TOWARDS KNOWLEDGE-BASED ECONOMIES IN APEC

Asia-Pacific Economic Cooperation

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FOREWORD

In their Kuala Lumpur and Auckland Declarations, APEC Leaders underscored the importance of knowledge as a key driver of future economic growth and development, and pledged to ensure that APEC economies be at the forefront of efforts at building and sharing expertise in this vital sector.

Addressing the challenges put forth by the Leaders, the project titled *"Towards Knowledge-based Economies in APEC"* (KBE project) was initiated by the APEC Economic Committee in the mid-1999. Further, as a research arm for carrying out the initiative, the KBE Task Force was formed in February 2000. The aim of the KBE project is to provide the analytical basis useful for promoting the effective use of knowledge, and the creation and dissemination of knowledge among APEC economies.

As a first step in moving forward the project, Korea organized a workshop in Seoul in June 1999 on "The Promotion of Knowledge-based Industries in the APEC Region." As the research work progressed, in June 2000, Korea organized an APEC symposium in Seoul on "Preconditions, Policies and Cooperative Potential for Promoting Knowledge-based Economies in APEC," with the aim of mobilizing various views and perspectives and discussing the project's interim research outputs.

Research work was carried out by Australia, Canada and Korea on the following topics: (1) assessing the preconditions for developing "knowledge infrastructure", (2) examining the policy environment conducive to expanding the knowledge base, and (3) examining possible areas of APEC cooperation for the promotion of KBE, respectively. Many other economies contributed to finalizing the report by way of reviewing the analyses and initial drafts.

This report is submitted to the APEC Ministerial Meeting in November 2000 in Brunei Darussalam. Key messages of the report are conveyed to APEC Leaders as well.

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Mitsuru Taniuchi

Chair, APEC Economic Committee

TOWARDS KNOWLEDGE-BASED ECONOMIES IN APEC

FRAMEWORK and SUMMARY

1. FRAMEWORK

Why is the KBE Important?

The term "knowledge-based economy" (KBE) recognises the crucial role that knowledge, in all its forms, plays in economic processes (see Box 1). Although the importance of knowledge acquisition has long been recognised, it has acquired a new urgency in the increasingly integrated global economy.

The internationalisation of production is creating new incentives and opportunities, and generating new pressures for knowledge acquisition. Unlike most other economic goods, knowledge often has 'public good' characteristics and increasing returns to scale. Therefore its growing importance raises new challenges for public policy. The interaction of mutually reinforcing pressures from the internationalisation of business and the drive for new knowledge makes the emerging business environment quite different from anything experienced in the past.

The transition to a KBE may turn into a structural change that differs in size and pervasiveness from the incremental changes to which all economies are constantly subject. For example, The US already gets more than half its economic growth from industries which barely existed a decade ago.[i] Similarly, many analysts foresee that recent dramatic changes in information and communications technologies - especially the rise of the Internet - may greatly increase international trade in services (such as banking and education) that were formerly barely traded.

Empirical evidence suggests that among the more advanced economies of the world, economic growth is most sustainable for those which are strong in all of the following four dimensions:[ii]

- Innovation and technological change are pervasive, and are supported by an effective national innovation system (that is, a network of institutions in the public and private sector whose activities and interactions initiate, import, modify, and diffuse new technologies and practices).
- Human resource development is pervasive: education and training are of a high standard, widespread and continue throughout a person's working life (and even beyond).
- An efficient infrastructure operates, particularly in information and communications technology (ICT), which allows citizens and businesses to readily and affordably access pertinent information from around the world.
- The business environment (that is, the economic and legal policies of government, and the mix of enterprises operating in the economy) is supportive of enterprise and innovation.

The strong performance of the "Asian tiger economies" over the last few decades has likewise ridden on strengths in all four of these dimensions, whereas those APEC economies which are still at a lower level of economic development have been weaker in at least one of these dimensions.

Importantly, these four dimensions are precisely those that characterise a *knowledge-based economy* or *KBE* (see Box 1). In short, it is becoming ever more the case that the most successful economies are those that are closest to being KBEs.

President Kim Dae-jung of Korea put this idea explicitly to the APEC leaders' meeting in September 1999:

> " In the industrial age of the 20th century, the dominant ingredients in production were tangible ones such as capital, labour and natural resources. But as we move into the new century, it is increasingly the intangible factors that matter most as new sources of growth potential, such as knowledge, information, and cultural character."

Box 1
What is a Knowledge-Based Economy (KBE)?

A *Knowledge-Based Economy* is an economy in which the production, distribution, and use of knowledge is the main driver of growth, wealth creation and employment across all industries.

In this context, being a KBE means more than simply having a thriving "new economy" or "information economy" that is somehow separate from a stagnant "old economy". In a truly knowledge-based economy, all sectors have become knowledge-intensive, not just those usually called "high technology".

Important features of an ideal KBE include: an openness to trade, new ideas and new enterprises; sound macroeconomic policy; the importance attached to education and lifelong learning; and the enabling role of information and telecommunications infrastructure.

Note that the knowledge required by a knowledge-based society is wider than purely technological knowledge; for example, it includes cultural, social, and managerial knowledge. The knowledge possessed by an organisation is much more than the information written in its files, and includes its culture, the way in which people interact within the organisation, knowledge about the contacts they use to gain information from outside, and so on. The organisation's knowledge consists of its capability in integrating information with experience and expertise to take action. This assimilation is no mean feat; as one wit put it: "Today we are drowning in information but starving for knowledge".

Background to this Report

Consistent with this interest from APEC Leaders, the Economic Committee of APEC agreed to produce the present summary report for possible consideration by APEC Leaders in 2000. This summary report draws on a fuller text [to be published by APEC Secretariat], and on workshops held in Seoul in 1999[iii] and in June 2000.

The report begins by assessing how far some representative APEC economies have moved towards becoming KBEs. Comparing the characteristics of these real economies to each other and to those of an idealised KBE suggests that for an economy at any particular stage of development, certain characteristics have to be put in place before it can move closer to becoming a KBE. Such characteristics are referred to as *preconditions*. Having identified these desirable directions for change, the paper goes on to suggest some possible instruments that might be appropriate to move a particular economy further in that direction. This analysis draws extensively on the policy experience of the case study economies.

Sharing of relevant experiences, as in this report, is an example of the potential for cooperation within APEC to assist member economies to develop towards KBEs. The report goes on to examine in a more thoroughgoing way, the potential for cooperation within APEC in each of the four key dimensions of the framework set out above. Within each dimension, the report identifies potential (broad) areas of cooperation, prior work by relevant APEC working groups, challenges to cooperation, and some suggestions on how to enhance cooperation between APEC economies. The report concludes with a few specific recommended actions.

Many individual economies, and the global economy, are evolving rapidly towards becoming knowledge-based economies. While there is no royal road to achieving a KBE, the authors hope that their study sheds some light on drawing participative efforts of the individual APEC member economies in promoting the KBE to its full bloom in the region.

2. HOW CLOSE TO KBEs ARE APEC ECONOMIES NOW?

Due to restraints in resources and time, detailed analysis in the present study was limited to seven case study economies chosen to represent four clusters of APEC economies:

- The Most Developed Economies (with Australia and Canada as case studies);
- High Performing Asian Economies (with Singapore and Korea as case studies);
- Asian Fast-Growing Economies (with Thailand and the Philippines as case studies);
- Latin American Economies (with Chile as a case study).

These four economy clusters are based primarily on levels of GDP per capita, with some allowance for geographic location and economic history. The case study economies were selected primarily on the basis of data available to the project team and their potential for generalisation to other similar APEC economies.

Bearing in mind the findings of the OECD growth project, we analyse the various aspects of KBE development in terms of the following four dimensions:

- Innovation system
- Human resource development
- ICT infrastructure
- Business environment

Knowledge Intensity of APEC Economies

The proportion of "knowledge workers" in the labour force is one measure of the knowledge-intensity of the economy (see Box 2). This figure is over 30% for all the most developed economies. For the Latin American Economies and the Asian Fast-Growing Economies, the proportion of knowledge workers lies between 9% and 20% of the labour force.

This correctly suggests that all the APEC economies are already to some degree knowledge-based, but that these two groups are significantly further away from being fully developed KBEs than the Most Developed Economies. There is also evidence to suggest that there is a broad correlation between economic development (measured by GDP per capita) and knowledge intensity (measured by the proportion of knowledge workers).

Box 2
Measuring the Knowledge-intensity of an Economy

There are very few published indicators that directly measure the extent to which a country is already operating as a KBE, as distinct from its capacity to become a KBE. A revealing indicator would be the proportion of current economic activity in an economy that is in some sense "knowledge-intensive". This proportion could be measured either by the amount of money involved, or by the number of people involved. These two possibilities respectively correspond to:

- the percentage of GDP contributed by "knowledge-based industries"
- the percentage of the labour force that consists of "knowledge workers".

It is important to realise that the extent to which a particular industry is "knowledge-intensive" is one of degree rather than a binary (yes/no) distinction. Nevertheless, for practical purposes, OECD (1999) groups high-tech and medium-high-tech manufactures, together with community, social and personal services, financial and other business services, and communications services as *knowledge-based industries* (KBIs). Using this definition, the contribution of KBIs to GDP is over 40% for the Most Developed Economies of Australia and Canada, and for the High Performing Asian Economies of Korea and Singapore. However, such data are not yet available for other APEC economies.

We can consider a "*knowledge worker*" to be one whose work lies primarily in the manipulation of symbols, and with a strong requirement for specialised knowledge. Operationally, for purposes of this paper, we classify as a "knowledge worker" anyone whose occupation is reported to the International Labour Organisation (ILO) as falling into any of the following categories: managers and senior government officials, professional workers, or "associate professionals".[iv] Since the ILO classification is based on what a particular worker (occupation) actually does, and not on what industry they work in, it gives an independent perspective from that based on classifying particular industries as "knowledge-based". But the major advantage of this indicator is that ILO Statistical Yearbooks yield a data set which gives reasonably comparable and readily available information for most APEC (and other) economies over several decades.[v]

Economy Comparisons

The characteristics of the sample APEC member economies relating to their performance as KBEs are summarised here.[vi]

The report presents sets of quantitative indicators in an attempt to capture the general stage of development of the sample APEC member economies relative to a fully developed knowledge-based economy, and the economies' current potential to become KBEs. The indicators are divided into groups corresponding to the four key dimensions of a KBE listed above, namely business environment, ICT infrastructure, innovation system, and human resource development. For all the indicators used, bigger values are "better" (more like a KBE).

This presentation emphasises the overall message of a group of related complementary indicators, such as those on innovation system. While each indicator in the group gives only a partial impression of the innovation system, the group as a whole gives an overall impression which is appropriate for the qualitative comparison between groups of countries.

Part 1 of the report shows that the indicators for Canada and Australia[vii] mostly cluster around the OECD average. This is not surprising as both are mid-range OECD countries in terms of most economic and social indicators; that is, they are typical of long industrialised economies. Both are relatively strong in ICT infrastructure, but fall below the OECD average in high-technology exports and foreign direct investment. The US is by far the largest economy in APEC and one of the most thriving "new economies", drawing particular dynamism from its ICT sector.

The indicators for both Korea and Singapore[viii] are similar to those for Australia and Canada, which suggests that the High Performing Asian Economies are comparable to the Most Developed Economies in APEC in their movement towards a KBE. This is closely related to the explicit and well-resourced national strategies of both Korea and Singapore to become KBEs, a "natural" evolution from the industrial strategies they have successfully pursued. Although the data suggest that Korea lags behind some of its competitors in ICT infrastructure, Korea has been devoting much of its resources to improving this aspect since 1997. Both Korea and Singapore have already committed substantial resources to building their base in education, science and ICT infrastructure, and this is reflected by the indicators. The experience of the High Performing Asian Economies suggests that wider and deeper education is the key precondition before the other aspects can take off. The relatively low score for patents from Singapore and the relatively high score for Business Expenditure on Research and Development (BERD) in Korea reflect the differing approaches these countries have taken towards the acquisition of new technology, with Singapore drawing more on multinational companies.

The indicator profiles of the Asian Fast-Growing Economies and the Latin American Economies[ix] are broadly similar to each other, but markedly different from the Most Developed Economies and the High Performing Asian Economies. In particular, a significant lag is apparent in ICT infrastructure, human resource development, and in indicators of the innovation system. From the case study of Chile, it appears that liberalisation of the telecommunications sector is leading to increased uptake of ICT, but the science and technology and innovation effort could be improved. School enrolment

rates in both groups are still relatively low, although they appear to be somewhat higher in the Asian group, while gross expenditure on research and development (GERD) appears lower. Malaysia's ICT indicators are notably higher than any other country in either group, reflecting a strong policy thrust in this field.[x]

Notably, the indicator "Exports of high technology products" is particularly high for Thailand, the Philippines, Singapore and Korea. However, this is somewhat deceptive since only in the latter two economies is substantial value added to these electronic products. Foreign direct investment (FDI) is particularly high in both Singapore and Chile as a consequence of conscious policy decisions to put the relevant framework policies in place.[xi] By substantial effort to develop linkages in all four KBE dimensions, Singapore has gained considerable new technology from this source and leveraged it to build industries with a strong local technological base. However, many other countries have had less success in fully acquiring knowledge from this source.

The indicators of business environment suggest that several of the Asian economies in particular have room for improvement in corporate financial transparency and in openness to domestic and international competition. Despite a general trend to liberalisation, many APEC economies could benefit from greater competition, especially in telecommunications. Those that have opened this sector to competition (for example, Australia and Chile) have obtained marked benefits in the form of wider access and lower prices.

Preconditions for a KBE

Basic education is a long-term investment, without which a KBE is unsustainable. In a fully developed KBE, high quality education services that are both widely available and widely used are a major priority for the economy and society. Without this background it is virtually impossible to build the other elements of the national knowledge base (such as R&D) to the level needed by a KBE. A major responsibility of government is therefore to ensure that such education services are in place. Secondary enrolment in both the Asian Fast-Growing Economies and the Latin American Economies falls well short of this precondition for a KBE, though some of those economies are making serious efforts to improve this.

ICT can be seen as an enabling technology for a KBE. Advanced information systems bring down the cost of information, facilitate access to wider pools of information, and promote the spread of ideas. Accordingly, a fully developed KBE has an advanced communications network and a policy and regulatory framework that encourages competition and supports the development and use of information hardware and applications. Because of the centrality of digitised information in a KBE, the telecommunications infrastructure in a KBE needs to include high bandwidth communication (which allow for the possibility of online video, and health and education services). The Most Developed Economies and the High Performing Asian Economies have the requisite policy framework in place, but continuous substantial investment is needed to bring these goals to fruition (for example, Internet penetration is still below 50% in all the case study economies). A few other APEC economies have appropriate policies in place, but have a long way to go in implementing them.

Because ICT technology is evolving, the infrastructure has to be renewed and upgraded decade by decade. This opens up the possibility for an economy to save on the cost of investment in one level of technology and go directly to a more advanced level (for example, going directly to mobile telephones without a widely wired network). Chile and Thailand appear to have pursued this route.[xii]

No nation has a monopoly on good ideas. The growth of a nation's knowledge base - including its widening into new fields - depends critically on its culture being open to new ideas, and especially to new ideas from outside. This is a precondition for a KBE.

A KBE can flourish only if the social, political, economic and legal framework of the economy is conducive to the development of the characteristics described above. In a KBE, an open environment for trade and investment helps create an incentive for innovation and allows for the implementation of technologies involving significant scale economies. A significant effort is also made to ensure that technology brought into the economy through foreign investment becomes a real and active part of the local knowledge base, through conscious adaptation and technology transfer. At the same time, support is available to encourage research into more general areas of knowledge development. The policy and institutional environment of a KBE promotes a beneficial spillover by encouraging interaction and cooperation among researchers in different institutions, disciplines and industries.

It also entails a policy and social framework which is attractive for investment in the future, but which handles structural transitions with social sensitivity. This covers such aspects as a competitive but fair regulatory environment for business, transparency of government and company reporting, an accepted rule of law, low inflation and interest rates, and a "safety net" which assists people to adapt to new social and economic structures without social turbulence.

3. POLICIES FOR PROMOTING THE DEVELOPMENT OF KBEs

Having identified the major policy challenges that APEC economies must address in their efforts to become KBEs, the following discussion focuses on identifying interesting and potentially exemplary policies that have been adopted to build the infrastructure of a KBE. The discussion distinguishes between economies at different stages of development, although it is recognised that there are differences among the economies within each group. Moreover, while economies can learn from APEC members at the same stage of development, they can also usefully draw on the experience of those at other stages.

Most Developed Economies

The most developed APEC economies must fill certain gaps in their policy frameworks and respond to new priorities associated with the increased importance of knowledge-based activities. Through their advanced educational systems, and carefully designed marketplace, macroeconomic and technology policies, the Most Developed Economies have addressed many of the most important requirements of a high quality innovation infrastructure. There remains scope for new policies that improve schooling outcomes and facilitate the transition to a system of lifelong learning. Although these economies have created a favourable business environment, the development of competitive and efficient tax systems is a continuing challenge. The establishment of policies that support

innovation and that foster the growth of ICTs also remains a focus of attention in these economies, although, in both of these areas, a number of significant policies have been introduced in recent years.

Australia and Canada, the two Most Developed Economies examined as case studies, have implemented a number of interesting policies to help strengthen their innovation infrastructures. These include policies to help students and families finance higher education (the Canadian Opportunities Strategy and Australia's Higher Education Contribution Scheme), and to facilitate and promote the use of ICTs (for example, The Canadian Electronics Strategy, SchoolNet, and Australia's Electronic Transaction Act and Information Technology Online programme). Science and technology policies have focused on strengthening links within the innovation system and increasing returns from these economies' limited investment in R&D. These objectives have been pursued through programmes such as Australia's Cooperative Research Centre initiative and Technology Diffusion Programme, and Canada's Networks Centre of Excellence and Industrial Research Assistance Programme.

High Performing Asian Economies

Important factors in the success of the High Performing Asian Economies (HPAEs) have been these economies' commitment to increasing educational access and to promoting efficient knowledge acquisition and use. The Asian financial crisis, however, brought to light weaknesses in some of their framework policies, most notably in Korea's capital market laws and institutions, and its corporate governance framework. These economies are also facing pressures to adjust their development strategies in the light of new market circumstances. It is becoming more difficult for firms to rely on licensing and reverse engineering, for example, because they are approaching the technological frontier in a number of fields.

There are lessons to be drawn both from recent policy initiatives of the HPAEs and from earlier policies that helped lay a foundation for the strong growth these economies have experienced. Among the latter are the successful government efforts in Korea and Chinese Taipei to raise rates of educational attainment. In Chinese Taipei, the Industrial Technology Research Institute has long made a significant contribution to technology acquisition, and for many years, the government has successfully promoted the development of industrial clusters that can facilitate technology spillover. More recent initiatives of note include Korea's efforts to reform its banking legislation and corporate governance regulations, and Singapore's efforts to promote knowledge-based growth through focused policies on human resource (Manpower 21) and technology commercialisation (Technopreneurship 21). The HPAEs are giving importance to the development of advanced information infrastructures, with Korea focusing on its Cyber 21 programme and Singapore completing its plan to create an "intelligent island".

Asian Fast-Growing Economies

Compared to the Most Developed Economies and the HPAEs, the Asian Fast-Growing Economies (AFEs) are at a relatively early stage in developing the infrastructure of a KBE. The AFEs must address a number of shortcomings, including: inadequacies in their market framework laws; limited access to post-secondary and tertiary education; deficiencies in their telecommunications systems and in other infrastructure facilities; and

weaknesses in their ability to adapt and utilise modern technologies. The AFEs are making progress in reforming their banking and capital market policies, and they are introducing new market framework policies in areas such as competition policy and intellectual property rights, but they have much to learn from policies of more developed APEC economies. At the same time, the AFEs' experiences in enlisting private initiative and resources to build needed infrastructure is of interest. Other economies can learn from Malaysia's experience in working with multinational enterprises to build training centres, and from Thailand's and Indonesia's experience in using public-private partnerships to build telecommunications facilities. Malaysia's efforts to promote high-tech activities through the establishment of a Multimedia Super Corridor also bear watching.

Latin American Economies

The Latin American Economies (LAEs) confront similar challenges to those facing the AFEs, but they are somewhat better positioned as KBEs (relative to all AFEs except Malaysia) as a result of their greater access to foreign direct investment and the imports of knowledge and technology which such investment entails. Like the AFEs, the LAEs must expand the reach of their education and training, build their science and technology capabilities, and promote greater ICT use if they are to progress more rapidly as KBEs. While Mexico is still in the process of strengthening its market framework laws, Chile has addressed a number of the issues involved in creating a favourable business environment. Other economies may learn from the banking reforms it implemented in the mid-1980s, and from the stringent monetary policy it followed to help maintain capital market stability over the subsequent period. Although the LAEs trail behind more advanced economies in their human resource policies, Chile's programmes to improve school outcomes merit examination. Mexico's recent implementation of a national system of competency standards to enhance training and technical education and facilitate labour mobility also deserves attention.

4. POTENTIAL FOR COOPERATION IN PROMOTING KBEs IN APEC

Drawing on the policy directions set out above, we can identify potential for cooperation in promoting KBEs in APEC. In order to draw specific policy recommendations for APEC, we focus on the four key dimensions related to promoting a KBE: business environment, innovation systems, human resource development, and ICT. For each dimension, we identify potential areas of cooperation, related APEC activities, and impediments to cooperation. Directions of APEC actions for each area are suggested that might fruitfully be pursued through relevant APEC technical working groups and other forums.[xiii]

Business Environment

A knowledge-friendly business environment is essential to promoting a KBE where the key players are entrepreneurs. In order to enhance private sector initiatives, it is important that the legal frameworks of the APEC member economies promote (and do not stifle) knowledge, ideas and innovation, and ensure macroeconomic stability. The following directions are suggested for possible action by relevant APEC working groups:

(1) Trade, Investment and Legal Systems: pursue multilateral agreements for FDI facilitation in the region, improve the level of automation of investment-related documentation, create an investment promotion body to generate and distribute "best practices" in legal systems.
(2) E-commerce: improve the level of related infrastructure in each economy, establish and coordinate legal systems pertaining to e-commerce, establish "e-payment systems".[xiv]
(3) Policy coordination: improve the computerisation level within APEC economies and build a computer network among governments, improve efficiency in contents management through standardisation of ICT area, establish a broadband network in APEC using the World Wide Web, coordinate policies for promoting Small and Medium Enterprises (SMEs) in APEC economies, establish programmes (including education and training) to assist developing member economies to move towards KBEs.

Innovation Systems

Innovation increasingly relies on the interaction between the knowledge base and the business sector. Moreover, the rapid progress of globalisation makes the innovation systems of national economies closely interdependent. In this context, challenges which APEC member economies can address collectively include: cooperating in basic research, identifying and disseminating non-technology-based knowledge of developing economies to promote innovative systems of more developed economies, sharing best practices in strengthening innovation systems, enhancing networking between firms and public institutions, providing the right climate for business innovation, and creating an APEC system for promoting flows of knowledge about innovations and innovation systems.

Human Resource Development (HRD)

In the transition to a KBE, the demand for intellectual workers with professional knowledge and creative minds increases rapidly. In order to adjust to this new trend in the labour market, it is important to invest in and develop human resources. HRD stabilises the labour market by reducing the knowledge gap among its constituents. HRD continues to be an important subject for APEC's activities in economic and technical cooperation (ECOTECH). In spite of the potential for cooperation, however, the vast differences in labour market structures and systems among APEC member economies impede substantial progress in this area. Potentially fruitful directions in which APEC's cooperative actions in HRD could be reinforced include: enhancing HRD assistance in developing economies through the internship of young IT experts from other economies; increasing assistance in training by large private companies (the 'Fortune 100 in APEC'); establishing a labour market information system and fostering linkages between learning and work, improving skill development through cooperation and participation; expanding e-education programmes; and strengthening linkages between the APEC working groups on HRD and services.

