inefficiency, because both waste substantial fiscal resources. Reforming public–sector governance and government structures are essential to achieve this goal. Fiscal revenues increased through reforms can be channelled into IT projects, which will in turn contribute to more transparent and efficient government services and policies.

Role of International Aid Agencies

International donors increasingly emphasise the importance of IT and have already initiated some assistance programmes. The Okinawa Charter on the Global Information Society is one of them. In July 2000, the G8 countries issued the Charter on the Global Information Society at their summit meeting in Okinawa, recognising that IT is one of the most important issues faced by all nations[9]. At the meeting, Japan committed $15 billion to help create a global information society. Bilateral and multilateral aid agencies have also begun some actions to assist low–income developing countries in adopting IT. Whether IT diffusion will be successful in these nations depends on the countries' own efforts, however. With this in mind, international donors need to recommend and ask individual countries to seek "informatisation" through active policy dialogue and arranging assistance conditions[10]. Donors' assistance should be helpful for reducing the obstacles — problems of infrastructure, education facilities and low literacy — discussed earlier. Careful co–ordination of assistance among donors will raise the value and effectiveness of assistance by avoiding project overlaps.

Conclusions

Since the early 1990s, IT has made remarkable progress and diffused rapidly in developed countries as well as in some advanced developing countries such as the NIEs. It has provided individuals and communities with enormous opportunities to raise economic productivity, facilitate business transactions and create new businesses. The positive role of IT in economic activities has been well documented in some countries including the United States. Nevertheless, many low–income developing nations in Asia and the Pacific suffer underdevelopment both economically and digitally. Besides the *inter*national digital divide, a significant *intra*national digital gap also exists, because IT is unavailable in rural communities and even in some urban areas. IT is neither a luxury consumption item nor a special production input related to only limited economic commodities; it is a basic production factor required for every kind of economic activity in this "information age." If the underlying problem is not properly addressed in the low–income developing nations, the digital gap and resultant economic disparity between countries, communities and individuals may increase at an accelerating rate.

Given this formidable challenge, it is urgent for low–income developing nations in the Asian and Pacific region to make strong policy efforts to minimise the existing digital gap. To this end, it is crucial to adjust their fiscal and financial policies as well as regulatory and institutional frameworks to meet the changing economic and technological context. It is also of great importance to mobilise financial resources for the government to improve telecommunications infrastructures and education facilities, while privatisation of related projects and programmes needs to be vigorously pursued. Educational reform is also required. To increase fiscal allocations for IT–related projects and education investments, it is essential to reprioritise fiscal programmes in general and rationalise those related to old–type transport and telecommunications technologies. The international donor community should assist these nations in these efforts.

Notes

1. The views expressed are those of the author and do not necessarily reflect the policies and views of the Asian Development Bank.
2. Japanese Ministry of Foreign Affairs *et al.* (2000).
3. There are different views on the contributions of IT to production, but the most convincing one recognises the positive role of IT. The next section discusses the role of IT in determining productivity.
4. Special telecommunications and value-added telecommunications services do not require own infrastructures but provide facility-based services (e.g. voice) and value-added services (e.g. data), respectively.
5. Henning Albrechtsten, a writer and academic, established the facility to provide the information and communications services and related training to the local community.
6. A success example: In January 1988, the Government of Chile sold about 50 per cent of its telephone company, CTC, to a strategic investor after an international tender. CTC's 1989–93 $1.36 billion investment programme was completed six months early and 6 per cent under budget. Line capacity doubled, with 787 000 additional lines installed, which implied an annual growth of 23 per cent, one of the highest in the world. Efficiency also improved. The number of employees per 1 000 lines fell from 13.7 in 1989 to 6.2 in June 1993.
7. Parties involved in private infrastructure financing are sponsors (owners), who provide equity, contractors, who construct or operate, government (as a participant or regulator), customers and financiers.
8. For example, the Microsoft Company donates a large amount of money for training and education every year.
9. The Charter emphasises the role of IT in creating sustainable economic growth, increasing welfare and fostering social cohesion. It also suggests that both private and public sectors make efforts to bridge the digital divide, underscoring an effective partnership among stakeholders through close policy cooperation.
10. In April 2001, for example, the Asian Development Bank approved a loan (total project cost: $33 million) for Viet Nam for RMIT International University Viet Nam (RIUV), which will assist RIUV in providing IT training programmes.

Appendix

Table A1. **IT Diffusion in Selected Asian and Pacific Countries and the United States**
(Numbers per 1 000 people)

	Telephone Main Lines 1999	Cellular Phones 1999	Personal Computers 1999	Internet Users 2000
Newly Industrialised Economies				
Hong Kong, China	577.5	636.1	290.5	260
Republic of Korea	441.4	504.4	189.2	323.1
Singapore	482	418.8	527.2	419.1
Taipei,China	545.2	522.4	180.7	288.4
Other East Asian Countries				
People’s Republic of China	85.8	34.2	120	13.4
Southeast Asia				
Indonesia	29.1	10.6	9.1	1.8
Malaysia	203	137	68.7	68.8
Philippines	39.5	36.6	16.9	6.2
Thailand	85.7	38.4	22.7	16.5
Viet Nam	26.8	4.2	8.9	1.3
South Asia				
Bangladesh	3.4	1.2	1	0.2
India	26.6	1.9	3.3	4.5
Nepal	10.6	n.a.	2.6	1.4
Pakistan	22.2	2.1	4.3	8.5
Sri Lanka	36.4	12.2	5.6	3.4
Central Asian Republics				
Kazakhstan	108.2	3	n.a.	4.2
Kyrgyz Republic	76.2	0.6	n.a.	2.1
The Pacific				
Papua New Guinea	11.4	n.a.	n.a.	0.4
Developed Countries				
Japan	494	449.4	289.6	213.8
United States	681.8	311.5	510.5	537.2

Sources: International Telecommunication Union (2000) and Nua Internet Surveys (2000) (cited in Quibria and Tschang, 2001, Table 2).