Information and Communication Technology (ICT)

In the creation, diffusion and application of knowledge, the competitive edge of a firm or nation is critically affected by the state of its ICT. In order to close the knowledge gap among the APEC member economies, specific measures of cooperation in the area of ICT

would be required, including: production of APEC ICT-related statistics; provision of a database of country-specific information; promoting the development of international intellectual property rights; support for international networking of medical and educational institutions; and effective propagation of the results of projects undertaken by APEC Telecommunications Working Group (though the proposed Knowledge Clearing House).

5. ACTION RECOMMENDATIONS FOR COOPERATIVE DEVELOPMENT OF KBEs IN APEC

Drawing on the above examination of potential areas of cooperation within APEC, the Economic Committee makes three specific recommendations for action. As regards the implementation of these recommendations, the lead economies of the Task Force will continue to take a leading role and propose detailed projects to be undertaken by relevant APEC fora.

1. Establishment of a 'Knowledge Clearing House'
2. Generation of 'Igniting Policies' for triggering the transition to KBE
3. Inclusion of 'KBE Status Indicators' in the APEC Economic Committee's 'Economic Outlook'

Recommendation 1: Establishment of a 'Knowledge Clearing House'

Purpose. APEC Knowledge Clearing House (KCH) aims to facilitate the exchange of various types of knowledge (including statistical data, know-how, manuals, guidelines, et cetera) pertaining to the development of a KBE among member economies. By creating an APEC-wide knowledge network first on the Internet, KCH will play the role of a focal point or information centre in the knowledge flows within APEC.

Potential Benefits. KCH is expected to reduce the knowledge gap between the developed and the developing economies in APEC. While the benefits to knowledge-receiving economies are rather obvious, knowledge-giving economies will also benefit from KCH by increasing the dissemination and utilisation scope of their existing knowledge. They can also learn how the other economies tailor their knowledge to suit local conditions, and thus avoid incurring their own cost of search and trial and error.

Recommendation 2: Generation of 'Igniting Policies' for Triggering the Transition to KBE

Purpose. This report provides ample information regarding the preconditions of and policies for KBE development. However, for an economy to actually trigger its transition to a KBE, what should the economy do on the first day? To be responsive to such realistic challenges that many economies will face, APEC needs to provide a more concrete set of action plans. Building on the diverse experiences of member economies, APEC can take the initiative to generate a "menu set" consisting of such igniting policies.[xv] Interested economies will be invited to evaluate them and choose policies for adoption.

Potential Benefits. Some igniting policies which were proved to be effective in other economies will provide a good reference point for policy choices, thus reducing search and investigation costs. A good example is Korea's five-year economic development planning that was successfully adopted by several Southeast Asian and Middle East

economies. APEC should also make the igniting policies sensitive to the local idiosyncratic differences of the member economies so that potential benefits are fully realised.

Recommendation 3: Inclusion of 'KBE Status Indicators' in the APEC Economic Committee's 'Economic Outlook'

Purpose. Using KBE Status Indicators, APEC provides information on how APEC is progressing towards KBE, both collectively and individually.

Potential Benefits. KBE Status Indicators have various potential benefits. First of all, they will provide valuable information as to how effective APEC's cooperative efforts are in making progress towards KBE in a given year. For individual economies, by comparing their progress with the previous year(s), a progress check can be done as well. Also, by observing how some economies are progressing faster than others, APEC as a whole can start to learn their formula for success, for possible later adaptation by other economies.

Technical Notes

[i] *The Economist*, 20 Feb 1999.

[ii] See working papers prepared for this project by Industry Canada and OECD, *A new economy? The role of innovation and information technology in economic growth*, Paris (July 2000)

[iii] APEC Studies Association of Korea (1999), *The Promotion of Knowledge-based Industries in the APEC Region*. Report of seminar proceedings, Seoul, Korea, 17-18 June 1999 [available from Ministry of Foreign Affairs and Trade, Seoul]

[iv] This definition is identical to what OECD (1998) refers to as "skilled white-collar workers". A complication is that some countries report their occupational data to ILO using a slightly different categorisation (ISCO-68 instead of ISCO-88). The adjustments made to allow for this are described in Appendix 2 of the full report.

[v] For a more detailed discussion, see Part 1 Chapter 3 and Appendix 2.

[vi] Specification of the indicators used to characterise the APEC sample economies is found in Table 3.2, Part 1 Chapter 3.

[vii] See Part 1 Chapter 4.

[viii] See Part 1 Chapter 5.

[ix] See Part 1 Chapters 6 and 7 respectively.

[x] The full report includes indicator profiles, not only for those economies studied in detail as case studies, but also for several other economies (US, Japan, Chinese Taipei, Malaysia, China, and Mexico).

[xi] For detailed discussion of comparisons amongst the case study economies, see Part 1 Chapter 8.

[xii] However, in general, economies - especially developing countries - need to exercise caution in adopting leading-edge technologies whose reliability has not been demonstrated elsewhere.

[xiii] Further detail of both current and possible future actions is given in Part 3 of this report.

[xiv] Establishment of e-payment systems is to be examined thoroughly in the Finance Minister's Process.

[xv] The policies discussed in Part 2 of the full report give a good start for this process.

GLOSSARY OF ACRONYMS AND KEY TERMS

ACTETSME	APEC Center for Technology Exchange and Training for Small and Medium Enterprises
APEC	Asia-Pacific Economic Cooperation
APEC KCH	APEC Knowledge Clearing House
ASEAN	Association of Southeast Asian Nations
ATCEG	Agricultural Technical Cooperation Experts Group
ATL	Accelerated Trade Liberalisation
BDC	Business Development Bank of Canada
BERD	Business Expenditure on Research and Development
BSFG	Business Facilitation Steering Group
BTO	Build-Transfer-Operate
CAP	Collective Action Plan
CAT	Communications Authority of Thailand
CRC	Cooperative Research Centre (Australia)
CORFO	Chilean Economic Development Agency
CTI SCSC	CTI Subcommittee on Standards and Conformance
DCGS	Development Cooperation Steering Group
ECOTECH	Economic and Technical Cooperation
EDB	Economic Development Board (Singapore)
EDI	Electronic Data Interchange
ESC	Ecotech Subcommittee
EVSL	Early Voluntary Sectoral Liberalisation
FDI	Foreign Direct Investment
FEEEP	Food, Energy, Environment, Economic Growth and Population Project
FSC	Financial Supervisory Commission
FTH	Fibre-to-Home
GERD	Gross Expenditure on Research and Development
HDI	Human Development Index
HPAE	High Performing Asian Economies
HRDF	Human Resource Development Fund (Malaysia)
HRD WG	Human Resources Development Working Group

HRD SG	Human Resources Development Steering Group
IAP	Individual Action Plan
ICT	Information and Communication Technology
IEG	Investment Experts' Group
IIF	Innovation Investment Fund (Australia)
IST WG	Industrial Science and Technology Working Group
IT	Information Technology
ILO	International Labour Organization
IPEG	Intellectual Property Rights Experts' Group
IPR	Intellectual Property Rights
IMF	International Monetary Fund
IRAP	Industrial Research Assistance Programme (Canada)
IST WG	Industrial Science and Technology Working Group
ITRI	Industrial Technology Research Institute (Korea)
KBE	Knowledge-Based Economy
KBI	Knowledge-Based Industry
KW	Knowledge Workers
LMI	Labor Market Information Framework
LSG	Trade Investment Liberalisation Steering Group
MAG	Market Access Group (established 1998)
MITI	Ministry of International Trade and Industry (Japan)
MNC	Multinational Corporation
MOFE	Ministry of Finance and Economy (Korea)
MOST	Ministry of Science and Technology (Korea)
MNE	Multinational Enterprises
MRA	Mutual Recognition Agreement
MSC	Multimedia Super Corridor
MTDP	Medium-Term Philippine Development Plan (Philippines)
NAFTA	North American Free Trade Agreement
NCE	Network Center of Excellence (Canada)
NGO	Non-Governmental Organisation
NTMs	Non-Tariff Measures
ODA	Official Development Assistance

OECD	Organisation for Economic Cooperation and Development
PDF	Pooled Development Funds (Australia)
PLGSME	Policy Level Group on Small and Medium Enterprises
PLDT	Philippine Long-Distance Telephone Company
R&D	Research and Development
S&T	Science and Technology
SME	Small and Medium Enterprises
SOM Taskforce	Senior Officials Meeting Taskforce
STAND	Science and Technology Agenda for National Development (Philippines)
STMP	Science and Technology Master Plan (Philippines)
TDB APEC	Tariff Database
TEL WG	Telecommunications Working Group
TFP	Total Factor Productivity
TILF	Trade and Investment Liberalisation and Facilitation
TNC	Transnational Corporation
TOT	Telecommunications Organisation of Thailand
TRIPS Agreement	Trade-Related Aspects of Intellectual Property Rights Agreement
UMAP	University Mobility in the Asia-Pacific
WCY	World Competitiveness Yearbook
WTO	World Trade Organisation
XML	Extensible Markup Language

PART I

TOWARDS KBEs: PRECONDITIONS AND ASSESSMENTS

1. INTRODUCTION

Knowledge is becoming an increasingly important stimulant of economic growth all over the world, but most noticeably in the more developed economies.

President Kim Dae-jung of Korea put this idea explicitly in the APEC leaders' meeting in September 1999:

> In the industrial age of the 20th century, the dominant ingredients in production were tangible ones such as capital, labour and natural resources. But as we move into the new century, it is increasingly the intangible factors that matter most as new sources of growth potential, such as knowledge, information, and cultural character.

Consistent with this interest from APEC Leaders, the Economic Committee of APEC has a programme to examine the implications for APEC members of this trend towards a "Knowledge-Based Economy" (KBE), including examining the extent to which member economies have moved towards this state, and what measures might be available to help them do so both individually and collectively

The KBE has already attracted a considerable literature, especially in OECD economies, some of which is summarised in the full report. The empirical evidence suggests that among the more advanced economies of the world, economic growth is most sustainable for those which have all of the following characteristics:

- Innovation[1] and technological change are pervasive and supported by an effective national innovation system (that is, a network of institutions in the public and private sector whose activities and interactions initiate, import, modify, and diffuse new technologies and practices).
- Human resource development is pervasive: education and training are of a high standard, widespread and continue throughout a person's working life (and even beyond).
- An efficient infrastructure operates, particularly in information and communications technology (ICT), which allows citizens and businesses to readily and affordably access pertinent information from around the world.
- The business environment is supportive of enterprise and innovation. (The term "business environment" includes the economic and legal policies of government, and also the mix of enterprises operating in the economy.)

The strong performance of the "Asian tiger economies" over the last few decades has likewise ridden on strengths in all four of these dimensions, whereas (as we shall see) those APEC economies which are still at a lower level of economic development have been weaker in at least one of these dimensions.

But these dimensions are precisely those that characterise a knowledge-based economy. In short, it is becoming ever more the case that the most successful economies are those that are closest to being KBEs. In this context, being a KBE means more than simply having a thriving "new economy" or "information economy" that is somehow separate from a stagnant "old economy". In a truly knowledge-based economy, all sectors have become knowledge-intensive, not just those usually called "high technology". Reflecting this last point, we slightly expand the OECD definition to define a *knowledge-based economy* as

one in which the production, distribution, and use of knowledge is the main driver of growth, wealth creation, and employment across all industries.

Knowledge comprises many forms, including "knowledge of", "knowledge about", "knowledge of how to", "knowledge in words", and "knowledge without words" (visual, tactile et cetera.). It is primarily personal - the totality of what a person knows. But, by an important extension, one can speak of the knowledge possessed by an organisation, which is much more than the information written in its files, and includes its culture, the way in which people interact within the organisation, knowledge about the contacts they use to gain information from outside, and so on. These categories are often distinguished as *codified knowledge* (that which is formally recorded, in writing or otherwise) and *tacit knowledge*, which is only in someone's head. The organisation's knowledge consists of its capability in integrating information with experience and expertise to take action.

Thus, information communicated to a person or organisation becomes part of their stock of useable knowledge only if it is learnt and assimilated by them. This assimilation is no mean feat; as one wit put it: "Today we are drowning in information but starving for knowledge".

Part 1 of this APEC report aims to:

- select a set of characteristics and indicators which relate to the development towards a KBE;
- examine these characteristics across a representative range of APEC economies; and
- identify which of these characteristics are in fact preconditions, as distinct from consequences, of a KBE.

All of these terms are defined more fully below. To this end, Part 1 is organised as follows:

Chapter 2 considers the characteristics of an idealised and fully developed KBE (which does not exist anywhere yet). These characteristics are considered in a qualitative way under the four key dimensions identified in the Introduction and Framework to the whole report, namely:

- innovation system,
- human resource development,
- information and communications technology infrastructure, and
- business environment.

This discussion brings out many general points about a KBE, such as its openness to new ideas and enterprises, the importance attached to education and lifelong learning, and the enabling role of its information and communications infrastructure.

The discussion is brought down to earth in the following chapters by examining these same characteristics with reference to actual APEC economies.

Chapter 3 shows how a set of quantitative indicators can be chosen to give some measure of how an actual economy stacks up along each of the four KBE dimensions.

For the purposes of this report, the APEC economies have been divided into four groups as follows:

Chapter 4: the Most Developed Economies (with Australia and Canada as case studies),

Chapter 5: the High Performing Asian Economies (with Singapore and Korea as case studies),

Chapter 6: the Asian Fast-Growing Economies (with Philippines and Thailand as case studies), and

Chapter 7: the Latin American economies (with Chile as a case study).

These groupings are similar to those used in much of the economic literature about the region, being mainly based on GDP per capita, with some allowance for geography and history.

In this paper, a *characteristic* is a qualitative description of one aspect of an economy (for example, secondary education). Each of the four key dimensions of a KBE embraces a bundle of characteristics. An *indicator* is a quantitative measure of a characteristic (for example, the percentage of an age cohort completing secondary education). A *precondition* is a characteristic which needs to be in place before an economy can become a KBE.

Since the case studies use quantitative indicators, and in order to keep the data requirements manageable, a sample of APEC economies was chosen in which all the groups are represented. However, the focus of the paper is on qualitative and conceptual issues, rather than on comprehensive statistical data. The quantitative indicators (tabulated in a Statistical Appendix) are primarily there to illuminate the conceptual analysis, which attempts to generalise as far as possible from the case studies to other similar countries.

The comparison between the mythical fully developed KBE ("Nikuda") and the real APEC economies should highlight the preconditions required in order for economies at different levels of development to progress towards a fully-fledged KBE. Chapter 8 attempts to pull together such conclusions.

2. *NIKUDA* - CHARACTERISTICS OF AN IDEALISED KBE

2.1 Introduction

Before examining the knowledge-intensity of some representative APEC economies in later chapters of this paper, it may be helpful to examine what would characterise a fully developed or idealised KBE. For convenience, we shall refer to this mythical economy as *Nikuda*.[2] To facilitate comparison with real APEC economies, Nikuda is described as though it is a nation state. However, since globalisation is one of the key drivers of the trend towards a KBE, Nikuda can also be thought of as a representative part of a wider future global (or perhaps, regional) knowledge-based economy.

In examining the characteristics of an idealised KBE within the four dimensions set out in the Introduction and Framework chapter, it seems natural to start from its innovative enterprises, that is, those that actually use the knowledge productively. The enterprises draw upon public and private R&D, on each other's knowledge, and on mechanisms that enable them to tap into knowledge from outside.

Together these constitute the *national innovation system*. Equally clearly, a KBE has to have a skill base from which these enterprises can draw, and which is continually upgraded to match technological and other developments - in short, a strong system of *human resource development*. The pace of technology diffusion and (more generally) the move towards KBEs has been accelerated in recent years by the spread of information and communication technologies (ICT); this set of characteristics of a KBE is grouped here as *ICT infrastructure*. Moreover, for innovative enterprises to thrive, the broader economic and social environment (that is, the *business environment*) must be conducive to a culture of enterprise.

In examining the characteristics of a KBE, we shall attempt to indicate how they bear on the acquisition, creation, dissemination and use of knowledge. We may also consider whether a particular characteristic is a "precondition" - an essential - for a KBE or whether it is more of a consequence. However, this latter discussion will be pursued more fully in subsequent chapters, in the context of economies at differing stages of development toward a KBE. It emerges that most of the characteristics are necessary but not sufficient to produce a KBE.

The characteristics examined are listed in the summary Table I-2-1 (at the end of the chapter), together with an indication of their state in an idealised KBE.

This chapter makes many assertions about a KBE without much explicit documentation of the literature that lies behind them. Some of the discussion in this chapter draws without further acknowledgment on a paper from Canada by Gera, Lee-Sing and Newton (1998) entitled "The emerging knowledge-based economy: trends and forces".

2.2 Business Environment

Since a KBE can flourish only when the broad culture is one that is conducive to enterprise and innovation, many of the structural, legal, and social characteristics of Nikuda reflect such a culture.

This entails an openness to new ideas, whether from inside or outside Nikuda, and a commitment to the development and productive use of new knowledge, broadly defined. At the same time, support is available to encourage research into more general areas of knowledge development where intellectual property rights cannot reasonably be established and enforced. The policy and institutional environment promotes the beneficial spillover from encouraging interaction and cooperation among researchers in different institutions, disciplines and industries.

It also entails a business environment which is attractive for investment in the future. This covers such aspects as a competitive but fair regulatory environment for business, transparency of government and company reporting, an accepted rule of law, and reasonably low inflation and interest rates - all of which are necessary for a prosperous economy of any kind, whether knowledge-based or not.

2.2.1 "Knowledge-Based Industries"

In the KBE of Nikuda, all industries are to a greater or lesser extent Knowledge-Based Industries (KBI). Industries which by their very nature are knowledge-intensive, wherever they may be located, include aircraft manufacturing and consulting services.

The former is knowledge-intensive in the sense that a substantial proportion of its total cost of production lies in research and development and design. Similarly the essence of consulting services is that the consultant brings to bear his special knowledge; this intangible is the principal asset of the service provider.[3]

A capacity in biotechnology is an enabling factor in increasing the knowledge-intensity, and hence the productivity and profitability, of a country's biologically-based industries, notably agriculture and pharmaceuticals. Since in almost all economies (except the city states) agriculture is still an essential industry, this makes biotechnology an important enabling technology, even if not quite as pervasive as ICT.

Indeed, in Nikuda, as a fully developed KBE, most primary and conventional industries - such as agriculture, mining, ceramics,[4] textiles, and electronics - are strongly knowledge-based. Even some traditional or indigenous wisdom or cultural assets could be considered as KBIs. These last two categories may or may not be knowledge-intensive in a particular economy today. Indeed, it is important to realise that the extent to which a particular industry is "knowledge-intensive" is one of degree rather than a binary (yes/no) distinction.

Moreover, some of the "high technology" industries are more essential to a KBE than others. For example, a country does not have to have an aerospace manufacturing or a ceramics manufacturing industry to be a KBE, whereas the essentiality of ICT services as part of the infrastructure of a KBE has been emphasised repeatedly.

2.2.2 Convergence of Sectors

Hirschhorn (1988: 380) observes:

> The service and goods sectors are converging. While services are industrialised - service companies are capitalising their workers while applying cost accounting and productivity measures inherited from the manufacturing world - manufacturing systems become increasingly like services. The convergence of the two and the new relationship between them are the best indicators of the emerging post-industrial economy, that is, of a KBE.

While it is difficult to discern this trend from economic data organised by the old-fashioned ISIC classification, whose conceptual basis is on what goods a firm ultimately produces rather than the activities by which it does so, the conclusion is unavoidable: that a modern economy is in large part a knowledge-based economy.

2.2.3 Investment

In Nikuda, a very substantial proportion of investment goes into the knowledge base and the associated infrastructure (including the ICT infrastructure). This includes both public and private investment.

This investment has an opportunity cost since knowledge is not free; economies have to forego current consumption to pay for the development of knowledge, including for the long-term investment in basic without which a KBE is unsustainable.

2.2.4 Openness

No nation (economy) has a monopoly on good ideas. The growth of Nikuda's knowledge base - including its widening into new fields - depends critically on its culture being open to new ideas, and especially to new ideas from outside. This is a precondition for a KBE. Landes (1998) gives several historical examples of nations that fell from prosperity principally because they saw their knowledge base as a closed system.

Closely related to an openness to new ideas is an openness to new people - in particular skilled immigrants and 'outsiders' (people outside the dominant group). For example, the United States benefited hugely from the forced exodus of Jewish scientists from Nazi Germany, and continues to gain from the numerous research students who come from around the world, many of whom remain working in the US after graduation.

2.2.5 International Orientation

The economic development literature shows a clear link between an outward, international orientation and the process of economic growth and development. When nations have moved towards autarky, growth slows; towards internationalisation, growth quickens - as illustrated by the economic histories of, for example, Japan, Korea, Singapore, and China.

For KBEs, international exposure is seen as a means of sustaining and growing domestic industry in a complex environment. Each economy aims to build international networks of complementary skills, analogous to those between firms, with an emphasis on communication and knowledge transfer rather than simply on price competitiveness.

It is not so much the goods traded but the ability to learn from the activity which becomes a key issue for policy. Traded goods represent codified knowledge. But in a KBE, the receptivity to flows of codified knowledge has to be complemented by an ability to process it. The ability to do so rests on the accumulated tacit knowledge of the economy (representing an investment in human capital), and how well it is mobilised (Rooney and Mandeville 1999).

Foreign direct investment (FDI) is an indicator of confidence (by overseas investors) in the capacity of an economy to produce a return on investment, and is also a measure of one kind of openness. If FDI is high, it suggests that the economy is heading in the right direction. However, while FDI may bring in new technology and knowledge, the presence of foreign investment does not necessarily imply a KBE. For example, rich mineral deposits may attract FDI - but lead only to a "quarry" economy. Indeed, the theory of comparative advantage can be taken to suggest that a country with such resources may be

better off with its economy in quarry mode than in knowledge-intensive mode. However, such a position may be tenable only in the short to medium term, unless the country concerned uses the cash flow from its natural resources for investments which facilitate its progress to a widespread modern economy.

Similarly, an indicator of economic prosperity and openness is when an economy has inward and outward trade comprising significant proportions of its GDP. Such openness to trade (especially if in both directions) tends to be associated with the openness to new ideas required by a KBE. Large markets and an open trade environment help create an incentive for innovation and allow for the implementation of technologies involving significant scale economies.

Sustained protection of an inferior local product stultifies innovation, so that when the market does eventually open up, the local product is bypassed by consumers, and its stagnant producer goes out of business, often taking its workforce with it.

The role of openness, along with well-developed trade and investment links in both facilitating access to knowledge and creating the necessary conditions for adoption of the new technology is further illustrated by the remarkable manner in which Japan's technology caught up with that of the US after 1945, but not earlier. Nelson and Wright (1992) attribute the difference to the greater trade and increased international flow of financial and physical capital in the post-war era. As compared to the inter-war years, the post-war environment was more conducive to the international flow of technology, and to the adoption of capital-intensive processes that required access to large markets.
These examples suggest the importance of low tariffs and mutual recognition of standards that allow relatively free movement of goods that can compete on quality (that is, on the extent of their embedded knowledge).

2.2.6 Regulatory Environment for Business

There was wide agreement at Seoul (1999) that a key role of government is acting as the provider of an environment which promotes less regulated product markets, freer trade and investment, and more effective incentive systems. Thus, in Nikuda, government in general takes a neutral approach to the development of KBIs, which allows an open market in ideas and investment to select the precise path forward, within a broad framework set by government on behalf of society.

An economy's ability to take advantage of international knowledge transfers has been found to depend not only on its level of human capital development, but also on its rate of capital formation. In Nikuda, therefore, attention is devoted to encouraging investment, and strengthening institutional factors - such as the efficiency of capital markets and the state of the country's physical infrastructure - that may affect the investment process. In KBEs, there is recognition that where inadequacies in infrastructure or the structure of capital markets constrain or distort investment, technological change could in turn be significantly impaired.

For example, Nikuda has an active competition policy which actively discourages collusive and anti-competitive closed deals, and allows new and emerging enterprises (including those from overseas) to freely enter its markets.

At a more basic level, the rule of law and the culture of Nikuda removes the risk for investors of arbitrary seizure of their new ventures. Property, including intellectual property, is protected by law. However the rules for intellectual property have to balance the need for good ideas to be actually used against ensuring a fair return for inventors. Bad government practices such as arbitrary takeovers by government, price manipulation by monopolies, cronyism, and corruption discourage enterprise and innovation and have no place in a KBE. In general, since several APEC economies have experienced some or all of these impediments, APEC governments are striving to avoid them in future.

While the taxation system in Nikuda has to collect enough revenue to support the public knowledge infrastructure and other social requirements, it is designed and set at a level to encourage private investment in productive enterprises.

More positively, there is competition and diversity within the financial system. Competition ensures that new ventures can obtain finance on a fair basis at a competitive rate from a source not linked to their competitors.[5] Diversity (which usually follows from competition) helps to provide venture capital on the basis of knowledge potential (and not just on the basis of physical assets).

2.2.7 Transparency

Both the markets and the electorate require open, honest, transparent, consistent, and accountable reporting about the operations of companies and government in order to make informed decisions. The better the information available to governments and market participants, the more soundly based can be their policies and decisions, thus helping to make economies less vulnerable to shocks, panics and imbalances. Improved transparency contributes to a more efficient allocation of resources by ensuring market participants have sufficient information to identify risks, informing market expectations, contributing to the effectiveness of announced policies, and ultimately enhancing the stability of financial markets by assisting in the prevention of a build-up of financial and economic imbalances.[6] A particularly pertinent - and new - aspect of such reporting in a KBE is the measure of the intellectual capital held by an organisation. Information of all these kinds forms an important part of the knowledge base of Nikuda.
It is the responsibility of the government of Nikuda to ensure that the rules require such transparency in corporate governance. Insider trading and closed deals not open to competition are in the long run both economically inefficient and socially untenable.

The rules for e-commerce in Nikuda are essentially the same as for other forms of commerce. However since e-commerce, like other forms, relies on trust between the parties, there must be workable authentication and other technical procedures that protect against fraud.

2.2.8 Macro-economic Environment

The macroeconomic environment in Nikuda (interest rates, exchange rates et cetera) are set at appropriate levels to encourage investment and growth. For example, high inflation rates discourage investment in productive uses or in intellectual capital, since the future financial returns are discounted, but monetary settings designed to hold inflation to zero may stifle the availability of funds for such investments.[7] This is critical since the continuing innovation that is essential to sustain a KBE requires investment now in

marketing, new plants and equipment, and product development which will improve productivity and profitability in the future. Designing and implementing policies that encourage useful investment is a matter requiring considerable expertise, drawing on the relevant national and international knowledge base. The government has similarly to skilfully and knowledgeably manage the budget balance and the foreign exchange balance - the latter being especially difficult in the face of globalisation.

2.2.9 Societal Values

To survive in office, the government of Nikuda must operate broadly in accord with the prevailing values of its society. Drucker (1998) notes that in many developed countries, these values require that the key consideration on policy is its impact on society, with the state of the economy considered more of a restraint on policies rather than their major determinant. Thus, Nikuda is concerned with avoiding the social turbulence that can result if the economy grows overall but at the expense of throwing large numbers out of work, and thus out of perceived self-worth. It is in the nature of a KBE that industries rise and fall as the knowledge base and the resource base change. However, in a KBE, the knowledge base of the people involved is continually adapting as a matter of course - people do not feel locked in to a particular decaying industry or to its skill base. Thus, transitions in the economic structure of Nikuda are handled with social sensitivity, for example, by employing training programmes which enable displaced workers from superseded industries to move into the new areas of growth. Traditional forms of knowledge-based activity outside the narrow confines of traditional employment are valued by society in Nikuda, so that people's self-esteem is not tied to their employment (Jones 1985).

Related concerns were raised at the 1999 APEC Seoul workshop, which pointed out that in several countries, the emergence and growth of a KBE has resulted in widening income gaps within an economy and among economies. Thus the workshop concluded that "narrowing income gaps within an economy and among economies should become one of the major goals of government policy".

Indeed, at the heart of the interface between society and government, a democracy cannot function properly if the citizens are uninformed about the issues of the day and the quality of the candidates standing for office. As James Madison (1822) wrote prophetically in the early days of the United States:

> A popular government, without popular information, or the means of acquiring it is but a prologue to a farce or a tragedy, or perhaps both. Knowledge will forever govern ignorance.

In a KBE such dangers are avoided because all citizens have access to a wide range of media and information sources, including those from abroad.

2.3 Innovation Systems

2.3.1 Innovation and the Firm

Numerous economists and business analysts, especially in recent times, have characterised the capitalist system as a process of creative destruction, in which new improved products continually supersede the older versions. In an open market, and especially in a global

market, there are always competitor firms striving to take over one's market, and/or to create totally new products which change the nature of the market, and/or create whole new markets. As Foster (1986) puts it: "Successful companies believe… that as risky as innovation is, not innovating is even riskier".

Essentially *innovation* is "the application in any organisation of ideas new to it, whether they are embodied in products, processes, services, or in the systems of management and marketing through which the organisation operates" (Maguire, Kazlauskas and Weir 1994: 5). More colourfully, Drucker (1985) characterises innovation as "the art that endows resources with a new capacity to create wealth". The words "art" and "ideas" indicate that innovation is about productively using knowledge. This is more explicitly brought out by TASC (1988), who refute the old idea that a good science base is sufficient to assure innovation:

> Innovation is centrally an organisational and managerial issue because innovations are produced within organisations that transform knowledge.

Innovation is often a result of insights gained from marrying knowledge in different disciplines, different activities and different industries. There can be important benefits, therefore, from arrangements that promote cooperation and cross-fertilisation both within and between organisations. This suggests that in KBEs, efforts should be directed towards encouraging the sorts of interactions among organisations, researchers and technicians that can lead to new findings.

For firms, these findings raise questions about how to structure their operations to allow opportunities for fruitful interaction among workers with different expertise. (Flatter, less hierarchical structures, have been one response to this.) They also suggest the need to open channels of communication with users and to explore possibilities for cooperative research and development ventures with other organisations, including firms developing complementary technologies in other industries.

Thus in a KBE, firms are continually engaged in strategic alliances relating to particular projects. Networking between firms with complementary skills is a key feature, including networking up and down the value chain or supply chain. As Arthur (1996) puts it:

> In a knowledge-based world, players compete not by locking in a product on their own, but by building *webs* - loose alliances of companies organised around a mini-ecology - that amplify positive feedbacks.

Some of these webs extend internationally.

Successful firms in a KBE have a culture that encourages knowledge-sharing within the firm, so that the different parts do not operate in isolation. In many innovative firms, for example, some of their best ideas come from customers and suppliers, with the ideas passed to product developers through contacts made by sales and marketing people. The Japanese practice of rotating staff between different areas helps promote such a culture. Combined with the new technologies such as Intranet and groupware, these practices form the new tool of *knowledge management*, which also includes attention to both systematic and serendipitous ways of acquiring new knowledge from outside.

For the incoming stream of information to become part of the organisation's stock of knowledge requires the organisation to have the technical capacity to assimilate it, to put it into a context relevant to that organisation. Empirical evidence suggests that an organisation incapable of creating knowledge is likely to have a low capacity to acquire it from outside; both activities require the existing knowledge and the time of skilled people. For example, the knowledge embedded in a bought-in product is not in fact acquired unless the product comes complete with the information needed to produce it or to adapt it to the users' circumstances, and the recipient has the capacity to understand this information.

In short, the most successful firms in a KBE have systematically transformed themselves into "learning organisations". They have put in place structures that not only effectively gather and process codified information, but also tap the tacit knowledge, including the insights and intuitions, of workers. In keeping with new understanding of the innovative process, successful organisations will have established teams and developed other interactive mechanisms that promote knowledge transfers among workers, cross-fertilisation, and joint efforts to improve the firms' products and processes.

Many of the "attacking" firms referred to by Foster in the quote above are new technology based firms (NTBFs) which by their nature are small and medium enterprises (SMEs). Clearly a KBE will have a culture and social, legal and governmental framework which encourages the setting up and growth of such companies.

2.3.2 R&D

Governments have traditionally supported research for which public returns are likely to substantially exceed private returns, as documented in Part II. Recognising that the spillover does not happen automatically, the government of Nikuda uses its research support to promote potentially beneficial linkages between scientific and engineering workers in different industries and in government, industry and academia.

2.3.3 Technology Diffusion

If knowledge is held only in isolated pockets, its benefits to the economy as a whole are limited. In a flourishing KBE, much knowledge diffuses readily between firms, between public research centres and firms, and across distance and disciplinary boundaries (including within organisations). Just as successful diffusion of knowledge within a firm requires active management to ensure that its culture and structures make for a "learning organisation", so too on a larger scale for diffusion of knowledge across an economy. Neither is easy.

Effective diffusion of technology implies that the knowledge is taken up (absorbed or assimilated) by the recipient; it involves much more than simply dissemination of information. Dissemination to passive recipients is relatively easy to arrange; for example, relevant information is simply placed on the Internet or made available as a printed report. Many APEC countries have, or have had at some stage, government programmes to capture a range of technological information that may be of relevance to industry in that country and put in some sort of repository. (Such information may come from publicly-sponsored R&D in that country or from systematic sweeping of information from elsewhere, such as through patent listings, trade fairs or abstracts of scientific journal

articles.) But such programmes, though a useful first step, have not been very effective unless complemented by firms whose culture is to actively make use of the information, often assisted by intermediaries who sort the information into packets tailored for their relevance to the recipient (subscriber) organisation. The informal information-sharing culture of Silicon Valley is famous. In Nikuda, all these conditions apply, and so technologies do diffuse.

2.4 Human Resource Development

2.4.1 Assimilation and Adaptation of Knowledge

At a national level, without skilled people capable of understanding the new knowledge and putting it in a local context, that knowledge will not be fully assimilated.

One of the best ways to be sure that such a capacity exists is to have a stock of people who are themselves engaged in creating similar or related knowledge. For example, those engaged in creating computer software for one application are likely to be able to appreciate and adapt other software for a related application, or one which works on a similar platform. This is part of the reason why university teachers in Nikuda are also themselves actively engaged in research: it keeps their skills and knowledge fresh and relevant to the environment into which their students are to go.

Moreover conditions do vary from country to country. Culture, language, background training, and physical environment differ so that what works in one place may not necessarily be appropriate elsewhere. For example, the rural population of Australia is scattered, often at low density, across a hot dusty continent, which sets technical requirements for telecommunications equipment that are unlike those of most other APEC economies. Local development and adaptation of equipment is required to meet such specific requirements, drawing on specialised local knowledge of materials and conditions. Therefore it is not just globally applicable knowledge that is needed for a useful knowledge base, but local (‘indigenous”) knowledge also.

2.4.2 Breadth of Knowledge

The knowledge base that Nikuda maintains is much wider than simply scientific and technological information. We have seen above that knowledge about the human aspects of an organisation - that is, actively applied knowledge about good management practice - is vital for any learning organisation. Without this, the organisation will not be a functioning learning organisation. Drawing further on this, it is clear that industry needs knowledge of market conditions and thus of the political economic and social factors which shape these - in short, not only the hard sciences but also the “social sciences”. Language skills are obviously important for an internationally trading economy.

But Nikuda goes further: the culture values all forms of knowledge, and there is a widespread culture of respect for learned people that encourages learning at all levels. Expressive arts, history, philosophy et cetera are all valued parts of the knowledge base, firstly because of the way they allow Nikudans to know who they are and their place in the world, and secondly because of their use in developing the critical analytical thinking without which a society cannot move forward.[8]

2.4.3 Education and Lifelong Learning

While teaching the basic proficiencies of reading, writing and arithmetic remains central to basic education, the new pervasiveness of ICT in modern society has meant that schoolchildren in Nikuda are comfortable from an early age in working with computers and in teams as part of their learning process. However, in some societies, school (and even university) education has been seen primarily as a process for instilling facts in a new generation. But facts are no longer the key form of knowledge - not least because new knowledge is continually arising, which renders many of the old "facts" obsolete, irrelevant or misleading. This is most obviously true about technological knowledge, especially in fields like information technology. The details of a programme or circuit laboriously studied a few years ago are of little use to a technologist in five years time. This points to the need for *lifelong learning*.

Arguably the key forms of knowledge for a person in a KBE are knowing how to assess what information one needs for a particular task, where to find it, knowing how to do so, and knowing how to assess the information once it is found. All these are teachable skills (at least to some extent), and lie at the heart of the Nikudan education system. Although the middle two skills (at least) change over time, they far outlast the rapidly evolving knowledge base.

While the focus of basic education is on universally applicable skills, much of the later learning is required by the evolving needs of industry as technology and fields of work change over time. It is important therefore that both the content and the delivery modes of such learning match these requirements.

2.4.4 Knowledge Workers

A strong indicator of the trend towards a KBE is in the skills base and occupational composition of the workforce. The data presented in Chapter 3 suggest that in many developed economies, already over 30% of the labour force are "knowledge workers". Thus in a fully developed KBE, the proportion of workers primarily engaged in information work (regardless of whether that work was for a steel works, an agricultural extension service, or a bank) would be well over 50%.

These information workers can be distinguished not only by their activity but also by their qualifications. In a KBE, there is a high proportion of people who have completed secondary education (to exit, "year 12" level), who have post-secondary qualifications, and (most characteristically) who are engaged in continuing education.

2.4.5 Knowledge as National Investment

In his seminal book *The Wealth and Poverty of Nations* (1998), Landes points to several societies that languished because, for religious or other reasons, they saw knowledge as a closed book, which had all been revealed in the past. Most of them have been conquered and/or bankrupted by other nations which had no such hang-ups.

Since for most economies, the national knowledge base is the key to sustaining its national wealth, an economy is vulnerable if most of its knowledge base is held by outsiders. An

economy whose wealth arises from fortuitous possession of natural resources cannot sustain its position if it fails to develop indigenous expertise and capacity in other areas.

In short, investment in such learning through schooling, initial post-secondary education, and subsequent lifelong learning mechanisms is a precondition for a KBE. In Nikuda, such human resource development is seen by all as a vital national investment - an investment in intellectual capital - and is thus a major priority for the economy and society. A major responsibility of government is therefore to ensure that such services are in place.

Since this investment in intellectual capital is a substantial national asset, and lives for the most part in peoples heads, it follows that the more people educated to higher levels, the better. In particular, this implies that in Nikuda, education is not restricted formally or informally by sex or income. It also implies that preservation of this asset is important - it should not be decimated through poor public health.

It is noteworthy that the characteristics that make knowledge a highly valuable and productive commodity also make it difficult to establish an efficient knowledge market — that is, a market that provides incentives for both the production of knowledge and its distribution to all those who can benefit from it.

2.5 ICT Infrastructure

The move towards KBEs has been accelerated by the spread of modern, high-capacity information and communication technology (ICT); this set of characteristics of a KBE is grouped here as "ICT infrastructure".

We have seen that communication is of the essence in the process of technology diffusion, be it within an organisation, across an economy, or internationally. While in some situations, face to face contact is still essential, there are many situations where communication can more effectively take place through telecommunications (notably telephone or email, both of which facilitate two-way communication). Thus a precondition for a KBE is an effective communications infrastructure, to which all citizens have access at reasonable cost.

In Nikuda every information worker has a telephone and computer on his or her desk, capable of reliable, high-speed, external communication (for example, through the Internet). And beyond that, every citizen has easy and cheap access to such facilities, for example, through communal facilities such as telecentres, access centres, or public libraries. (In Nikuda, occasional use of such facilities is offered free of charge for reasons of social equity.) Similarly, in a KBE it is important both for training and for widening the horizons that schools have good and affordable access to the information infrastructure.

The importance of the computer for all workers in the information sector (the most numerous class of workers in a KBE) arises from the technology's capacity to handle, merge and process information. Indeed, even in today's industrialised economies, the possession of a computer on one's desk is virtually a defining characteristic of a primary information worker.

Even for those who are not primarily information workers, the modern machinery with which they deal often embodies computing elements. More specifically, there is a degree of convergence between telecommunications and information processing technologies.

Thus ICT can be seen as an *enabling technology* for a KBE.

Advanced information systems bring down the cost of information, facilitate access to wider pools of information, and promote the spread of ideas. Accordingly, Nikuda has an advanced communications network and a policy and regulatory framework that supports the development and use of information hardware and applications. Because of the centrality of digitised information in a KBE, the telecommunications infrastructure in Nikuda is not restricted to low-bandwidth media (such as voice and text email) but encompasses also higher bandwidth communication (which allow for the possibility of online video, and health and education services). [9]

Thus a reasonably advanced and far-reaching ICT infrastructure - even if not so advanced and far-reaching as that in Nikuda - is a precondition for an economy as a whole to become a KBE. Although this infrastructure is an essential part of the operation of a KBE, the cost of investing in it is not small. It is a responsibility of the government to ensure that this investment takes place, and that the resulting infrastructure is available to all citizens at reasonable cost. However, this does not mean that the government has to directly fund or build the ICT infrastructure. On the contrary, recent experience around the world suggests that opening the telecommunications sector to competition is one of the best ways to facilitate the necessary investment and to keep costs down, provided that suitable technical standards and community service obligations are in place (*Economist*, 9 Oct 1999).

Note that the “knowledge infrastructure” is not the same thing as the ICT infrastructure. The former includes such elements as the education system and the public library networks.

But so central is ICT to knowledge acquisition and diffusion that it is hard to imagine a KBE which does not have a strong base in these enabling technologies. Even then, it is the intelligent use of these enabling technologies that is the key characteristic, rather than the mere possession of a manufacturing facility in one’s territory. However, a true indigenous capacity for design, production and management (which may of course be built on a foundation of knowledge acquired from elsewhere) does contribute to an economy’s capacity to benefit from the enabling technology. This applies even more to software capability.

Another example of the power of ICT as an enabling technology is electronic commerce (e-commerce). Electronic commerce provides new tools for improving the efficiency and profitability of business transactions by making them through ICT networks. By its speed, reliability and power, it enables some totally new forms of transaction to take place, especially business to business (for example, up and down the value chain, and in the finance sector). This is but one example of the emergence of new arrangements of work, production, shopping, and education, based on the application of ICT. "Virtual firms" and "virtual factories" have come into being as entrepreneurs take advantage of the new opportunities for reducing transactions costs.

Table I-2-1
Summary of Characteristics Examined with Indication of Their State in a Fully Developed KBE.

CHARACTERISTICS	IN KBE
Innovation system	
Promotion of innovation	Supportive culture within firms, society and government
Capacity to assimilate knowledge from outside	Strong, helped by skill base and internal creativity
Relationships between firms and research institutions	Close relations between firms with complementary skills, and between firms and research institutes, assisted by formal and informal mechanisms
Technology diffusion	Actively facilitated
Role of SMEs	Numerous new technology based firms
Role of knowledge management	Knowledge actively acquired and well shared within firms
Human resource development	
Investment in intellectual assets	Including human capital, widespread
Education and training system	Near universal base education to at least upper secondary
Policies that encourage lifelong learning	In industry, government and educational institutions
Preservation of intellectual capital	Good knowledge/information management systems
Other knowledge	Also needed and valued, for example, management, cultural
Knowledge workers	Employment dominated by knowledge/information work
ICT Infrastructure	
Telecommunications	Advanced telecommunications widespread and affordable
Role of ICT	ICT important as enabling technology
Government and other investment in infrastructure for ICT	Necessary as support to KBE
Business environment	
International orientation	
- Growth in FDI	Indicates confidence in economy
- Growth in trade	Strong performance and global orientation
- *Knowledge networks*	Strong international links of knowledge
- Openness	Ready entry of new ideas and products
- Immigration	Skilled migrants embody new ideas
Knowledge-based industries	Knowledge intensity high in *all* industries
Role of government	As market facilitator, rather than dominant participant
Regulatory environment for business	
- Financial system	Transparent, efficient and open
- Capital formation	Available venture capital
- Intellectual property rights	Protected but open knowledge
- Competition policy	Encourages innovation
- Sound macroeconomic foundations	Conducive to prosperity
- Transparency in corporate governance	Avoidance of cronyism
Social values	Reflected in policy
Information needed for democracy	Readily available and used

3. CHOOSING THE SAMPLE ECONOMIES AND INDICATORS

3.1 Introduction

This chapter explains how the chosen case study economies were selected, and also discusses general issues about numerical indicators of various characteristics of a KBE.

First, some broad comparisons of the APEC member economies are presented, on the basis of which these economies are classified into a number of groups. The chapter indicates some of the broad differences between the groups and some of the broad similarities within them. On this basis, a representative sample of APEC economies is chosen for more detailed analysis in the following chapters.

Indicators of a KBE are presented in a framework which places them in relation to both the key dimensions used in the case studies (that is, innovation system, human resource development, ICT infrastructure, and business environment), and in relation to the processes of the creation, acquisition, dissemination, and productive use of knowledge. For use in the case studies, a precise set of comparative indicators is specified that is publicly available for all the countries on a comparable basis.

3.2 Grouping the Economies

To allow for the wide range in their levels of economic and social development shown in Tables SA-1 and SA-2 of the Statistical Appendix, the APEC economies have been broadly classified in these tables according to levels of GDP per capita, with some allowance for geographic location and economic history. This classification places all but a few into four groups often used for comparative economic analyses of the region, namely:

- Most Developed Economies
- High Performing Asian Economies
- Asian Fast-Growing Economies
- Latin American Economies.

A few of the APEC economies (Brunei, Papua New Guinea, and Russia) have characteristics which are sufficiently unique to justify not including these economies in any of the above groups.

It can be seen from the Tables in Appendix 1 that APEC economies span a wide range of populations and wealth - much more so than the OECD economies. However, based on the GDP criteria used by the World Bank and the UN, no APEC country counts as “low income”; they are all either “middle” or “high”. Although affected by the Asian Financial Crisis of 1998, GDP has resumed growth in almost all APEC economies.

Inflation is within manageable bounds in the Most Developed Economies, reasonable in the High Performing Asian Economies and some of the Asian Fast-Growing Economies, but too high in others, especially Russia. Many APEC economies are highly trade exposed: in eight of them, exports exceed 30% of GDP, and in Singapore and Hong Kong even exceed 100% of GDP.

Social indicators are also fairly healthy, by world standards, for all APEC economies (see Table SA-2). Literacy levels across these APEC member economies are high, with the majority rating over 90%. Life expectancy is also relatively consistent across member economies, averaging about 72 years. Population growth is fairly consistent across the group, averaging about 1.3% per annum. The high rate of female enrolment in education shows equitable access to education, regardless of gender. This strong performance across a range of indicators is reflected in the relatively high "human development indices".