Table A2. **Basic Education Indicators in Asia and Pacific Developing Countries**

(Per cent)

	Adult Literacy Rate[a], 1995		Gross Primary School Enrolment Ratio, 1996	
	Female	Male	Female	Male
Afghanistan	15.0	47.2	34.1	68.4
Bangladesh	26.1	49.4	77.7	89.6
Bhutan	28.1	56.2	n.a.	n.a.
Cambodia	n.a.	n.a.	99.3	118.9
China (People's Republic of)	72.7	89.9	119.9	120.9
Taipei,China	91.1[b]	98.1[b]	101.8[b]	99.5[b]
Cook Islands	n.a.	n.a.	n.a.	n.a.
Republic of Fiji Islands	n.a.	n.a.	136.3	137.2
Hong Kong, China	88.2	96.0	98.1	96.2
India	37.7	65.5	90.4	110.0
Indonesia	78.0	89.6	112.3	116.9
Kazakhstan	n.a.	n.a.	95.9	95.3
Kiribati	n.a.	n.a.	n.a.	n.a.
Republic of Korea	96.7	99.3	94.5	93.7
Kyrgyz Republic	n.a.	n.a.	106.5	110.1
Lao People's Democratic Republic	44.4	69.4	97.0	124.5
Malaysia	78.1	89.1	91.8	90.2
Maldives	93.0	93.3	123.5[b]	127.0[b]
Marshall Islands	n.a.	n.a.	n.a.	n.a.
Fed. States of Micronesia	93.0	94.8	93.9	93.5
Mongolia	77.2	88.6	92.2[b]	88.2[b]
Myanmar	77.7	88.7	98.1	101.7
Nauru	n.a.	n.a.	n.a.	n.a.
Nepal	14.0	40.9	83.9	124.5
Pakistan	24.4	50.0	51.0	109.2
Papua New Guinea	n.a.	n.a.	72.9	85.3
Philippines	94.3	95.0	118.7	116.4
Samoa	n.a.	n.a.	103.4[b]	111.3[b]
Singapore	86.3	95.9	92.9	95.3
Solomon Islands	n.a.	n.a.	93.4	102.4
Sri Lanka	87.2	93.4	108.1	110.0
Tajikistan	n.a.	n.a.	91.8	95.3
Thailand	91.6	96.0	87.9	88.2
Tonga	n.a.	n.a.	n.a.	n.a.
Tuvalu	n.a.	n.a.	n.a.	n.a.
Uzbekistan	n.a.	n.a.	78.2	80.4
Vanuatu	n.a.	n.a.	104.2	105.3
Viet Nam	91.2	96.5	112.3	117.7

a. Refers to population of 15 years old and over, except for Taipei,China where the reference age is 25 years and over.
b. Refers to 1997.

Source: ADB (1999).

Table A3. **Secondary Level Education Indicators in Asia and the Pacific, 1996**
(Per cent)

	Gross Secondary School Enrolment Ratio	
	Female	Male
Afghanistan	11.4	31.8
Bangladesh	13.1	24.0
Bhutan	n.a.	n.a.
Cambodia	20.3	34.7
China (People's Republic of)	66.9	74.2
Taipei,China	98.9[b]	95.6[b]
Cook Islands	n.a.	n.a.
Republic of Fiji Islands	69.6	69.4
Hong Kong, China	77.3	72.8
India	39.2	58.7
Indonesia	47.6	55.8
Kazakhstan	88.9	80.3
Kiribati	n.a.	n.a.
Republic of Korea	102.0	101.6
Kyrgyz Republic	70.4	88.9
Lao People's Democratic Republic	22.7	36.3
Malaysia	66.1	57.5
Maldives	64.9	60.4
Marshall Islands	n.a.	n.a.
Fed. States of Micronesia	84.7[a]	78.4[a]
Mongolia	65.0	47.5
Myanmar	35.9	34.8
Nauru	n.a.	n.a.
Nepal	25.1	48.7
Pakistan	21.0	38.4
Papua New Guinea	11.2	16.4
Philippines	80.2	78.1
Samoa	65.8	59.4
Singapore	73.5	71.6
Solomon Islands	14.0	21.6
Sri Lanka	78.1	71.2
Tajikistan	71.7	80.6
Thailand	56.5	57.5
Tonga	n.a.	n.a.
Tuvalu	n.a.	n.a.
Uzbekistan	87.6	98.4
Vanuatu	19.0	23.0
Viet Nam	39.7	41.4

a. Refers to 1994.
b. Refers to 1997.

Source: ADB (1999).

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