3.3 Choice of Case Study Economies

The choice of representative economies within each group for detailed case study was largely based on availability of material to the project team. The case studies chosen are: Australia and Canada, Korea and Singapore, Chile, and the Philippines and Thailand. However, in the chapters on each group, pertinent material from other economies has been incorporated where possible.

3.4 Choice of Indicators

The quantitative indicators used in this study attempt to capture the general stage of development of these economies relative to a fully developed knowledge-based economy and the economies' current potential to become KBEs. The indicators cover the groups of characteristics used in discussing Nikuda and the case study economies, namely: innovation system, human resource development, ICT infrastructure, and business environment. The indicators have also been chosen to cover the four phases of knowledge flow described by Dahlman (1999), namely acquisition, creation, dissemination, and use. Table I-3-1 presents a matrix illustrating how the indicators fit into this framework - bearing in mind that the various categories shade into one another.

The choice of indicators is somewhat constrained by the availability of data, especially in a form comparable across all the sample countries. The principal sources of such publicly collated data are the World Bank, the World Competitiveness Yearbook (WCY) and the OECD. Both the first two obtain many of their indicators already collated by specialist UN agencies such as UNESCO.[10] Although the latter two sources present some indicators that are not covered by the World Bank publications, they do not cover all APEC economies. In particular, though the OECD publications give much sectoral detail, they only cover OECD countries (that is, the "Most Developed Economies" within APEC). The WCY, however, covers all OECD and APEC countries except for Peru, Brunei, Papua New Guinea and Vietnam. This is one reason why none of these four countries has been chosen as a case study.

Appendix 2 presents a matrix similar to Table I-3-1, but shows some desirable indicators for which data are not currently available for enough APEC economies to be used in this report.

Table I-3-2 sets out for each of the main indicators its precise definition and its significance as an indicator of development towards a KBE. Most of the data in the main tables and charts of this report are for 1997, but some are for other years as specifically indicated in particular tables.

Table I-3-1
Matrix of Indicators

	Business environment	ICT infrastructure	Human resource development	Innovation system
Knowledge acquisition	FDI (% of GDP); openness rating	Computers p.c.	Secondary enrolment	Company-university cooperation rating
Knowledge creation	***GERD (% of GDP);***		Natural science graduates per annum	BERD (% of GDP); researchers p.c.; Patents awarded in the US per annum
Knowledge dissemination		Telephone mainlines p.c.; Internet hosts p.c.; mobile phones p.c.	Newspapers p.c.	Company coop rating
Knowledge use (industrial production)	*High tech exports as % of GDP*; Exports of services; *KBIs as % of GDP*	Internet users p.c.	% of knowledge workers	*E-commerce revenue*
Other	*Govt transparency (rating); corporate transparency (rating); competition policy (rating)*		Human development index (HDI)	

Note: Indicators shown in *italics* are, at this stage, available only for a few of the APEC economies.

Table I-3-2
Specification of Indicators for the Economy Scorecards.

Indicator	Significance for KBE	Details
Business environment		
KBIs	Indicates current status as a KBE	Value added by "knowledge-based industries" as % of GDP. (KBIs as defined by OECD 1999 Scoreboard - see text). Not available for all countries.
Exports of services	Indicator of knowledge-intensity and size of service sector. (Exportable services tend to be knowledge-intensive; Most Developed Economies tend to have higher proportion of services)	As % of GDP. Commercial services includes transportation, travel, other private services and income. Data are not always fully comparable across countries.
High-tech exports	Indicator of knowledge intensity of manufacturing.	As % of GDP. World Bank data for 1998 gives % of mfg exports. Converted to % of GDP using UN trade data. "High-tech" covers any product from certain sectors (similar to but not identical to those called "high-tech" by OECD).
Foreign Direct Investment (FDI)	Indicates investor confidence in economy. Also indicates openness to outside influence (and knowledge).	As % of GDP.

Con't of Table I-3-2

Government transparency (rating)	Indicates clarity of policy and (to lesser extent) absence of cronyism - both needed by a KBE	WCY 1999, scale 1-10. (10= "The government communicates its policy intentions clearly")
Financial transparency (rating)	Without reasonably high rating, outside investment is deterred	WCY 1999, scale 1-10. (10= "financial institutions provide adequate information about their activities")
Competition policy (rating)	Competition encourages innovation	WCY 1999, scale 1-10. (10= " govt policy prevents unfair competition in this economy")
Openness (rating)	Openness to outside goods and services indicates openness to outside ideas	WCY 1999, scale 1-10. (10= "National protectionism does not prevent foreign products and services from being imported")
ICT infrastructure		
Mobile Telephones (per 1,000)	Indicator of new technology take-up.	Number of mobile telephones in use per 1,000 inhabitants.
Telephone mainlines (per 1,000)	Primary indicator of domestic telecommunications capacity	Number of telephone mainlines in use per 1,000 inhabitants.
Computers (per capita)	Indicates take-up of new ICT by business and broader community	Number of computers (PCs, mainframes, et cetera) per 1,000 inhabitants
Internet users	Indicates take-up of new ICT by business and broader community. Indicative of ability to engage in e-commerce and modern information collection and dissemination.	Number of Internet users, as % of population (1998 and 1999*), from various sources.*
Internet hosts (per 10,000)	Indicates active participation by business in the digital economy	Number of Internet hosts per 10,000 inhabitants
E-commerce	Indicates extent to which traditional industries are adapting to the digital economy	Expected revenue from e-commerce in 1999 (US$). Various sources, so probably not consistent series. *(For most countries refers only to Internet, except for Canada?)*
Human resource development		
Secondary enrolment	Potential for skilled workforce in the future	This UNESCO figure is the total enrolment, regardless of age, divided by the population of the official age group which corresponds to a specific level of education.
Natural science graduates per annum	Indicates flow of high-level technical skills into the economy	Number of new graduates in natural sciences and engineering in year specified *(UNESCO)*
% of knowledge workers	Indicates current status as a KBE	As percentage of the labour force. Based on ILO occupational statistics - see text for details.
Daily newspapers per 1,000	Indicates popular diffusion of ideas and (in part) openness of culture	Daily circulation per 1,000 inhabitants
Human Development Index	Broad indicator of social development; KBE cannot develop unless all components of HDI are reasonably high.	UNDP index based on three indicators of human development: longevity (measured by life expectancy at birth), educational attainment (measured by a combination of adult literacy [2/3 weight] and the combined 1st, 2nd, 3rd-level gross enrolment ratio [1/3 weight]), and standard of living (measured by purchasing power, based on real GDP per capita adjusted for the local cost of living [purchasing power parity]). (Maximum value= 1.000)

Con't of Table I-3-2

Innovation system		
BERD /GDP	Commitment by enterprises to knowledge creation	Business annual expenditure on R&D as % of GDP.
GERD/ GDP	Indicates current effort to create new (technical) knowledge	Gross annual expenditure on R&D, that is, BERD and public expenditure on R&D (as % of GDP).
Patents awarded in the US per annum	Industries which patent extensively mostly do so in the US (a major technology market) as well as at "home"	Number of US patents awarded in specified year to residents of specified country.
Researchers p.c.	Indicates potential to create new (technical) knowledge	Stock of researchers per million of the population.
Intercompany cooperation (rating)	Partial indicator extent of knowledge networks	WCY 1999, scale 1-10 (10= "technological cooperation is common between companies")
Company-university cooperation (rating)	Partial indicator extent of knowledge networks	WCY 1999, scale 1-10. (10= "research cooperation is sufficient between companies and universities")

Source: IMD, *The World Competitiveness Yearbook*, May 1999. Switzerland.

3.5 Indicators of Knowledge Intensity

Many economic indicators (such as foreign investment) measure the potential for prosperity rather than the state of prosperity (which is measured by GDP).

Similarly there are many indicators that give a measure of some characteristics of a KBE - most such indicators measure a characteristic associated with a KBE or that may lead to a KBE (such as availability of computers). But there are very few published indicators that directly measure the extent to which a country is already operating as a KBE . A revealing indicator would be the proportion of current economic activity in an economy that is in some sense "knowledge-intensive". This proportion could be measured either by the amount of money involved or by the number of people involved. These two possibilities respectively correspond to:

- the percentage of GDP contributed by "knowledge-based industries"
- the percentage of the labour force that are "knowledge workers".

To get useful information on either of these indicators, we need first to clarify what we mean by "knowledge-based industries" and "knowledge workers". There are no simple, unique definitions of either of these terms, but (as discussed below) working definitions can be established which yield meaningful and comparable data. The results are tabulated in Table SA-3.

3.5.1 What is a "Knowledge-Based Industry"?

Some industries by their very nature are knowledge-intensive, wherever they may be located. For example, there are manufacturing industries in which a substantial proportion of the total cost of their production lies in research and development, and design; these

knowledge-intensive industries include information and communications, aerospace, environment, bioengineering, and mechatronics. Similarly, there is a range of service industries the essence of which is that the consultant brings to bear his special knowledge. This intangible is the principal asset of the service provider; the industries include finance, audio-visual, communications, design, data processing, and consulting.[11] Looking at a wider view, some traditional or indigenous wisdom or cultural assets could be considered KBIs. Some primary or conventional industries may or may not be knowledge-intensive in a particular economy today. Indeed, it is important to realise that the extent to which a particular industry is "knowledge-intensive" is one of degree rather than a binary (yes/no) distinction.

The OECD has operationalised these ideas to give comparable statistics on the contribution of KBIs to GDP, although they may be misleading in the way they treat some particular industries in particular countries. The OECD, for example, classifies as "high technology" those manufacturing industries where (on average across the OECD) the investment in R&D as a proportion of value added exceeds 15%, and as "medium-high technology" those manufacturing industries where it lies between 4% and 15%.[12] In 1994, these industries accounted for nearly 10% of GDP in OECD countries.

OECD (1999) groups high-tech and medium-high-tech manufactures, together with community, social and personal services, financial and other business services, and communications services, as *knowledge-based industries*. The contribution of these sectors to GDP can be calculated using the national accounts and input/output matrices. As indicated in Table SA-3 (Appendix 1), this group of industries accounted for just over 50% of GDP in OECD economies in 1994.[13] However, this is a more broad-brush view of KBIs than is taken elsewhere in this paper; some parts of these industries are not particularly knowledge-intensive at this time, whereas parts of other industries are knowledge-intensive in particular economies.

3.5.2 What is a "Knowledge Worker"?

A strong indicator of the trend towards a KBE is in the skills base and occupational composition of the workforce. For the US and many other long-industrialised economies, such data show not only a dramatic decline in the percentage of the population employed in agriculture since the 19th century, but also a sharp decline in industrial employment from 1960. This is accompanied by a less steep rise of employment in the service industries in the same period, and a spectacular rise in the proportion of the labour force engaged in "information occupations", a category closely related to "knowledge workers" (Machlup 1962; B.O. Jones 1985; Porat 1977).[14]

Some form of occupational statistics is collected by almost all countries as part of their census process. The International Labour Organisation (ILO) annually compiles these statistics into an internationally comparable form. Though this compilation process loses much fine detail, it does result in a data set which gives reasonably comparable and readily available information for most APEC (and other) economies over several decades.

We can consider a "*knowledge worker*" to be one whose work lies primarily in the manipulation of symbols, and with a strong requirement for specialised knowledge. Operationally, for the purposes of this report, we thus classify as a "knowledge worker" anyone whose occupation is reported to ILO as falling into any of the following

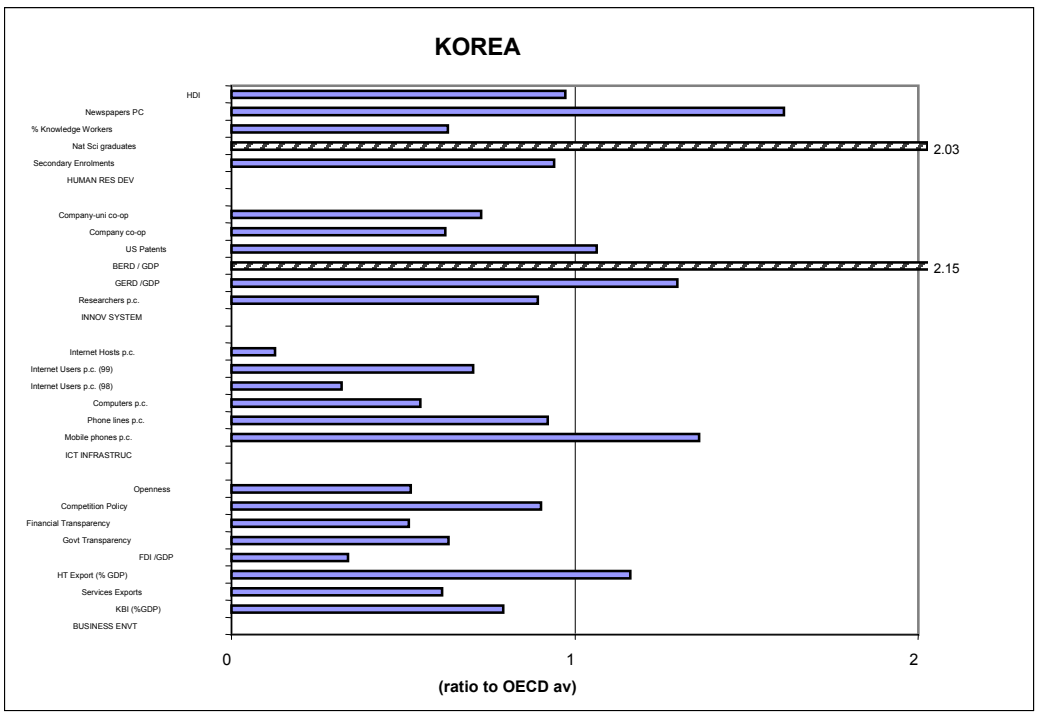
categories: managers and senior government officials, professional workers, and "associate professionals". Since the ILO classification is based on what a particular worker (occupation) actually does, and not on what industry the person works in, it gives an independent perspective from one based on classifying particular industries as "knowledge-based". "Knowledge workers", defined in this way, already comprise over 30% of the workforce in most OECD economies (see Table SA-3 of Appendix 1).

3.6 Graphical Presentation of Indicators

The characteristics of the sample APEC member economies relating to their performance as a KBE are summarised in subsequent chapters through country "scorecards" (charts), of which Figure 3.1 is an example. The scorecards use a range of indicators (detailed in Table I-3-2), which are consistent with, but not identical to, those in similar plots presented by Dahlman (1999).

As shown in Figure I-3-1, the indicators are divided into groups corresponding to the key dimensions of a KBE, namely business environment, ICT infrastructure, innovation system, and human resource development. In the chart, each indicator is scaled against the OECD average value for indicator, so that the value 1.0 represents the OECD average value for each indicator.[15] Most of the data are for 1997, and thus give a reasonable comparative representation of the present situation (with the likely exception of ICT where uptake rates are especially rapid; see Chapter 8). The hatched bar(s) in the chart represents values greater than 2.0, as indicated on the chart.

Figure I-3-1
Example of "SCORECARD"



This presentation emphasises the overall message of a group of related complementary indicators, such as those for the innovation system. While each indicator in the group gives only a partial impression of the innovation system, the group as a whole gives an

overall impression. This is appropriate for the qualitative comparison between groups of countries, which is the focus of this study.

Longitudinal indicator data from 1992 were assessed. There was marked growth in the uptake of computing, Internet and mobile telephone technology for the average OECD country. Other structural changes involved growth in GERD, US patenting activity, foreign direct investment and service exports. Similar trends were apparent in APEC sample economies.

4. MOST DEVELOPED ECONOMIES

4.1 Introduction

Within APEC, the group of "Most Developed Economies" comprises Japan, the United States, New Zealand, Australia and Canada. All of these are market-based economies, which have been industrialised for nearly 100 years, and as such have been members of the OECD for decades. Like almost all OECD countries, their economies have been steadily becoming more knowledge-intensive since the 1950s.

The chosen case studies for this group are Australia and Canada, although some reference is also made to the US and Japan where aspects of interest arise. Both are middle-sized economies, which may make their experience more relevant to other APEC economies than that of the much larger economy of the US. In both countries, the governments have facilitated the movement towards a KBE through consistent support over decades for education (at all levels), and for research and development, although the nature and scale of such support has evolved over time. Recently, in Canada, this has been explicitly put in the context of the move toward a KBE (Speech from the Throne 1999, Chretien 2000). In Australia, some Ministers have occasionally referred to the "ideas-based economy" - which is essentially a different name for a KBE (Minchin 1999). Arguably however, in both countries the movement towards a knowledge-based economy has been driven more by global economic trends than by explicit government direction.

4.2 Business Environment

4.2.1 Macroeconomic Overview and Historical Context

Australia has recognised that a strong macroeconomic foundation is a key to success in a knowledge-based economy. Gross domestic product (GDP) has continued to grow strongly with an average growth rate of 3.6% over 1990-1998. Inflation has been consistently low, averaging only 2% during 1999-2000.[16] This has been combined with solid employment growth, real exchange rate depreciation, and continued low interest rates. Efforts to slow the growth of the current account deficit have further encouraged this low interest rate environment, and have boosted confidence in financial markets. Australia's net debt levels were only 8.2% of GDP during 1999-2000, compared with average net debt levels of approximately 43% of GDP for OECD countries over the same period.

Canada has experienced economic growth averaging 2.2% annually over 1990-1998, but this has increased over the last two years. In 1997-1998, annual per capita growth in GDP was 5.1% and in the last year 4.2%. Unemployment in Canada has been similar to levels in

Australia, decreasing to 6.8% in 1998, while inflation in 1998 was only 2.3%. Combined with low interest rates, this has produced a sound overall macroeconomic foundation, although the level of government debt has been seen as a constraint on policy. Canada's economy is strongly influenced by its geographical proximity to the United States and the consequent close trade links - the more so since the advent of the North American Free Trade Agreement (NAFTA) in 1992.

In addition to holding general macroeconomic settings at appropriate levels to encourage investment and growth, both Australia and Canada promote free trade and investment and efficiency in capital markets. Competition laws in these economies discourage collusive and anti-competitive behaviour, and allow the entry of new firms into markets. In particular, the financial systems in Australia and Canada are competitive and enable new ventures to obtain finance at competitive rates. Both countries need to develop access to venture capital and are actively pursuing policies to achieve this. Companies and the governments in Canada and Australia are generally open, transparent and accountable in their reporting (see Part II).

A tax system which encourages investment in productive enterprise is important for a fully developed KBE. Tax reform is a current policy focus for Australia. From 1 July 2000, a goods and services tax (GST) will be introduced in Australia at a rate of 10%, replacing the earlier and highly non-uniform wholesale sales tax. A few exemptions will apply to this broad-based tax, most notably in relation to some food. Income taxation is to be lowered. In addition, a review of business taxation has recently been completed with a view to achieving internationally competitive and economically efficient business tax arrangements. Following this review, the government has announced a number of changes, which include trading off accelerated depreciation for a lower company tax rate, and reducing capital gains tax in an effort to encourage further foreign investment and new technology start-up companies.

The Australian Government is also committed to minimal intervention in markets, relying on a "light touch" regulatory environment. The microeconomic reform Australia undertook in the late 1980s addressed a range of impediments to economic efficiency. However, microeconomic reform in Australia does not yet fully reflect the increasing impact of the KBE on both new and traditional areas of the Australian economy. In particular, areas such as education and training, intellectual property, standards, and the regulatory environment (including laws relating to mergers and acquisitions) need to be examined in this context.

The light-handed approach to economic management favoured by governments in Australia and Canada is similar to that in the US and New Zealand, but contrasts greatly with the strong "guidance" which Japanese governments has employed for decades (Okimoto 1989). The latter has also served as a model for Singapore and Korea (see Chapter 5).

In Australia and Canada, protection against imports is low and both governments are moving to further reduce tariffs and promote the development of mutual recognition of standards in order to promote the free flow of quality goods. Intellectual property rights are well protected in both Australia and Canada.

Given that competitiveness in a KBE is increasingly driven by investments in intangibles or intellectual capital, these countries may need to examine whether existing programmes are favouring traditional areas at the expense of new, faster growing areas of the economy. This would entail reviewing programmes such as R&D support and measures to encourage foreign investment to ensure they are neutral with respect to these new and different areas, and ensure that they adequately address intangible investment.

4.2.2 Structure of the Economy

Australian production has historically been resource- and agriculture-based. Poorer terms of trade in recent years and a recognition that Australia needs to increase levels of sophisticated manufacture and further develop service industries has led to an increasing focus on these industries as a source for Australia's future success and prosperity. Australia's service sector is now generally world competitive in cost and performance. Compared to other OECD economies, Australia has a small manufacturing sector at 13.3% of GDP, and a larger service sector which represents 68.9% of GDP (Key Australian Industry Facts, DISR 1998/99).

Similarly in Canada, there has been a shift away from the resource sector and goods production towards services in terms of both employment and value added as a percentage of GDP (see Appendix 1).

4.2.3 Foreign Direct Investment (FDI)

In both Canada and Australia there is a general culture of openness to new ideas and innovation. This can be particularly seen through government policies that actively promote research and innovation, and through the high levels of trade and foreign direct investment (see Appendix 1).

Canada's inward and outward FDI stocks have increased in importance over the decade. Gera *et al.* (1999: 23) note that "by improving market access, outward FDI has improved incentives for Canadian firms to undertake R&D and to install equipment involving the latest technological innovations". This general culture of openness is also evident in Australian and Canadian immigration policies. However, there is internal concern in Canada that outward FDI may be at the expense of employment within Canada.

Australia particularly benefits by its open culture through the ripple effects of US investment in new technology as Australia purchases a significant share of imports from the United States and is a host to many US multinational corporations. However, slow investment growth may have moderated the impact of this favourable access to the United States for both Canada and Australia.

4.2.4 Knowledge-Based Industries (KBIs)

Nearly half the workforce in both Australia and Canada comprises of "knowledge workers" (Table I-4-1; see also Chapter 3). This parallels the shift from goods production to services in the Canadian economy described previously. Also, the growth of KBIs over the first half of the 1990s has been significantly greater than that of medium- and low-knowledge industries (Gera *et al.* 1999: 29). Notably, Table 4.1 illustrates that in both

Australia and Canada, KBIs contribute approximately half of all value added, but that high technology manufactures are only a small fraction of this, especially in Australia.

Exports of high technology manufactures from Australia grew by 15.6% per annum from 1980 to 1994 - one of the highest growth rates in the OECD, although from a very low base (DISR2: 6). Since then, Australian high technology exports have barely increased, and are still less than one-tenth those of Canada in value (World Bank 1999).

Table I-4-1
Scale of Knowledge-Based Industries

	Australia	Canada
Total value added by KBIs (% of GDP)	*48.0*	*51.0*
Of which:		
High technology manufacturing industries	0.9	2.2
Medium-high technology manufacturing industries	3.2	6.1
Communications services	2.9	3.3
Finance, insurance and other business services	26.1	24.1
Community, social and personal services	14.9	15.4
"Knowledge workers*"* as % of workforce	35.5	33.3

Source: value added: OECD Science Technology and Innovation, p.115 (1996 figures).
Workforce: based on ILO Yearbook of Labour Statistics (1997 figures), see Chapter 3 for detail.

The Canadian information and communication technology (ICT) sector experienced considerable growth in the period 1990 to 1996. During this time, both the real growth rate of this sector (7.6%) and growth in labour productivity (over 5%) was more than five times that of the overall economy. Over the same period, software and computer services experienced employment growth of 90% (Gera *et al.* 1999: 30-31).

If the value to the economy of various components is measured by stock market valuation instead of by contribution to GDP, a very different picture emerges in the developed economies. In the last year or two, there has been a dramatic stock market boom in Internet–based companies (the so-called dot.com companies), many of which have yet to make a profit. This leads many observers to expect that a shakeout will occur at some stage with only the strongest and most efficient dot.com companies prospering (*Economist*, 26 Feb 2000).

4.3 Innovation Systems

4.3.1 Research and Development

Both Canada and Australia have a well-established science base - another important characteristic in a KBE. Australia is world-class in terms of scientific publications and citations, and the number of papers produced per capita is one of the highest in the world. Research and development in Australia and Canada is high by international standards and in particular, investment in these activities is higher than in most APEC member economies, with gross expenditure on R&D exceeding (GERD) 1.5% of GDP (see Statistical Appendix). Australian governmental support for R&D in universities and public institutions as a proportion of GDP is the third highest in the world. Although both Australia and Canada have significantly increased their investment in R&D over the last

few decades, it remains lower as a proportion of GDP than for many other industrialised countries, especially in terms of business expenditure on R&D (BERD). Indeed, Korean industry invests more than three times as much in R&D as do either Australia or Canada.

Although Australian levels of domestic patenting are high relative to other OECD economies, Australia takes out substantially fewer patents in the US (the main international market for new technology) than do either Korea or Canada.

The low levels of investment in R&D (and as an extension, low levels of patenting activity) for Canada and Australia are partly attributable to relatively favourable access to new technology through strong economic links with Japan and the United States, which are two of the main information-producing economies. Indeed, productivity improvements in Canada appear to be more strongly related to R&D spillover from abroad than to domestic influences (Gera *et al.* 1999: 22). Nevertheless, the low level of private sector investment in R&D (which occurs despite research and development tax incentives that are considered generous by international standards) may be of serious disadvantage for Canada.

Similarly in Australia, the predominance of multinational companies in manufacturing and the relatively high proportion of GDP (by OECD standards) accounted for by "commodity" exports are a partial explanation for the relatively low business expenditure on R&D. However, the Australian Government is attempting to encourage greater business expenditure on science and innovation. To this end, the government currently spends about A$3.9 billion per annum on a range of programmes including: a 125% tax concession and the Start programme of grants to industry (both of which apply to projects of industry's own choice), a Technology Diffusion Programme to facilitate industry access to leading-edge technologies, over 40 Cooperative Research Centres established to improve science and industry links and achieve greater levels of commercialisation, and an Innovation Investment Fund providing approximately A$345 million (including private capital) to small new technology firms (see Part II).

4.3.2 Innovative Enterprises

In Australia, it is the private sector who will make the necessary investments and take the necessary risks to determine Australia's success in a knowledge-based economy. For this reason, the expectation is that business will lead this process of modernisation by responding to the spur of competition and by exploiting new markets. In particular, a fully developed KBE has a cultural and social, legal and government framework which encourages SMEs. In Australia, small and medium enterprises are a major generator of growth and employment, with SMEs such as Orbital, Bishop and Décor leading Australian industry in patent development. Canada also has a number of policies designed to encourage the growth of SMEs.

The Australian venture capital market also needs to be developed further. The government has established a number of programmes (including the Innovation Investment Fund and the Pooled Development Fund) to encourage access to finance for small, higher risk companies. Nevertheless, some surveys suggest that access to capital may be a major

impediment to innovative activities by firms (McKeon 1999). Recent initiatives following a review of business taxation in Australia aim to reduce the rate of capital gains taxation and corporate taxation to encourage further investment and to attempt to alleviate some of these concerns (Treasurer 1999).

Australia held a National Innovation Summit in February 2000 to develop policies to strengthen innovation and improve the commercialisation of R&D. Its three themes were: creating a competitive environment, investing in new ideas, and building industry-research linkages. The government is currently considering the many constructive suggestions that were made, with an Implementation Group that was due to report in August 2000 (Summit website 2000).[17] Canada and the United States have also recently held similar summits.[18] The US summit in 1998 focused on the relative decline in America's "national innovative capacity" which was projected to arise from the decline in government support for R&D following the end of the Cold War (Technology Review Nov 1999). Nevertheless, the US - and its many clusters of innovation, of which Silicon Valley is merely the most famous - remains a model for many other countries.

In Canada and the United States there is a relatively high level of experimentation, adoption of high-performance work practices in large firms, and extensive outsourcing of inputs and services (OECD TPJ: 279). The organisational innovation and diffusion systems in these economies are supported by a relatively large share of business expenditure on R&D financed by the government and a well-developed government research infrastructure (OECD TPJ: 279). However, in both these economies, the relevance of the technology programmes and the incentives for intangibles to shift investment strategies to long-term needs to be strengthened. Furthermore, the adoption of best practices in small firms should be further expanded (OECD TPJ: 279).

In a fully-developed KBE, open channels of communication and cooperation within and between firms are important, so it is significant that these economies have well-established government/university research infrastructures but that these are often weakly linked with business. Although, both Australia and Canada have government policies and programmes to encourage cooperative research centres and networking amongst firms, corporate incentives are often set up in a manner which do not actively encourage sharing but instead reward individual achievement (Gera *et al.* 1999: 37). Flexibility and a culture that encourages knowledge diffusion are also important characteristics of a fully developed knowledge-based economy.

Burton-Jones (1999) presents a new model of the firm, which explains the strong trend in Canada, the United States, Australia and New Zealand towards forms of work other than full-time "permanent" employment as a consequence of the trend towards a KBE. In his "knowledge supply" model, the form of contract between the firm and the worker depends on how central to the firm and how specific is the knowledge which the worker offers. Table I-4-2 gives some examples. As a striking example of these trends, the largest private employer in the United States is no longer General Motors (the largest manufacturer) but Manpower (a firm which supplies "temporary" staff).

Table I-4-2
Employment Contract as a Function of Knowledge Supplied
(Based on Burton-Jones 1999)

Form of knowledge	*Form of contract*
Central to firm's operation and planning	"Permanent" employee, probably with share option
Not firm-specific but specialised and required only occasionally	Consultancy
Firm-specific but peripheral	Part-time work (often by former full-time worker) or "dependent contractor"
Not firm-specific	Temporary worker supplied by staff supplier

In Canada, most firms use very few of the organisational and human resource innovations that are needed to realise the full potential of advanced technologies. In fact, 70% of respondents of a recent human resource survey were judged to be 'traditional' in their practices, and companies have been slow to introduce new organisational structures and work practices that could utilise opportunities from these new information and communication technologies (Gera *et al.* 1999: 38).

4.4 Human Resource Development

4.4.1 Investment in Knowledge

Table I-4-3 shows some "investments in knowledge" for some of the APEC OECD countries, calculated as the sum of expenditure on R&D, public spending on education, and investment in software. This investment is clearly substantial, exceeding 6% of GDP for all these countries, and of the same magnitude as investment in new plant and equipment, which at the very least shows that knowledge is seen as important in all these economies.

Table I-4-3
Some Investments in Knowledge (1995, as % of GDP)

Country	Total	Public spending on education *	R&D	Software
Australia	6.8	4.3 (1.1)	1.4	1.0
Canada	8.8	5.9 (0.7)	1.4	1.4
Japan	6.6	3.0 (1.1)	2.7	0.9
US	8.4	4.6 (1.7)	2.3	1.5

* Figure in brackets is additional private expenditure on education (in 1997), though some of this may be subsidised. Source: OECD (2000e)
Source: OECD (1999)

As OECD (1999) notes, this figure is clearly an underestimation of investment in knowledge, as it excludes (for reasons of data availability) several components such as payment of licences for technology and non-government spending on education and training. An estimate of the latter component is given (in brackets) in Table I-4-4, and in some countries adds quite substantially to the total.[19] In a fully developed KBE, where investment in knowledge would be the dominant investment, the numbers might be higher still.

4.4.2 Education

Critical to the success of a knowledge-based economy is a strong education system. Specifically, in a fully developed KBE, education up to upper secondary level should be nearly universal. All of the Most Developed Economies have a secondary enrolment rate of over 90% (see Statistical Appendix). In addition, tertiary enrolment is over 15% in the age group 17-34 (WCY 1999), and over 30% of the workforce have some form of tertiary qualification (DISR 1999).

Nevertheless, the proportion of the workforce with low academic or vocational qualifications (that is, below upper secondary level) is higher than it should be in a KBE - around 38% in Australia and 16% in Canada.[20] In all of these economies, levels of early school leaving need to be further reduced, so that the whole population can benefit from the shift towards a KBE (OECD TPJ: 283). Effective lifelong learning outcomes would also need to be generated.

Higher education in Australia is predominantly provided through public institutions (unlike, for example, in the US or Korea). Resources invested in higher education remain an important issue for Australia's higher education system. Since the late 1980s, there has been rapid growth in higher education enrolment, which has risen by more than a quarter of a million in that period, at an average annual growth rate of 6% (Higher Education Funding Report for 1999-2001 Triennium). Since 1989, students have again made a contribution to the cost of their education through the Higher Education Contribution Scheme (HECS). Under this scheme, an average of 37% of course costs is recovered from students. Students have the option of paying upfront or of making repayments, through the tax system, after the student has reached a specified income level (usually after they graduate). Course fees, industry investment, bequests, and commercial activity are becoming increasingly important sources of additional funding for universities. Overseas students in Australia are charged the full cost of their course, and from 1998, universities have had the flexibility to provide a small number of places for full-fee-paying Australian undergraduate students, under specified conditions.

4.4.3 Lifelong Learning

Skilled workers are crucial in a knowledge-based economy, and the changing nature of the labour market ensures that flexibility is a further critical quality in a KBE. Firms therefore need to promote lifelong learning, build entrepreneurial skills, and improve links between industry and the education sector to ensure that skill requirements are met and that institutions can effectively meet new demands. Furthermore, it is important that students develop strong information technology skills from an early age.

In both Australia and Canada, there has been a clear trend towards upskilling and retraining (see Table I-4-4). However, the provision of training by employers in Canada is low compared to some other OECD countries, with only 63% of workplaces offering formal training opportunities. This is especially limited for part-time and less educated employees of small firms or firms which are newly established, or who are in industries with a high turnover of staff (Gera *et al.* 1999: 25). Participation rates for on-the-job training in Australia are similar, but the duration of training is lower than in Canada, averaging only 167 hours per year (OECD 1998).

Table I-4-4
Lifelong Learning

	Australia	Canada	United Kingdom	United States
Percentage of the population, 25-64 years, participating in continuing education and training*	36%	37%	45%	42%
Percentage of the population, 25-64 years, participating in job-related continuing education and training	30%	30%	40%	38%

Source: OECD (1998) *Education at a glance*, p.216
* "Continuing education and training" includes university education and vocational education and training.

Both Canada and Australia have taken steps to ensure to minimise ICT skill deficiencies by raising awareness of ICT career opportunities, improving information flows between industry and the education sector, and conducting research into future industry needs and recruitment.

4.5 ICT Infrastructure

4.5.1 ICT Investment

In general, the Most Developed Economies have near universal telephone access, high levels of computer access and Internet penetration. These are all-important aspects for developing a knowledge-based economy.

Due to its size and position, Australia is heavily dependent on telecommunications networks to maintain strong links both domestically and with the rest of the world. In fact, Australia is the second largest market in the Asia-Pacific after Japan for information technology and telecommunications, and is one of the most globally networked countries in the world. Australia's telecommunications infrastructure is the most deregulated and competitive in the Asia-Pacific region, and investment in telecommunications as a percentage of GDP is the third highest in the world, with only Korea and Germany investing more. Telephone and Internet charges in both Australia and Canada are relatively low compared to other APEC economies.

Internationally, mobile phone usage has greatly increased (to around 50 subscribers per hundred people in both Australia and Canada), although a number of issues relating to access and quality remain. In the next few years, the International Telecommunications Union will establish a global standard and will begin to distribute higher frequencies which will enable wireless users to transmit data at much faster speeds. This should improve the current inconvenient situation that travellers face because of inconsistent standards (The Economist Telecommunications Survey 1999: 10).

In Canada, over the last twenty years, a high proportion of industrial investment (up to 13.5% in service industries) has been allocated to information technology (Gera *et al.* 1999: 26). Telecommunications services are easily accessed, modern and inexpensive.

Major investments have been made in the areas of digitisation, advanced switching, and high-capacity fibre optics.

In terms of infrastructure for diffusion of digital information, Australia and Canada are two of the more advanced countries in APEC. In 1997, both had over 40 computers per 100 people and over 30 Internet users per 100 people; both figures are still rapidly increasing (see Figure I-4-1 and Appendix 1). Internet access has been strongest in the finance, manufacturing and wholesale industries, and particularly in the service sector. However, small and medium enterprises (SMEs) in Australia have not pursued this access as quickly as the larger companies, and although household computer ownership is strong, household Internet access remains low (ISR2: 47).

In most economies, including both Canada and Australia, most ICT equipment is imported. This is largely because of the specialisation of ICT production in different industrialised economies. For example, although Canada has strong private sector R&D in telecommunications equipment (some 37% of BERD in 1996), it is concentrated in a few specialised areas - notably in switching circuitry and routers.

Electronic commerce is a further area for development in the progression to a knowledge-based economy. In Australia, the private sector will lead the growth in this area, and a number of Australian businesses have already used e-commerce to improve efficiencies, open up new markets, and increase revenue (Alston 1999). Australia is particularly well positioned to further develop e-commerce capabilities (both business to business and directly to the consumer) due to the high number of firms with computer and Internet access. This has made e-commerce a more affordable and accessible alternative, particularly for smaller firms (Alston 1999). A recent report for the National Office for the Information Economy (NOIE) suggests that GDP will increase an extra 2.7% by 2007 as a result of productivity gains from e-commerce (NOIE 1999). To encourage this process, the Australian Government has set itself a target of undertaking all appropriate transactions online by 2001.

Nevertheless, at this stage, uptake of e-commerce by consumers (as distinct from business to business) remains limited as many consumers lack confidence in either the security (and privacy) of Internet transactions, or the reliability of delivery of any goods ordered (especially in those countries where mail order has not traditionally been a major part of retailing). Canada has enacted Internet privacy legislation intended to allay some of these concerns, and Australia has foreshadowed similar legislation.

Physical capacity is another issue. Australia has established a 'National Bandwidth Inquiry' to "investigate whether Australia will have the bandwidth capacity over the next five years to meet the anticipated demands of information economy". However, private telecommunication firms have not waited for the results of the Bandwidth Inquiry, but are already busily rolling out high-bandwidth optical fibre networks in most Australian cities.[21]

On grounds of social equity, it is highly desirable that e-commerce and other benefits of the digital economy not be confined to the rich or to cities. To move closer to universal access ("networking the nation"), the Commonwealth's five-year, A$250 million Regional Telecommunications Infrastructure Fund is helping to bridge the gaps in telecommunications services, access and costs between urban and non-urban Australia. (A

further A$250 million was allocated for this purpose in December 1999.) Canada similarly has a substantial Community Access Programme, which provides financial and other support for communities to gain affordable access to Internet services; the intention is to have 10,000 public access centres by 2001.[22] In parallel with this, Canada successfully linked all its schools to the Internet by mid-1999.

4.6 Comparison with Other Most Developed Economies

The US is by far the largest economy in APEC and one of the most thriving "new economies". Japan is of interest as it is the largest economy in the western Pacific and has been a model for the High Performing Asian Economies in shaping their post-war economic development. For these reasons, indicator profiles for both countries are shown in Figure I-4-1, even though the special characteristics of their economies mean that they are less representative of economic development within the region. (An indication of this is that several of their respective indicators are well in excess of the OECD average.)

The contribution of "knowledge-based industries" to GDP is over 40% for all of the Most Developed Economies, which supports the general impression that these economies are already, to a considerable extent, knowledge-based economies. This impression is confirmed by the other main indicator of an economy's current status as a KBE - the proportion of "knowledge workers" in the labour force, which is over 30% for all the most developed economies. The proportion of workers in knowledge-based activities is expected to remain high (and probably increase slightly).

Figure I-4-1
Some KBE Indicators for the US and Japan
(Scale: 1.00 = OECD Average for That Indicator)

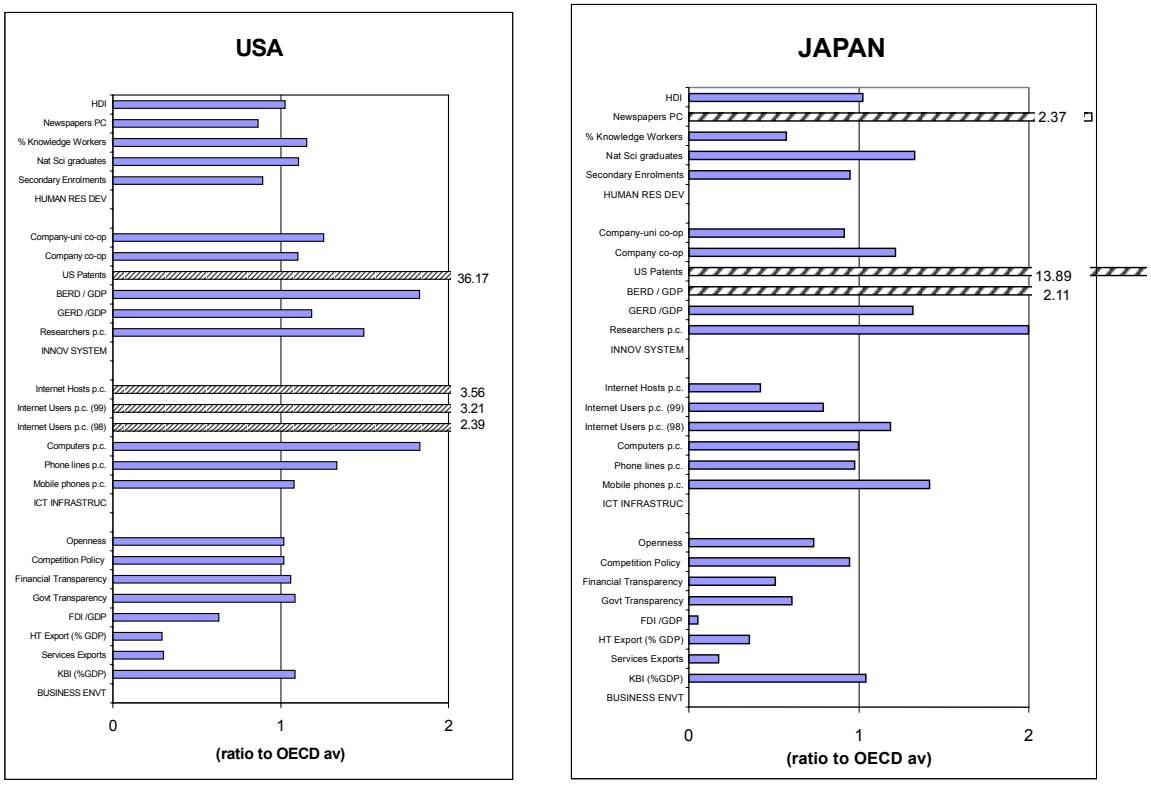


Figure I-4-2
Some KBE Indicators for Australia and Canada
(Scale: 1.00 = OECD Average for That Indicator)

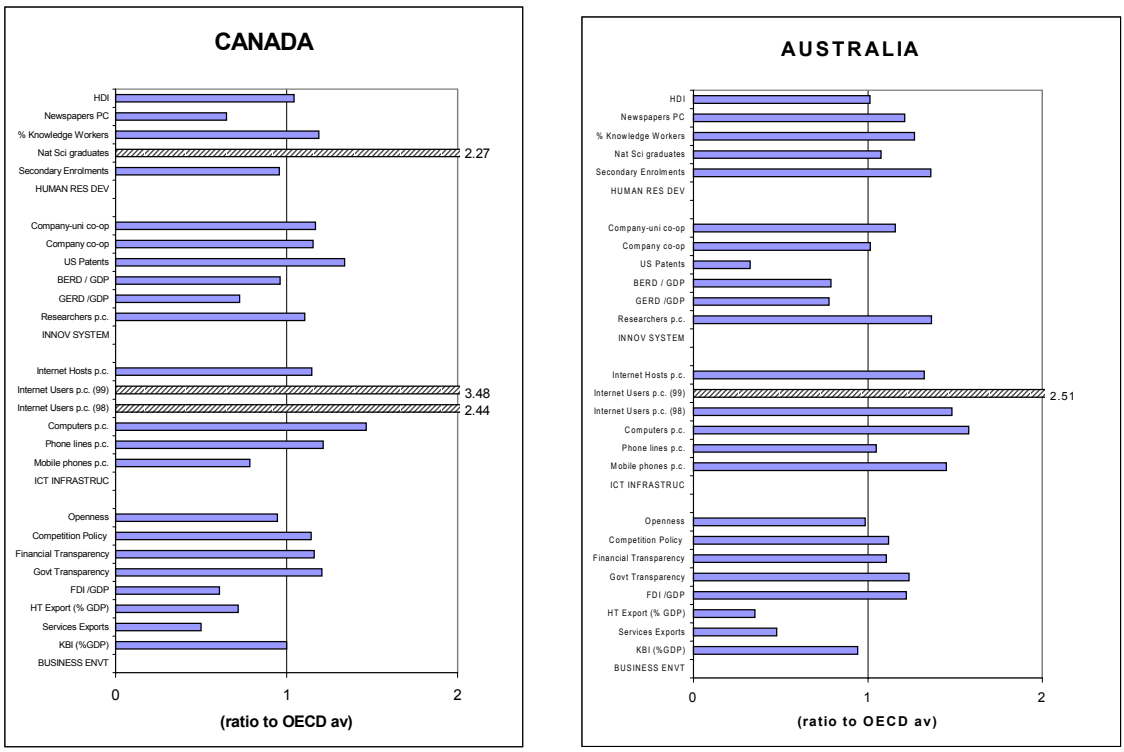


Figure I-4-2 shows, for each of the case study economies, four groups of indicators which relate to an economy's preparedness to become more knowledge-based, namely: information and communication technology infrastructure, human resource development, innovation system, and business environment. From Figure I-4-1, we see that all the indicators for Canada and Australia cluster around the OECD average.[24] This is not surprising, as both are mid-range OECD countries in terms of most economic and social indicators, that is, typical of long industrialised economies. Both are also relatively strong in ICT infrastructure.

Australia and Canada are competitively positioned to gain the benefits from a highly developed ICT sector. In particular, high Internet usage and electronic commerce provide a solid foundation for future ICT expansion. If we consider Australia and Canada as representative studies for other highly developed economies, it appears that further efforts are required by these economies to improve access to computers and the Internet, and to ensure that the costs of this access, and telephone charges (particularly business) are further reduced. Both Canada and Australia have already experienced some of the benefits coming from a well-developed information and communications technology infrastructure, namely higher productivity and employment growth. However, they need to ensure they remain well equipped for future challenges coming from the transition to a fully developed knowledge-based economy.

Both Australia and Canada have a relatively high level of education and training and have recognised the importance of lifelong learning. Nevertheless, the importance of lifelong learning needs to be further emphasised, and training also needs strengthening in participation, length and quality. Australia and Canada also recognise the significance of

research and development and access to venture capital. However, these economies need to further improve commercialisation of research, investment in research, and development by business enterprises.

5. HIGH PERFORMING ASIAN ECONOMIES

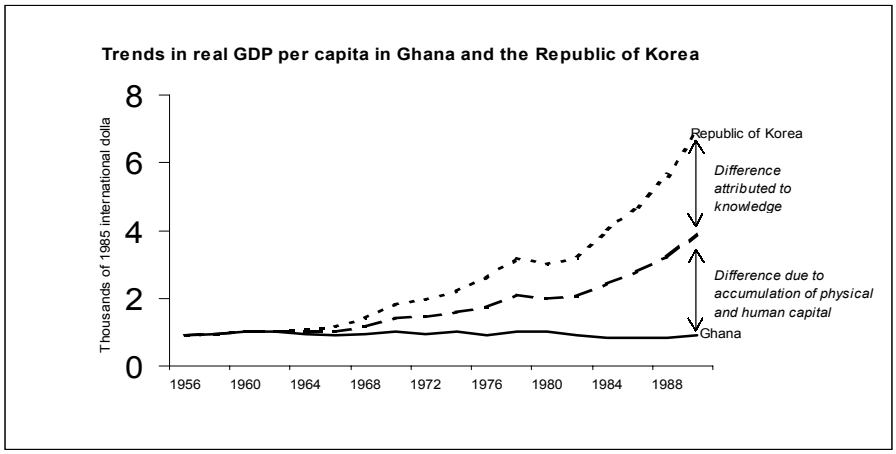
5.1 Introduction

This group of APEC economies comprises Korea, Singapore, Chinese Taipei and Hong Kong (China). All of these economies have been characterised by a rapid and thoroughgoing industrialisation over the past 30-40 years, with a correspondingly rapid growth in GDP, to the point where some of them have a GDP per capita exceeding the average of the long-industrialised OECD countries.

What has enabled these economies to attain this remarkable economic growth, when so few other economies starting from apparently similar positions have not been able to do so? This has been the subject of extensive academic and political analysis,[26] but it is clear that it is not their endowment of natural resources. (None of these economies is particularly rich in natural resources, and the city-states have virtually none apart from a harbour.) In a revealing comparison, Dahlman (1999) has suggested that the key reason, for example, the economy of Korea has grown much faster than that of Ghana, is "the effective use of *knowledge*, broadly defined to include technical and policy knowledge including effective economic management" (see Fig I-5-1).

The economies of most of this group stuttered in 1997, as financial structuring of major industries (in Korea) proved less solid than that of the Most Developed Economies. Much of the work of the APEC Economic Committee since 1997 has been devoted to analysing the causes of, remedies for, and progress in recovering from this "Asian financial crisis".

Figure I-5-1
A Comparison Between Korea and Ghana, Illustrating the Effect of Knowledge on Economic Growth



Source: World Bank (1998), "Knowledge for Development", *World Development Report* (p.22), Reproduced in Dahlman(1999: 38)

It is clear that in both Korea and Singapore, economic growth has since subsequently resumed. One response to the crisis has been to look at microeconomic reform of the regulatory framework of the financial and related sectors, in order to make their markets more open to outsiders.

Another response has been to look to build up a set of new industries - the knowledge-based industries - which appear to offer better and more sustainable growth prospects for the future than those industries which have just foundered. This is one of the major motivations for the APEC project of which this research paper is a part.

This response is exemplified in the two economies chosen as particular case studies, namely Korea and Singapore. In both the government has recently articulated a clear vision of the country's future as a *knowledge-based economy*, and set in train resources and guidance to help the private sector take the economy down this path. The framework for discussion of these countries is the four dimensions outlined in the Introduction, namely business environment, innovations system, human resource development and ICT infrastructure. [27]

5.2 Business Environment

5.2.1 Macroeconomic Overview and Historical Context

In 1960, *Singapore* was a trading port with little domestic industry. Since independence in 1965, while its population has roughly doubled, its GDP has increased 20-fold and its trade 50-fold. Its GDP per capita is now one of the highest in the world. This has come about through the trading and entrepreneurial drive of its people, harnessed by a series of government economic plans taking its economy rapidly through a variety of structural phases. Successively these have included import substitution, labour-intensive industries (drawing on its then relatively low wages for competitive edge), encouragement of foreign investment in capital- and technology-intensive areas such as electronics and petrochemicals (as wages rose), and a strong trading orientation (both for export of finished product and import of raw materials). Explicit financial incentives were offered to multinationals to base their regional headquarters in Singapore, drawing on its central location, educated population, and communications infrastructure. Since 1996, the emphasis has been explicitly on a drive towards a knowledge-based economy, as affirmed (for example) in the *Industry 21* plan of the Economic Development Board (EDB), which states:

> Singapore's knowledge-based economy will be driven by the twin engines of manufacturing and services. Industries will be nurtured under the EDB's six key programmes, supported by a strong foundation of talent, knowledge and infrastructure. These elements strengthen one another in a growth cycle for the knowledge-based economy.

Industry 21 is only one of a series of closely linked initiatives and plans across the full span of government. Others include Technopreneurship 21 (which sets aside around US$1 billion for venture capital), Manpower 21, Singapore-One (which aims to have a computer for every citizen), and "Thinking schools, learning nation".[28] Many of these are described further in other sections of this paper. All of these expand on the vision of Singapore as a KBE, set out in the long-term sections of the report of the Committee on Singapore's

Competitiveness, and offer means of advancing it in particular domains. Coherence of the various strategies is ensured by their shared provenance, and by the cohesion of Singapore's governmental processes.

Government policy has emphasised the efficiency of the market, and non-viable industries are not supported. As Singapore is one of the most open economies in the world, with few restrictions on merchandise trade and capital transactions, competition - albeit with a few exceptions - remains healthy.

As one of the most trade-dependent economies in the world (with both imports and exports valued at over 100% of gross domestic product) Singapore has consistently been a strong supporter of the multilateral trading system, and of greater liberalisation.

As in Singapore, the expansion of modern industry in *Korea* has proceeded through several phases, all of them marked by strong government guidance on the sectors to be pursued, and by an export orientation. Textiles were the first major industry, followed by artificial fibres, and then diversification into heavy industries (steel and then shipbuilding). Since the 1980s, electronics has also become a significant industry. In the past, government guidance has been most influential through direction to the banks, with the government in effect guaranteeing loans to the *chaebol* (family-owned conglomerates) for government-approved projects. (This model of guidance through control of finance and especially of foreign exchange is very similar to the way the Ministry of International Trade and Industry (MITI) exerted "guidance" to industry in Japan for many years.)

This model of directed banking unfortunately also opened the way for the *chaebol* to pursue many projects which were not commercially viable, and left the banks exposed to defaulting loans - which came to a head in 1997.

Korea was thus much harder hit by the "Asian economic crisis" of 1997 than were Singapore and Chinese Taipei, where the industries and exports were more diversified and the financial sector more prudently managed, enabling them to mostly ride out the crisis. In response to the crisis, a major restructuring of the Korean economy was put in place with the assistance of the IMF.

The crisis also provoked a fresh look at the relative role in the economy of heavy, light and service industries. Korea has found itself competing internationally, on the one hand with China (which has taken over Korea's former position as a low-wage manufacturer), and on the other with Japan (which has held an advantage of a higher technology base). One upshot of these considerations has been a more explicit attention in Korea to knowledge-based industries as the engine of growth in the future.

In wider terms, a vision of Korea becoming a knowledge-based economy has now become a key objective of government policy. President Kim Dae-Jung's own book, *DJ-Nomics*, describes a knowledge-based industry as one where added value is enhanced through the efficient use of knowledge and information (that is, maximising the use of computers and the Internet). Thus, the better the technology, the more competitive the industry. Typically, though not always, such industries are found in the services sector.

Korea's policy drive to become a more knowledge-based economy covers a range of sectors including small and medium enterprises (SMEs), education, tourism and the

environment. In 1999, each government ministry has been directed to promote KBIs, which the Ministry of Finance and Economy (MOFE) will integrate into a comprehensive draft policy due to be presented to the President's Economic Advisory Committee by the end of 1999.[29]

MOFE sees the government's role in achieving a KBE as "supporting the development of Korea's human resources, R&D and information infrastructure". As in Singapore, considerable financial resources have already been set aside for such support, and ambitious targets set (see details in following sections). For example, Korea aspires to become one of the "top ten advanced information societies in the world", with one million new jobs and US$23 billion of new production over the next four years from IT alone.

The drastic economic measures taken by Korea from 1997-1998 (including a substantial currency devaluation and restructuring of the financial sector) have taken effect to the point where the Korean economy has turned around quickly following its worst recession of the post-war era. As indicators of this, the short-term interest rate came down from its peak of around 30% to around 7% by the end of 1998, and foreign exchange reserves have risen to a level substantially higher than the country's short-term debt (OECD Economic Survey for 1999). In 1999, real GDP grew by 10.7%,[30] though from a base weakened by the crisis (average rate from 1990-1999 was 6.65%). With crisis management no longer centre-stage, the scene is set for thinking through the new industrial, educational, infrastructural, and social directions that a knowledge-based economy will require.

5.2.2 Structure of The Economy

Various aspects of the structure of the economy for both Korea and Singapore are summarised in Table I-5-1.

Table I-5-1
Structure of the Economy

	Korea	Singapore	OECD average
Foreign direct investment (% of GDP)	0.6% (in 1997)	8.2%	1.1%
Main sectors (% of GDP)	Services (51%), industry (32%) (of which 18% is automobile and shipbuilding)	Financial and business services (25%), manufacturing (26%, of which 11% is electronics)	----
KBIs (% of GDP) [(a)]	40%	57% [(b)]	51%
ICT expenditures (% of GDP)	6.2%	3% [(C)]	6%
Exports of "high technology" manufactures (% of GDP) [31]	11%	91%	10%

(a) Source: OECD *STI Scoreboard* 1999 (wide definition).
(b) Source: Toh, M-H. (1999*) Size of KBE in Singapore and its economic impact*, unpublished paper, NUS.
(c) Source: Toh, *op cit.*

The *Korean* economy has been dominated by the *chaebol,* which are essentially conglomerates controlled by family holdings, and analogous (though not identical) to the *keiretsu* in Japan. The largest *chaebol* are big businesses even by world standards: in 1996 the top four *chaebol* between them accounted for somewhere between 12% and 50% of GDP.[32] As indicated above, several of the *chaebol* moved in the 1980s and 1990s into high technology knowledge-based industries from their former strengths in heavy industry. For example, Samsung and Goldstar (LG) have become major global players in electronics and ICT. Thus by 1997, the principal business sectors in Korea are as indicated in Table I-5-1.

5.2.3 Foreign Investment

Foreign investment, which had been relatively minor in *Korea* before the crisis (Table 5.1), is now more actively encouraged. In 1999, foreign investment in Korea increased to more than US$15 billion (that is, about 2% of GDP) due to the revision of laws and the nationwide restructuring effort.

The differing approaches to foreign investment in Singapore and Korea are related to their differing approaches to technology acquisition, discussed below under "innovation system". In *Singapore*, foreign investment has been actively encouraged since independence in 1965. The main mechanism for doing this is the powerful Economic Development Board (EDB), one of the many government corporate agencies used as policy instruments. Multinational companies (MNCs) represent a key pillar of the economy. They are attracted to the small island republic because of its level of development, advanced infrastructure, the ease of doing business (including language), the pool of labour, a low tax base, and consistent government policies aimed at facilitating business and trade.

Moreover, the Singapore Government maintains a highly visible presence not only as an economic planner and regulator, but also as a player through ownership of various business enterprises. (Unofficial estimates are that the government and companies in which it holds a controlling share account for 60% of GDP.[33])

The Singapore Government now seeks to create a new breed of Singapore-owned multinational corporations. To this end, the EDB aims to nurture promising local enterprises over the next decade to each achieve an annual turnover of over S$100 million. Already a number of Singaporean companies can be considered as MNCs, such as Singapore Airlines, Creative Technologies, and Chartered Semiconductor (significantly, the last two are in ICT). Already there is considerable investment by Singaporean interests in other economies of the region, especially within Malaysia, China and Indonesia.

5.2.4 Knowledge-Based Industries (KBIs)

In Singapore, KBIs are now about 57% of GDP and in Korea 40% (Table I-5-1). Growth of KBIs in both countries has been quite rapid. In Singapore, KBIs (using the OECD "wide" definition),[34] grew from 43% of GDP in 1983 to 57% in 1997 (Toh 1999b); this figure is particularly high because of the relatively large contribution to Singapore's economy from financial and business services, and the low contribution from agriculture. In Korea, KBIs more than doubled between 1985 and 1999 (OECD 1999). This growth rate is much greater than that for the Korean economy as a whole, but the growth pattern

in KBIs in Korea is relatively biased towards hardware production compared to that in other OECD countries.[35]

There are recent projections which suggest that KBIs in Korea will grow to 50% of GDP by 2010, with manufacturing in high-tech sectors (such as biotechnology, telecommunications, and mechatronics) growing by nearly 9% per annum over the next five years. With similar growth projected for knowledge-intensive service industries (such as design, audio-visual engineering, and business consulting) this may lead to over 700,000 new jobs over the period 1999-2003.[36] However, some feel that such projections may be over-optimistic, particularly for knowledge-intensive service industries which are relatively underdeveloped in Korea because of heavy regulation and lack of competition (Hong 1999).

In a knowledge-based economy, investment in ICT hardware and software is increasingly important. By investing in high technology embedded goods, industries can absorb and utilise state-of-the-art technology, and increase value added and productivity. In Korea, investment in information processing equipment such as office and computing equipment, communications equipment, and professional goods increased from 15.5% of total investment in 1990 to 21.4% in 1995.

The growth of ICT hardware manufacturing in Korea is mainly due to the increase in export demand. The ICT industry share of exports rose from 11.2% in 1985 to 24.6% in 1995. The main items are semiconductors and monitors. The volume of high-tech exports from Singapore (US$55 billion in 1998) similarly grew at an average rate of 14% annually from 1990 to 1996. In both countries, there was little growth in these exports from 1996 to 1998.

5.3 Innovation System

5.3.1 Institutional Vehicles for Leveraging Knowledge

Singapore and Korea have succeeded in entering and competing very successfully in the knowledge-intensive semiconductor and computer industries, in large part through adopting strategies focused less on knowledge creation and more on knowledge acquisition, dissemination, and use. Mathews & Cho (2000) argue persuasively that each of these countries has consciously built up an institutional framework - a "*national system for economic learning*" - for leveraging the resources available from the more established players in these industries (notably the US and Japan).

The Korean approach was to use as vehicles of leverage the existing large firms that had been created in the early years of industrialisation. Thus, the Korean policy approach in the semiconductor industry was to prod the existing large firms, which had honed their leverage and export skills through earlier phases of industrialisation, to enter the high-investment high-risk area of VLSI semiconductors in the 1980s. Korea had used a similar process in the 1970s to establish its shipbuilding industry, using technology transfer from friendly overseas concerns to build up indigenous capacity (Amsden 1989: chap. 11; Kim 1999).

The Singapore approach is to recognise that multinational corporations constitute the world's most abundant source of technological competencies, and to use them to secure

access to these competencies. Under this approach, multinationals are offered favourable conditions for location of their activities in the host country, with a view to raising overall skill and technological capabilities, and to set in train a process of upgrading through inducing the multinationals to enhance their own operations and pass on (indigenise) more and more of their own internal capabilities. Since then, many others have followed Singapore's example, and now many regions of the advanced countries, in North America and Europe, also compete vigorously for multinational investment. (However, many would-be emulators of this approach have been much less successful than Singapore in persuading the multinationals to upgrade or indigenise the new technologies. The "secret" of Singapore's success appears to be the resources they put into ensuring strong linkages between relevant policies in all four KBE dimensions, including actively fostering linkages between firms and between sectors.)

5.3.2 Research and Development

In *Korea*, expenditure on R&D by industry is exceptionally high at over 2% of GDP (Table I-5-2). This expenditure grew rapidly between 1994 and 1997, increasing by 15% annually, but stuttered during the financial crisis of 1998, during which many firms closed or reduced their research institutions. Korean patents applied for abroad (in the US) rose by a factor of five over the last decade, while gross expenditure on R&D nearly doubled (from 1.6% of GDP to 2.9%). This reflects Korea's success in semiconductor and telecommunications technology. Korea's arrival at the technological frontier in this field has forced a change in approach from one based on acquisition of knowledge from elsewhere to having to produce their own R&D.

Table I-5-2
Indicators of Research and Development

	Korea (1997)	Singapore (1998)	OECD average
Gross expenditure on R&D[37] (GERD) (US$ billion)	8.6	1.4	29.2
GERD/ GDP (%)	2.9%	1.76%	2.2%
Business expenditure on R&D (% of GDP)	2.1%	1.1%	1.38%
Research scientists and engineers (per million people)	2600	3300	Around 2700
Patents (awarded by US patent office in a year)	2300	120	2200

In most OECD countries, government expenditure on R&D exceeds that of industry, but as shown in Table I-5-2, the proportion of R&D financed by government is relatively small in Korea. While the government has been increasing the resources going into R&D, relatively few government-sponsored research projects are commercialised, and the number of patents and publications arising from them are low. If industries, research institutions, and the academic circle cooperate in carrying out R&D projects, projects will be more market-oriented and the results will be more easily commercialised (Hong 1999).

Many local governments in Korea are building techno-parks and trying to entice domestic and foreign business enterprises, and research institutions with financial/tax benefits. They have hopes that the close interaction inside the techno-parks will result in dynamic

business activity like that occuring in Silicon Valley in the US or the Hsinchu Science Industrial Park in Chinese Taipei.[38] However, experience in other countries suggests that establishing a research-based industrial cluster requires much more than simply supplying cheap real estate near an existing research institution (Scott 1992).

More than 80% of Korea's R&D expenditure is directed towards manufacturing, although some goes to the service industries. Academics perform a considerable proportion of research, but industry is responsible for most commercial activity. A significant role is also played by the numerous industry-sponsored research institutes. For example, one such institute was largely responsible for the development of the CDMA system for mobile telephones now being adopted in many other countries, including Australia.

The *Singapore* Government has committed to further developing Singapore's science and technology capabilities. In 1996, the second five-year S$4 billion National Science and Technology Plan 2000 was introduced to develop strong science and technology capabilities and to support industrial clusters. By placing greater emphasis on R&D, Singapore aims to create new growth areas and opportunities for companies located here.

At 1.6% of GDP in 1998 (over four times what it had been in 1990), Gross Expenditure on R&D (GERD) in Singapore is as big as that in some of the Most Developed Economies, though smaller than in Korea. Notwithstanding the adverse economic conditions which began in mid-1997, the private sector continued to be the biggest contributor to GERD, providing 63% of GERD (that is, around S$1.1 billion.) Similarly, the number of research scientists and engineers in Singapore in 1998 was double what it had been in 1990. The government funds some 14 research institutes and centres at a national level to benefit partner companies, strengthen and preposition industries, and spin off new businesses.

5.3.3 Entrepreneurs and Venture Capital

The National Science and Technology Board (NSTB) of Singapore has for some years now been providing substantial funds and infrastructure to assist the development of high-tech entrepreneurial business in Singapore, to develop Singaporean talents and attract talent to Singapore.

For some years the NSTB has been nurturing "technopreneurs", that is, people with the capacity to build high-tech start-up enterprises. Currently there are about 70 venture capital funds in Singapore, including NSTB's S$150 million Technology Development Fund. To further boost technopreneurship development, a *Technopreneurship 21*(T21) plan has been formulated, to be overseen by a ministerial committee. A key feature of T21 is a very substantial US$1 billion Technopreneurship Fund. In terms of infrastructure, the current science parks are to be further developed into a $5 billion Science Hub, with the intention of nurturing and developing into commercial ventures ideas born within the scientific community.

With the encouragement of the government, large *Korean* firms have been willing to back new product development. Nevertheless, financial institutions still hesitate to lend money or invest in smaller venture businesses since they don't have the know-how to evaluate venture business (Hong 1999). To loosen this credit blockage to venture business, the Korean government lends start-up expenses at a low interest rate and forms matching funds with private financial institutions to invest in venture business. To induce

individuals to invest in venture business, it also offers various tax incentives and develops the stock market for venture firms (KOSDAQ).

5.4 Human Resource Development

5.4.1 Knowledge Workers

The proportion of the workforce which can be classified as "knowledge workers" is particularly high in *Singapore* (around 38% - see Table I-5-3), in part because Singapore has built itself up as a regional centre for financial and business services, particularly in the form of regional headquarters of MNCs. The corresponding figure for Korea (33%) is not much less if "craft and related workers" are included. These figures compare favourably to the OECD average of around 28%, reflecting the relatively high educational standards in all these countries.

Table I-5-3
Some Indicators of Human Resource Development

	Korea	Singapore	OECD average
Expenditure on public education[39] (% of GNP) (B)	3.7	3.0	4.6%
Secondary Enrolment[40]	97	72	87.6
Adult education participation rate (% of age group 25-64)	5.4%		Around 20%
% of population with post-secondary qualifications[41]	21.1%	7.6%	16.75%
Knowledge workforce (% of total)[42]	18% (30%)	38% (53%)	Around 30%

5.4.2 Education and Training

In both Korea and Singapore, rates for literacy and completion of secondary school among recent cohorts are on par with other developed countries. The base of primary education was vital to the industrial development of both countries from the 1960s. The biggest educational change since the 1960s has been the increasing proportion of people completing tertiary qualifications. In both Singapore and Korea, the proportion of each cohort with tertiary education has jumped five-fold in the last 20 years.[43]

In relation to the HPAEs generally, Amsden (1989: 9) points out that the agent of expansion in all late industrialising countries is the modern industrial enterprise. The protagonist of industrialisation has shifted from the entrepreneur in the late 18th century to the corporate manager in the late 19th, to the salaried engineer in the late 20th. Salaried engineers are key figures in late industrialisation because they are the gatekeepers of foreign technology transfers.

In Korea in particular, salaried engineers have performed exceptionally well because society has invested heavily in education from the primary level up (compared to many other countries which were also underdeveloped in the 1950s and 1960s). In terms of sheer quantity, enough engineers have been trained to ensure that sufficient numbers

pursue the career intended by their eduction. The relatively high pay of teachers is another indicator of the importance attached to education, as are the educational qualifications of many senior managers and officials in Korea.

In recent times, movement of labour, rapid changes in technology, and downsizing have discouraged firms from investing in retraining programmes, and firms have considered them a cost rather than an investment. As a result, adults in Korea have a relatively low education participation rate (Table I-5-3). In response, the Korean government aims to increase the flexibility of the education system, including the vocational training system, to more adequately satisfy the demands of industry in a knowledge-based economy.

To address the industry manpower needs in a knowledge-based economy, the Singapore Government has similarly made changes to curricula in schools and universities so that students have more time and opportunities to explore and experiment. This should help to nurture the innovative and creative capabilities required by a knowledge-based economy.

The Singapore Government has also increased the funding support for manpower and innovation development. Funding for the *Initiatives in New Technology* grant scheme for manpower development in leading-edge technologies has been increased to S$800 million, while that for the *Innovation Development Scheme* has been increased to S$750 million. The Singapore Government has also initiated numerous more specialised and smaller training programmes (some described by Toh 1999). These include the S$120 million Skills Redevelopment Programme, to help mature and retrenched workers reskill for employment in new industry areas, and the International Manpower Programme designed to bring skilled foreign workers into Singapore.

Over the last few decades a large number of students from Korea and Singapore have undertaken postgraduate studies overseas, especially in the US. Considerable policy attention is paid to ensuring that they bring their expertise back to their home country. Such technically trained returnees were especially important to skills development in Chinese Taipei in the 1980s, when their numbers exceeded 14,000, which was over 40% of the home-trained counterparts.

5.5 ICT Infrastructure

The main programme of the *Korean* Government to promote the knowledge-based economy is *Cyber 21*. A committee chaired by the Prime Minister developed this ambitious programme, the basic aim of which is to strengthen Korea's infrastructure so that by 2002, the digital network will cover every household. The intention is to provide equal access across all areas. The pricing policy aims to provide high-speed Internet access at less than 40,000 won (US$40) a month by 2002. In developing this goal, the government noted the forecasts for the GNP for 2002, which suggest that at this price everyone will be able to afford access.

To construct a high-speed information network, the Korean Government not only provides investment funds for the national information infrastructure, but also addresses various problems such as standardising application software programmes and nurturing competent professional human resources. According to the 1997 White Paper by the Ministry of Information and Communication, a total of 40.2 trillion won is to be invested between 1998 and 2010.

The government will fund only 3.2% of the total (mainly to construct KII-G, that is, the sub-network for use within the government); the rest is intended to be provided by the private sector. However, since demand for information and communications still remains low, and firms have financial difficulties due to the IMF situation, the private sector has postponed much of its investment. To achieve the KII-G project on schedule, the government is assisting the private sector to finance funds with direct measures (financial and tax incentives). Indirectly the government induces the private sector to invest in KII-G by introducing competition and deregulation in the telecommunications market.

This support is part of the very substantial US$1 billion per annum allocated by central government for "informatisation" – an umbrella term which appears to cover the whole range of policies directed towards bringing Korea into the information economy, ranging from the development of infrastructure to the implementation of particular administrative practices, and projects such as putting cultural images into digital form.

Internet usage in Korea has certainly grown dramatically, with the number of users doubling every year since 1994 - including from 1998 to 1999 (Table I-5-4).

In his New Year's message for 2000, President Kim Dae-Jung announced plans to implement the education component by the end of 2000, two years earlier than originally scheduled. This involves installing the high-speed network to every primary, middle and high school, while offering computers free of charge to teachers and schoolrooms.

To facilitate access by the general public, the government is organising, through the post offices, around 100 Internet plazas that provide free Internet access. They will be developed at the rate of 25 each year and will be in medium-sized cities. Big cities already have good access. For example, within Korea there are already around 6,000 PC games rooms - all of which have computers that provide fast Internet access at 1,200 to 1,500 won an hour. There are also many free computer education programmes that target the rural population. The Ministry maintains a database containing full information on these courses. These courses may be available through post offices, training rooms, or through firms such as Samsung.

One problem for Korea is that most information on the Internet is in English. The Internet is not just a national environment but an international trading environment. Thus, the government is urging Koreans to improve their proficiency in English. It is also looking at Chinese because this may become a major Internet language. The government has no special programmes to promote or encourage Korean language home pages.

MOCIE has drafted legislation to help establish the regulatory environment for electronic commerce and trading. The National Assembly has passed the legislation and is now working on the Presidential implementation decrees. The legislation addresses issues such as security and privacy.

Table I-5-4.
Selected ICT Indicators

	Korea	Singapore	OECD average
ICT expenditure (% of GDP)	6.1		6.9
- hardware	1.7		1.3
- software			2.8
- telecommunications	3.6		2.8
% of households with a personal computer	Over 50% (2000)	59%	n/a
Mobile phones per 100 people (annual % of growth rate 92-97)	46% [Oct 1999] (growth 89% per annum)[44]	40% [2000]	15 [1997] (growth 60% per annum)
Internet hosts per 10,000 people	40	210	470 (high income economies, Jan 1999)
Internet users (% of population)	5.9 million (Sept 1999) (13%) 14 million (Mar 2000) (30%)	1.6 million (June 1999) (42%)	

Source for 1999 and 2000 data on Korea is MOCIE working paper.

Singapore has a similarly ambitious programme to install the world's first nationwide broadband network, *Singapore-One*. Announced in June 1997, it is intended to deliver a new level of interactive multimedia applications and services to every home, school and office in Singapore. It has two main components:

- an infrastructure of high capacity networks and switches (with capacity to handle ATMs, and voice, data and audio and video information
- applications and services (such as online shopping, home banking, news, education, games, government services).

By October 1999, the cabling (rated at 1.5 Mb/s) had been connected to the doors of almost all households in Singapore, and a wide range of government information (and entertainment) is available over the network; interactive government services such as bill-paying, however, are still to come.[45]

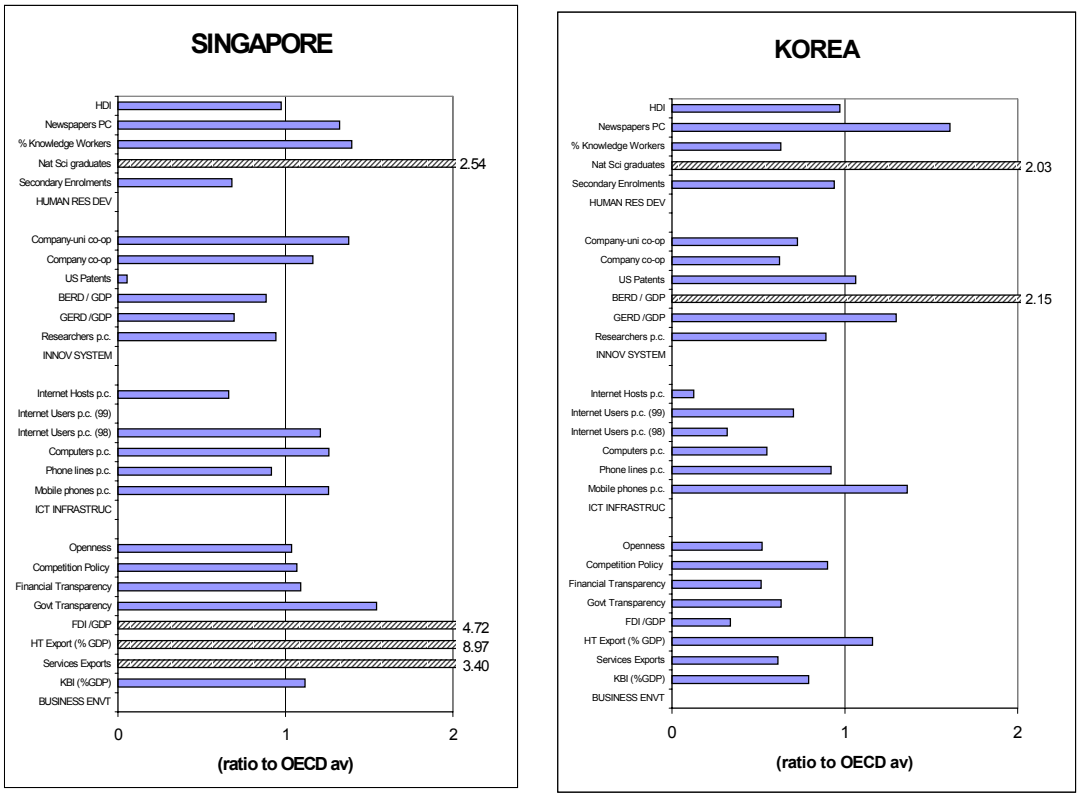
Somewhat contrary to this effort to open communication to the world, Singapore attempts to censor the Internet, as do a few other APEC economies. Regulations of 1996 require Singapore's Internet Service Providers (ISPs) to install proxy servers to block access to sites that "may undermine public morals, political stability or religious harmony". However, it is widely believed in the ICT industry that such regulations are likely only to pass business from local ISPs to overseas ISPs, which by the universal nature of the Internet are readily accessible.

5.6 Summary and Conclusions

Figures I-5-2 collects key indicators relating to a KBE for Singapore and Korea respectively (Scale: 1.00= OECD average for that indicator). As indicated on the figures, the indicators are divided into groups corresponding to the groups of characteristics reviewed in this chapter, namely: ICT infrastructure, human resource development, innovation system, and business environment. In the charts, the value 1.00 is the OECD average for each indicator. Most of the data are for 1997.

For *Singapore*, each group of indicators is close to, or exceeding the OECD average, showing that Singapore has the ICT infrastructure, human resource development and business environment in place to allow it to continue its growth as a KBE, at least as strongly as the most developed OECD economies. This is a consequence of the strong and conscious national drive to establish Singapore as a KBE, following the analysis of the influential 1997 Committee on Singapore's Competitiveness, which concluded that the KBE path offered Singapore's best – perhaps only – path to sustained economic success (given its almost complete lack of natural resources and its high wage structure, which has followed from Singapore's rapid and planned movement up the value chain over the past 20 years). Indeed, on the two key indicators of current status as a KBE (as distinct from preparedness to become one), Singapore outranks most OECD countries. (These indicators are: the proportion of "knowledge workers" in the labour force, and the value added by "knowledge-based industries as a proportion of GDP".) Given the resources it has devoted and continues to devote to education, training, and ICT infrastructure, and to encouraging foreign investment that adds value and brings new technology into their clusters of KBIs, it would be fair to say that Singapore is "betting the economy" that the KBE is its path to the future.

Figure I-5-2
Selected KBE Indicators for Singapore and Korea



Like Singapore, *Korea* has over the last 30 years consciously and successfully pursued an export-led national strategy to move up the value chain into ever more knowledge-intensive industries. All of these "Asian tigers " have enjoyed spectacular growth in GDP and knowledge-intensity to the point where all are major players in a cluster of high-technology industries centred on semiconductors and IT. Korea's strategy for leveraging

knowledge from elsewhere into production has been different from Singapore's, giving a greater role to its own large industrial concerns (the *chaebol*) and less to multinational foreign investors. This difference is reflected in Korea's exceptionally high figure for business expenditure on R&D (BERD); this expenditure nearly doubled in the 1990s, as Korea found itself at the technological frontier in some key industries. Although Figure I-5-2 suggests Korea lags behind some of its competitors in ICT infrastructure, Korea has been devoting much of its resources to improving this aspect since 1997, as part of an explicit national drive to become a KBE, so that on more current figures Korea would compare more favourably.[46] The proportion of value added by "KBIs" in Korea is lower than that in Singapore, in large part because of its smaller commercial and financial service sector, but is still very substantial. In short, Korea, like Singapore, already has many of the characteristics of a KBE, and has the preparations in place to move further in this direction.

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6. ASIAN FAST-GROWING ECONOMIES

6.1 Introduction

This group of APEC economies comprises Thailand, the Philippines, Malaysia, Indonesia, the People's Republic of China, and Viet Nam. They are all Asian economies whose state of industrialisation and GDP per capita are currently somewhat less advanced than the High Performing Asian Economies discussed in Chapter 5. To make the task manageable, the analysis in this section focuses on Thailand and the Philippines. These economies have been chosen as case studies because reforms currently under way in both are illustrative of the general direction of various reforms adopted throughout this group of economies, and the availability of data on them. These case studies provide a broad overview of the characteristics indicative of the development of a KBE relevant to economies at roughly similar stages of development. While China and Viet Nam now have many characteristics similar to others in this group, their histories as centrally planned economies have resulted in a very different economic character.

In the wake of the Asian financial crisis, the development of this group of APEC economies has been subject to intense examination. Prior to 1997, having experienced sustained rapid economic growth throughout the 1980s and early 1990s - in which the GDP of some achieved double-digit growth rates – these economies were being hailed as yet further examples of the 'Asian miracle' beyond even the High Performing Asian Economies. However, the massive flight of foreign capital from Thailand in the early half of 1997 - which left the economy with a foreign debt of US$89 billion - and the subsequent floating of the Thai baht in June 1997 marked the beginning of a recession affecting not only these particular economies, but also others throughout the entire region.

A significant consequence of the crisis has been to stimulate discussion regarding the efficacy of the development model adopted by these economies. The widespread economic and political reforms undertaken in the process of recovery have highlighted various structural weaknesses. The direction of the reform programmes initiated by Thailand and the Philippines, as discussed below, is broadly consistent with the development of a knowledge-based economy. The framework for discussion of these countries is as outlined in the Introduction, namely: business environment, innovation system, human resource development and ICT infrastructure.

6.2 Business Environment

6.2.1 Macroeconomic Overview and Historical Context

Thailand had the world's fastest growing economy between 1985 and 1995 with GDP growing at an average rate of 10% per annum. This rapid growth was the result of dramatic changes in the Thai economy, which saw its transformation from a largely agrarian economy in the 1960s to a newly industrialising economy in the 1990s.

In the 1950s and 1960s, Thailand sought rapid development by promoting the growth of agricultural exports. Unlike economies such as Korea and Taiwan, where agricultural land and other natural resources were so limited that they had to pursue manufactured export growth earlier on, Thailand was able to rely on prolonged primary export and import-substitution growth based on agricultural expansion. The imperative to embark on export-oriented industrialisation strengthened only in the 1980s as the limits of import-substitution and agricultural growth were manifestly exhausted.

Beginning around 1988, Thai policymakers signalled this new direction through export-oriented promotion incentives which included exemptions and reductions in income taxes and business and sales taxes, as well as exemptions on import duties for machinery, equipment and raw materials. These incentives were conditioned upon an industry's export performance - namely, 80% - 100% of output had to be for export (Rong-I Wu 1998). Encouraging foreign capital investment and corporate activity became an overarching economic goal. In particular, the involvement of transnational corporations (TNCs) as a source of capital which could replace state investment but continue the drive for expanded industrial activity was considered essential. Importantly, "TNCs were also seen as providing technical and entrepreneurial skills" (cited in Bello 1998: 11); the new strategy sought to develop Thai manufacturing capability through a mixture of infant industry protection and access to foreign technology.

While the Thai government pressured foreign companies to set up joint ventures, it made no attempt to require or accelerate technology transfer. While some firms were successful in absorbing technology from their overseas partners, the government did not insist that such transfers be obligatory. This reinforced the objectives of these companies in choosing Thailand because of its favourable labour costs (TDRI 1992). The enthusiastic response of foreign and domestic capital to Thailand's new emphasis on export-oriented manufacturing convinced policymakers that they could now rely on manufacturing for export growth as they had relied on agriculture in the past. As one author asserts, "the overriding mindset of policymakers remained the same: Thailand's development still depended on export success, and the government's role was still to facilitate exports, except that the source of export growth had changed from agriculture to industry" (Jomo 1997: 66).

The opening of the Thai economy to international trade and capital flows produced a decade of unprecedented high growth from the late 1980s to the mid-1990s. However, an apparent lack of financial planning and policy miscalculations in the 1990s undermined Thailand's trade competitiveness and facilitated excessive foreign capital inflows, particularly short-term borrowing, much of which went to speculative activities. By the mid-1990s, after years of double-digit growth, the overheated Thai economy went into recession. Symptoms included the collapse of the stock market (beginning in 1996), the

sharp decline in export growth to negative levels after exceeding 20% in 1994 and 1995, and the concomitant fall in import growth from over 30% in 1995 to less than 1% in 1996. By mid-1997, Thailand was in the midst of its worst financial crisis since independence.

Extensive scholarship has been devoted to discerning the cause of the economic crisis and, more importantly, the means to avoid its recurrence. This endeavour has prompted debate regarding the fundamental sources of economic growth and development and ways to sustain that process. In particular, commentators have questioned the sustainability of the rapid economic growth experienced by Thailand based simply on "increasing factor inputs – that is, accumulating physical capital, mobilising labour and acquiring technology developed elsewhere – rather than on the development of new technology and the enhancement of efficiency of production" (APEC Economic Outlook 1998: 67). With respect to Thailand, some authors have expressed this argument in terms of the apparent lack of a comprehensive industrial policy to guide long-term economic growth (Jomo 1997; Bello 1998).

The financial crisis of 1997/1998 turned the spotlight on serious structural weaknesses in the Thai economy and the policy making and implementation processes. Consequently, since 1997, the government, with the support of the IMF programme and other international financial institutions, has introduced several important structural reforms and is committed to implementing many more. The implementation of these wide-ranging reforms - affecting economic and corporate governance, the allocation of capital, and the operation of the legal system[45] - is critical to Thailand's emergence as a KBE.

Following independence in 1946, the outlook for the economic and social development of the *Philippines* was optimistic. Endowed with favourable natural and human resources, the economy appeared likely to generate rapid economic growth. In 1960, Philippine per capita income ranked sixth in East Asia after Japan, Hong Kong, Singapore, Chinese Taipei and Malaysia. Of the population aged 10 years and over, 72% were literate. It was one of the first countries to provide universal primary education, with the public system supplemented by a network of private educational institutions. Various agreements between the Philippines and the US gave the Philippines preferential access to US markets and created a level of political comfort that made the Philippines a favourite destination for US foreign investment. However, despite such favourable conditions, the Philippines' subsequent economic history was one of unfulfilled promise.

From the 1970s to the early 1990s, the Philippines had the lowest GDP growth in the region. This poor economic performance has been attributed largely to a combination of poor economic planning, external shocks, natural disasters and political instability. The Philippines pursued inward-oriented, protectionist, import-substituting trade and industrial strategies longer and more indiscriminately than did any of the more successful East Asian economies (DFAT 1998). Tariffs replaced generalised import controls in the early 1960s, and by the mid-1970s, the Philippines had the highest average tariff rates in ASEAN. Shielded by high rates of protection, production efficiency fell well below world best practice. Consequently, growth stagnated and the economy lagged behind neighbouring Asian economies.

However, reforms instigated under the Aquino administration (1986-1992) and largely implemented during the presidency of Fidel V. Ramos (1992-1998) have transformed the Philippine economy. Wide-ranging liberalisation of the economy has been undertaken in

the form of the elimination of monopolies, the opening of restricted or banned sectors to foreign investment, the privatisation, wholly or in part, of government corporate holdings, and the easing or lifting of tariff and other trade barriers (EIU 1999: 3). By contrast, however, the development of the mining sector has been severely held back by widely held public attitudes of economic nationalism and negative perceptions of mining for environmental and social reasons (poor track record of local miners as well as foreign-owner environmental disasters). This has deprived the economy of much potential export revenue.

The IMF has argued that the implementation of such reforms - although to varying degrees - has been essential to the Philippines' gradual emergence in the 1990s from decades of slow growth and economic imbalance, and in ameliorating the effects of the recent "Asian crisis". However, the pressure of recent shocks has highlighted remaining structural weaknesses that need to be addressed for sustained rapid growth and development.

6.2.2 Structure of the Economy

Foreign Investment

Foreign direct investment has played an important role in *Thailand's* rapid economic growth. Between 1985 and 1990, the net flow of foreign direct investment increased 14-fold from US$178 million to US$2.5 billion. The proportion going to industry rose from about a third of total net inflow in the early 1980s to over 40% later in the 1980s and 1990s (Liepziger 1997: 363). The proportion going to export-oriented industries also increased from 41% in 1980 to 88% in 1989 (Jomo: 70).

From the late 1980s and in the 1990s, over two-thirds of the net inflow came from Japan, Hong Kong and Chinese Taipei. As these economies prospered from their own earlier export booms, wages and other production costs increased. Consequently, Thailand presented an attractive alternative location for cheap labour costs. In recent years, the majority of investment has flowed into labour-intensive assembly of the electrical, electronics and automotive industries. Prior to the crisis, the scale of industry grew significantly. Honda started building its largest plant outside Japan designed for worldwide export in Thailand. Samsung announced a huge new semiconductor plant. Toshiba laid plans for a range of electronic component plants. For most of these products, Thailand has primarily remained an assembly base.

Indicative of Thailand's recovery from the upheaval of the economic crisis, levels of foreign direct investment remain high at 2% of GDP. As foreign investment is central to Thailand's economic policy, maintaining competitiveness is essential, and ever more so with low-cost competitors like China and VietNam becoming increasingly attractive to foreign investors. To remain competitive, Thailand must develop its technological capabilities in order to move beyond labour-intensive industries to more skill-intensive industries.

The *Philippine* economy is diversified with a wide range of resource endowments, both physical and human. In recent years the contribution to GDP of manufacturing has been about 25% - 26%, of agriculture, fishing and forestry 22% - 23%, and of the services sector around 30%. The manufacturing sector is the single most important production sector in the economy (EIU 1999: 21). A notable feature of the Philippine economy is the

substantial proportion of remittances from expatriate Filipino contract workers and emigrants. The World Bank has estimated that such remittances were in the range of 2.2% - 4.5% of GDP in 1991, and the percentage has risen substantially since then. Trends in these inflows have an impact on the pace of overall economic growth (EIU 1999: 22).

Under the Ramos administration, most sectors of the Philippine economy were opened to foreign direct investment, removing many previous impediments to foreign investors by such means as lowering tariffs and removing other barriers to trade, and introducing new laws, such as the Build-Operate-Transfer law, which were seen as pro-business (DFAT 1998: 26). These liberalised investment policies built business confidence in the Philippines and facilitated the sharp acceleration in FDI after 1993. From 1993 to 1996, FDI grew at an average annual rate of 43%.

Leading the FDI recovery has been manufacturing investment with a strong and reasonably sustained rise from 1990 to 1996. Over this time, the sector attracted about 55% of total FDI inflows. Within manufacturing, the key growth sector is electrical and electronic products with the Philippines becoming an increasingly attractive destination for foreign investors as wages increased in Singapore, Malaysia and Thailand.

The revitalisation and expansion of special economic zones in the early 1990s has been of particular significance to the recent growth of FDI. Economic zones and industrial parks are very popular with investors as generally they provide tenants with reliable infrastructural services, good transport links to ports and airports, generous fiscal incentives, and streamlined government procedures. Registered foreign and domestic firms operating in these zones increased from 57 in 1986 to 553 in 1996. Exports from the economic zones rose to 42% of total Philippine merchandise exports. Zone imports increased from 3% of total Philippine imports in 1986 to 19% in 1997.

Trade Exposure

Thailand has long relied on international trade as an engine of development. Thus, since the mid-19th century Thailand has maintained a relatively open economy. Thailand's main trade destinations are the United States and Japan, with 22.3% of total exports and 13.7% respectively. However, Thailand also conducts significant trade activity within the region, primarily to Singapore, Hong Kong and Malaysia.

Prior to the crisis, Thailand maintained a trade to GDP ratio of around 50%. A key contributor was (and still is) the electronics export industry, with 14.21% of GDP comprised of high-tech exports. Electronics and computer equipment have become the principal export products with over US$7 billion exported in 1998. Textiles, once the principle export, have been reduced to around US$4 billion. Thailand has recovered steadily since its negative export growth in 1996. This improving export performance continues as a result of increased volumes of electronics exports.

Similarly, the US and Japan are the *Philippines'* dominant trading partners. However, the Philippines has diversified its markets and, in particular, expanded its trade with Singapore, Hong Kong and Thailand. As an import source, Japan has been growing in importance, reflecting its substantial investment in manufacturing in the Philippines. 80% of China's foreign trade and 90% of its overseas capital are also sourced from the region, with Japan, the US, Hong Kong, South Korea and Chinese Taipei as major trading and

investment partners.

The Philippines had a trade to GDP ratio of around 56% in 1997, of which the main contributor was also the electronics export industry. The significance of electronics and electrical equipment to Philippine export earnings is illustrated by its dramatic increase since the mid-1970s. In 1976, electronics and electrical equipment accounted for 3% of total export earnings, rising to 15% in 1981, 24% by 1990 and to 51% in 1997.

KBIs

World Bank figures show that high-tech exports (computers, integrated circuits, electrical appliances) from Thailand account for 43% of manufactured exports. Technology-intensive exports grew almost 12% from 1990-1994, with electronics playing a key role at about 30% of total exports. By 1995, computers and related parts displaced clothing as the top export earner.

Export growth in the *Philippines* in the 1990s has also been driven largely by exports of microcircuits and semiconductors. The average annual value of semiconductor and electronic microcircuit exports increased more than five-fold between 1980-1985 and 1994-1997, lifting this category from 11% to 27% of total exports. The industry has been instrumental in attracting high quality foreign investment and providing employment - employment in integrated circuit (IC) packaging and related activities in the Philippines passed 100,000 by the mid-1990s. The Philippines is also home to a large IC packaging operation owned by the Korean Anam group, which by the 1990s had become the largest contract IC packaging firm in the world (Mathews 1999: 59).

Despite this high growth, the figures conceal an underlying problem for the Thai and Philippine economies and societies generally: that the technology upon which such export growth is based is not indigenously developed but imported. For Thailand, while the acquisition of such industries may seem advantageous for the development of local industry, this advantage may be superficial. In other words, Thailand is being used merely as an assembly plant, and the continued low level of education for the majority of Thais lessens the likelihood that Thailand will have a large pool of local technicians available to make the transition toward high-tech manufacturing. A notable example is the US-owned software house Microsoft, which recently chose Malaysia over Thailand for its Southeast Asian plant, apparently because more trained workers were available (EIU 1999: 25). Without indigenous input in its high-tech industries, there is little to guarantee that this situation could change quickly as manufacturers move to other countries with a cheaper skilled labour pool.

In the Philippines, analysts are concerned that the assembly and testing that constitutes the main component of the IT industry in the Philippines is low value added. Furthermore, since assembly and testing do not require any sophisticated manufacturing technologies, technology transfer is minimal. The low-level assembly characteristic of the IT industry is in itself a constraint for the industry to absorb new and more advanced technologies which is a critical factor to remaining competitive, given the rapid change of technology in the industry (PIDS 2000: 20). This situation is compounded by the lack of investment in R&D as will be discussed below.

6.3 Innovation System

6.3.1 Science Base

In the late 1980s, the *Thai* Government turned its attention to policy proposals for the improvement of educational levels and research and development as Thailand increasingly found itself less competitive than many of its neighbours when it came to wages. Yet total R&D expenditures in Thailand came to only 0.22% of GDP in 1990 and fell to 0.18% in 1997. While the mid- and late-1980s saw the founding of a number of government R&D institutes or government-linked university-based research centres, R&D remains in an embryonic state.

In 1997, Thailand's R&D expenditure came to US$277 million. Although higher than Malaysia and the Philippines, who spent US$195 million and US$115 million respectively, it was significantly lower than that of Korea (at US$13,522 million), Chinese Taipei (at US$5,445 million) and Singapore (US$1,417 million). These figures are even starker as a percentage of GDP, with Thailand at 0.18%, Korea 2.79%, Chinese Taipei 1.9%, and Singapore 1.48%. The share of business expenditure on R&D was even bleaker at only US$42 million.

Similarly, the number of research personnel is very low. With only 12.8 full-time equivalent (FTE) researchers per 1,000 population, Thailand falls behind even the Philippines with its 15.6 FTE researchers per 1,000 population.

Recently, a number of programmes and plans have been launched recognising the need to strengthen and modernise the *Philippine* science and technology base. These include the S&T Master Plan (STMP 1990-2000), which was prepared in 1990, and which has served as the framework for S&T development in the economy; the Science and Technology Agenda for National Development (STAND Philippines 2000), which outlined the medium-term technology development plan for 1993-1998; and the IT Action Agenda for the 21st century (IT21),[47] which was launched in 1998 as a follow-up to the previous plans, reiterating the Philippines' recognition of the importance of science and technology development.

However, despite the expressed importance of science and technology and R&D development in the Philippines and this series of well-intentioned strategies, the state of science and technology and R&D development remains significantly behind other Asian economies. Possible reasons for this are the failure to utilise science and technology for development as reflected in the low value added and low productivity of the production sectors, particularly the manufacture of electronics and electrical equipment; slow commercialisation of technologies due to poor linkages between science and technology organisations and industry and government agencies; underinvestment in science and technology development in terms of human resource capabilities and technological services; and low private sector participation in R&D activities. To achieve the desired transformation of the Philippines into a "knowledge centre in Asia" within the first decade of the 21st century[48] - for which IT21 provides the strategic agenda - these factors must be resolved.

A more fundamental problem facing the Philippines' science and technology sector is the lack of coordinated planning in relation to science and technology development and R&D.

Such generalised plans for science and technology modernisation as outlined in STMP and STAND 2000 appear ambitious, given the limited financial resources available for these programmes. This suggests a weak linkage between planning and budgeting. That in 1997 R&D expenditure was only 0.22% of GDP - of which 60% came from the government - underlines the very limited scope for substantial science and technology development for the foreseeable future.

Most of the technologies being used in the Philippines are imported but are not accompanied by the development of an indigenous science and technology capability. This is shown by the proportion of patents granted in the Philippines to foreigners. Of the 19,404 patents granted for the period 1985-1994, 14,164 or 73% were foreign-owned. Conversely, in 1998, a mere eight patents were approved in the US for Filipino residents. In the period 1979-1993, there were 1,504 technology transfer agreements (TTA) with foreign technology suppliers.

6.3.2 Technology Diffusion

"Effective technology transfer means having the expertise to use the hardware in question, being able to adapt the new technology and existing systems to make them fit each other, and rethinking methods of organisation, skills development, and operation" (Vervoorn 1998: 254). In Thailand, the scarcity of local skills in science and technology is imposing a bottleneck on the rapid diffusion of knowledge. The impact of this bottleneck is best illustrated by the fact that it is now 20 years since the first integrated circuit (IC) factory was set up and still the development of a local electronics industry has not materialised.

At present, there are more than ten multinational producers of ICs in Thailand, but most of their operations consist of low value added, low-skilled chip-assembly work (TDRI 1992: 102). Many of these companies were invited in under the rationale that they would be transferring technology or spurring technological innovation. The low level of technological innovation reflects the fact that in foreign-owned firms and joint ventures, "almost all product development in the industries, particularly products manufactured for export, has so far taken place overseas, with export products being manufactured according to the specifications required by and submitted from parent firms or buyers overseas" (Yuthavong 1997: 32). In other words, the foreign subsidiaries or joint ventures are meant to be centres not of technological innovation, but of cheap labour using sophisticated equipment (TDRI 1992).

In the Philippines, there is policy recognition of the importance of promoting innovative enterprise and R&D amongst local industries. Legislation introduced in 1992 provides incentives packages to small and medium enterprises (SMEs) to encourage the development of inventions and facilitate their commercial application, such as tax exemptions, loan assistance to support training, study tours, piloting and laboratory testing. However, despite these incentives, significant hurdles remain for SMEs to acquire technology and engage in R&D, of which the most problematic are lack of financial support, lack of technological know-how to utilise more advanced technologies, and inadequate mechanisms for the transfer of technology (PIDS 2000: 12).

As evident in Thailand, a significant gap exists between the high levels of foreign investment in the Philippines by high-tech manufacturing companies such as Intel, Apple Computers and Cypress Semiconductors, and the capacity of local industry to absorb and

adapt this technology. Technology Transfer Agreements are in place to facilitate the process, but infrastructural and institutional bottlenecks and the inadequacy of the educational system to meet the human resource requirements of the industry severely constrain the development of a competitive local industry.

6.4 Human Resource Development

6.4.1 Education and Training Base

In the education sector, the reform movement currently underway is the most comprehensive and far-reaching in *Thailand's* recent history. With the introduction of the new *National Education Act,* a major overhaul of the education system is envisaged.

Perhaps the most glaring human capital problem facing Thailand is a bottleneck at the secondary school level. The share of the employed population with a secondary or vocational school education was just 9% in 1996, which is consistent with the enrolment rate at secondary school at just over 40%. More than 60% of the Thai labour force is still in the agricultural sector as opposed to 40% in the Philippines. Out of the total labour force, 72% still have only primary education or less (Khoman 1999: 5).

The problematic low rate of continuation to the secondary level has long been considered one of the most important impediments to economic and social development. Government initiatives to reduce the cost of school attendance, particularly in provincial areas, have been undertaken. These include free schooling (now considered a right of all citizens under the 1997 Constitution), school lunches, free uniforms and textbooks, the addition of secondary grades to several existing rural primary schools with excess classroom and teacher capacity, and increasing the geographic accessibility of secondary schools to the rural population (Khoman 1999: 8).

The current recovery process has highlighted the urgency of the need to improve the education system. With the increasingly prominent role of technologically sophisticated sectors in Thailand's industrial development, the ability of the labour force to adapt to rapidly changing conditions of work and skill requirements has become ever more crucial. Such capability is particularly essential for the process of drawing upon indigenous knowledge and use of local materials, processes and know-how. The shortage of appropriate skills is becoming an issue for most MNCs.

Key reform initiatives however include the "Reverse Brain Drain Project", which was launched by the National Science and Technology Development Agency (NSTDA) in 1997 after the Thai government approved a ten-year budget of Bt2.2 billion to encourage Thai professionals working in developed countries to return to Thailand, in the hope of helping the development of science and technology in the economy.

The urgency of the market and the slowness of the government response have led to the emergence of a number of private universities. Government involvement is imperative however, especially in science and technology where the high cost of equipment and R&D is a limiting factor. Professor Yongyuth Yuthavong (formerly NSTDA Director) states that the government "must do more in the way of support and less in the way of control. In the long run, the government has no choice but to invest much more in education and in science and technology. The levels of investment in public education, some 4% of GDP and in research and development, 0.2% of GNP, are far too low for the production of a

knowledge-based economy, which is what Thailand needs for the future" (NSTDA Press Release, 24 October 1997).

Deficiencies in Thailand's human capital development will take a long time to overcome. Substantial policy and institutional reforms are required, and it will take many years for new generations to participate in and benefit from reformed systems. In addition, the financial crisis has delayed reform by hurting school enrolment, reducing budgets, and diverting policy development resources from this important concern.

In comparison to most developing countries, *Philippine* educational standards are quite high. Of the population aged 15 and over, 90% are literate. In 1990, some 99% of children of the relevant age were enrolled in primary schools, and 73% in secondary schools. There is a fairly high level of tertiary education: 27% of the relevant group were enrolled in 1990.

However, these figures can be misleading. About one-fifth of the adult population is thought to be functionally illiterate (that is, they cannot read and write with any fluency) because, although there has been universal enrolment at the primary level for over two decades, nearly one-third of primary school pupils do not complete their education. (This caution also applies to the high literacy rates reported for many other countries in Appendix 1, Table SA-2.) This national figure also conceals the disparity between Manila and the poorer provinces: in the former, nearly 100% complete their primary education; in the latter, only around 30% do so. This reflects a number of factors, including general underinvestment in education (at only 2.2% of GDP) as this sector has fallen victim to the squeeze on government spending caused by the Asian financial crisis. In addition, the state's percentage contribution to primary education costs has fallen in recent years whereas its contribution to tertiary education has risen (EIU 1999: 26).

However, the present educational system does not appear to align very well with the development needs of the economy. While the Philippines has one of the largest numbers of college graduates, compared to other economies, it generates one of the smallest number of graduates with science and engineering skills. Despite the great demand for technical and engineering graduates by local industries, private tertiary institutions continue to produce mainly non-technical graduates. A key factor advanced to explain this is that private universities, which dominate the tertiary level, prefer not to go into these technical-related courses because of the high cost of laboratory equipment (PIDS 2000).

Exacerbating the lack of supply of technical and engineering graduates in the economy is the fact that a large number of these graduates leave the economy every year to seek higher-paying jobs abroad. From 1990-1993, an average of 7,360 professionals migrated to countries like the US, Canada and Australia. The importance of developing programmes to encourage Filipino expatriate scientists and researchers to return to the economy is noted in the Philippine National Development Plan (1994-2000);[49] however, strategies to achieve this aim are not considered.

Another important factor is the lack of appropriate teacher training and the low status of the teaching profession. Often, secondary school science teachers have no formal training in science and/or mathematics. Rather, their teaching is based on a degree in education that emphasises form instead of content. Thus, there is an urgent need to improve the quality of teacher training and to reform the high school curricula (PIDS 1999: 32).

6.4.2 Non-formal Education

In *Thailand* the emphasis has been on raising basic education levels more than on promoting lifelong learning. Nevertheless, Thailand has introduced a number of innovations in its approach to education which contribute to the concept of lifelong learning, in particular the promotion of non-formal education.

The Thai Government has adopted the Jomtien Declaration (1990) which established guidelines for education development amongst UNESCO Member States. The guidelines emphasise the provision of basic education and programmes to facilitate universal access to education. To encourage literacy and to meet its commitments under the Declaration, programmes developed by Thailand include the establishment of Community Education Centres, a Mobile Educational Service, and a Mobile Volunteer Library. The government is also experimenting with new technologies to boost education, such as distance education, work apprenticeships, and mass education via satellite relays. These services are aimed at advancing literacy and education amongst those who missed out on formal opportunities of learning. Such programmes lay the foundations for lifelong education.

The concept of apprenticeships is being revived to allow young people to divide their time between school and training, together with the provision of adult education to allow workers to retrain for new jobs, keep up with developments in fast-moving fields, and learn new skills (Khoman: 31). Such initiatives suggest a policy emphasis on the process of learning and building the capacity to learn, potentially providing for flexibility in application of know-how and increased capacity for adapting and assimilating a wide variety of knowledge and skills. In turn, this forms the fundamental basis for the development of a KBE.

Non-formal education in the Philippines faces significant difficulties. It is particularly affected by disparities in income and educational opportunity, cultural and linguistic diversity, unevenness in the provision of social services, and the archipelagic nature of the country that has resulted in a largely heterogenous population. A notable example of the difficulties presented by the language specificity of education programmes is in Muslim minority areas where the languages in the formal schools are English and/or Filipino, whereas the language of the community schools or *madaris* are the local language and Arabic. In addition, metropolitan newspapers are mostly in English, with some in Filipino, but none are in the local language or Arabic. This has led to the perception that to be able to gain access to better education, one must learn to read and write both English and Filipino, especially English.[50] Amongst minority communities this has prompted concerns about the potential effect of education upon their culture and way of life, and thus has resulted in a reluctance to participate in educational programmes delivered in either English or Filipino.

Efforts to design practicable and accessible non-formal education programmes have been undertaken by the Philippine Bureau of Non-Formal Education. A key initiative was to commission a study of the effectiveness and prevalence of functional literacy programmes across a diverse range of Philippine communities. It was envisaged that the findings of this study would help shape the content and delivery of education programmes in order to be more effective across the various communities of the Philippines.[51]

6.5 ICT Infrastructure

6.5.1 ICT Investment

Investment in *Thailand's* own ICT infrastructure remains low. For the period 1995-1997, investment in telecommunications as an average percentage of GDP was only 0.17% - far below the Philippines' figure of 1.13% of its GDP. Use of computer technology is similarly low, with only 33 computers per 1,000 people and only 0.03 host connections to the Internet per 1,000 people in 1998. The lack of investment in Thailand's ICT infrastructure poses a significant hurdle to the development of a knowledge-based society. As discussed later, this also significantly affects the level of the skills base of the Thai populace, inhibiting the growth of technology-intensive industries and the research and development required for long-term sustainable development.

In Thailand, the government has traditionally provided telecommunications. The telecommunications sector is tightly controlled by the Ministry of Transportation and Communications, with services provided through the government-owned Telecommunications Organisation of Thailand (TOT) and the Communications Authority of Thailand (CAT). Its inefficiency has been highlighted by the evident shortfall in the number of telephone lines per capita in Thailand, including Bangkok. Specifically, penetration is among the lowest in Asia. On average it is about 10%, approximately 4 lines per 100 of the population in the provinces, and 43 per 100 in Bangkok (Cairns 1997: 2). Installation of a telephone line takes about five years. Long-distance demand into and out of Bangkok exceeds current capacity at peak times (Cairns 1997: 2).

A proposal of Thailand's 1997-2006 Master Plan for telecommunications policy is to expand the network by six million lines and increase line penetration to 18.5%. Budgetary and infrastructure constraints are a significant impediment for an expansion of this magnitude. As such, the Plan outlines a cautious proposal for the liberalisation (including the partial corporatisation) of TOT and CAT, and opening up the sector to foreign investors.[52] Such initiatives signal the recognition that opening up the sector to competition may better facilitate a more efficient and cost-effective service. However, the implementation of a "Build-Transfer-Operate" scheme to facilitate private sector participation suggests the unlikelihood of the wholesale privatisation and deregulation of the sector. It seems likely that for the foreseeable future, TOT and CAT will retain substantial control of service provision.

The rapid expansion of cellular telephony in Bangkok in the 1990s has highlighted the relative efficiency of the private sector in this area. Compared with the fixed line market, by the end of 1997 there were 6.1 million fixed telephone subscribers growing at around 15% per annum, and over 2.4 million mobile users growing at 47% per annum (Paul Budde Communications 1999: 117). Cellular penetration in Thailand, at about 20% of fixed lines, is among the highest in Asia (along with Hong Kong and Korea).

Generally, *Philippine* investment in ICT equipment for domestic use is comparable with that of Thailand, although marginally lower with respect to computer usage, with only 16 computers per 1,000 people. Internet connection is also quite low with 0.21 hosts per 1,000 population. In contrast, investment in the telecommunications infrastructure is impressively high at an average 1.134% of GDP from 1995-1997, just lower than Chinese Taipei (1.147%) and Korea (1.279%). After decades of underinvestment, the Philippine

government signaled a new direction with deregulation of the sector in 1993,which consequently ended the monopoly enjoyed by the Philippines Long Distance Telephone Company (PLDT). Typical of the monopolies that dominated the Philippine economy during the Marcos era, PLDT enjoyed special treatment and protection from competition. Characteristic of its inefficient operation were long waiting periods for new connections, which in 1993 averaged 8.9 years compared to 6.3 years in Thailand, 0.4 years in Indonesia and 0.5 years in Malaysia. Telephone density in the mid-1980s was only 1.02 per 100 persons (Profile: 24).

Although PLDT remains the dominant service provider, the Philippine government is promoting competition in the telecommunication sector by increasing the number of operators licensed to provide international and cellular services. More importantly, to promote increased access to telephone services in under-serviced areas, new licensees must provide new fixed line connections. Cellular licensees must install 400,000 lines within five years and international licensees must install 300,000 lines within three years. The licence agreements also contain a universal service obligation and include a specified mix of urban and rural lines in new service regions (DFAT: 211). Consequently, by 1996, telephone density had risen to 4.09 per 100 of the population and an additional 4.8 million telephone lines were planned for installation between 1995 and 2000 to bring telephone density to 7-8 per 100 by 2000.

As in Thailand, cellular telephony is increasingly the preferred entry point for many new telecommunications companies in light of the low fixed costs of mobile telephones. In addition, the unreliable fixed line system for so long operated by PLDT created a much broader demand for cellular services than initially anticipated (DFAT: 210). In comparison to Thailand, however, cellular mobile phone subscription is quite low at only 19 subscribers per 1,000 inhabitants in 1998.

The expansion of cellular networks in both economies highlights the unique opportunity such new technologies present for nations with underdeveloped networks to leapfrog conventional stages of technological development, especially in the field of telecommunications.

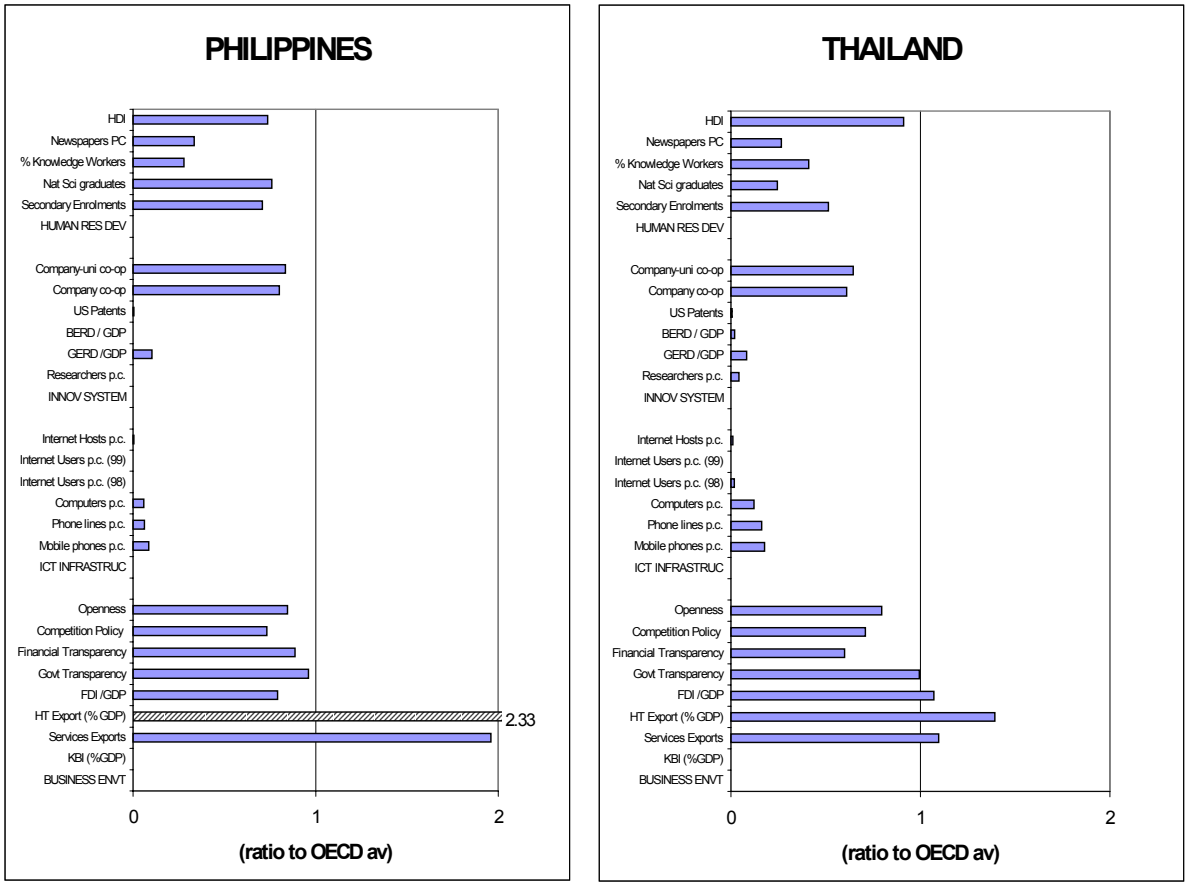
6.6 Comparison with Other AFE Economies

The quantitative indicators in Figures I-6-1 and I-6-2 attempt to capture the general stage of development of these economies, relative to aspects of a fully developed knowledge-based economy, and also the economies' current potential to become KBEs. The charts are scaled according to the OECD average value for each indicator (that is, the scale is 1.00 = OECD average for that indicator). The Statistical Appendix shows that most of the values apparently missing from the indicators graphs (for example, Internet users for 1998) are not missing, but are indeed very small.

The successful transition to a knowledge-based society is necessarily shaped and determined by local circumstances and technological traditions. The importance of the tacit nature of know-how, and its cumulative and localised nature is critical to an understanding of social and economic change (Vervoorn: 256). More importantly, it helps explain why technological catch-up is so difficult and the very crucial role of education and training for facilitating development within the localised knowledge framework.

Although Thailand is a substantial exporter of "high technology" electronic products, its contribution to these products continues to be mostly at the labour-intensive low-technology end. The strength of Thailand's recovery and its transition to a KBE is largely contingent upon the effective implementation of wide-ranging infrastructural reforms, including the need to improve the Thai education system, and its research and development base. Although R&D levels are well below those of the High Performing Asian Economies, this may largely be attributed to Thailand's current stage of development (see Figure 6.1). The information and communication technology infrastructure is also underdeveloped. However, recent government initiatives reflect a cautious commitment to undertake far-reaching and long-term reforms to improve this situation. While the Thai Government has shown an awareness of the importance for reform in these areas and has taken tentative steps to address them, considerable progress has yet to be made.

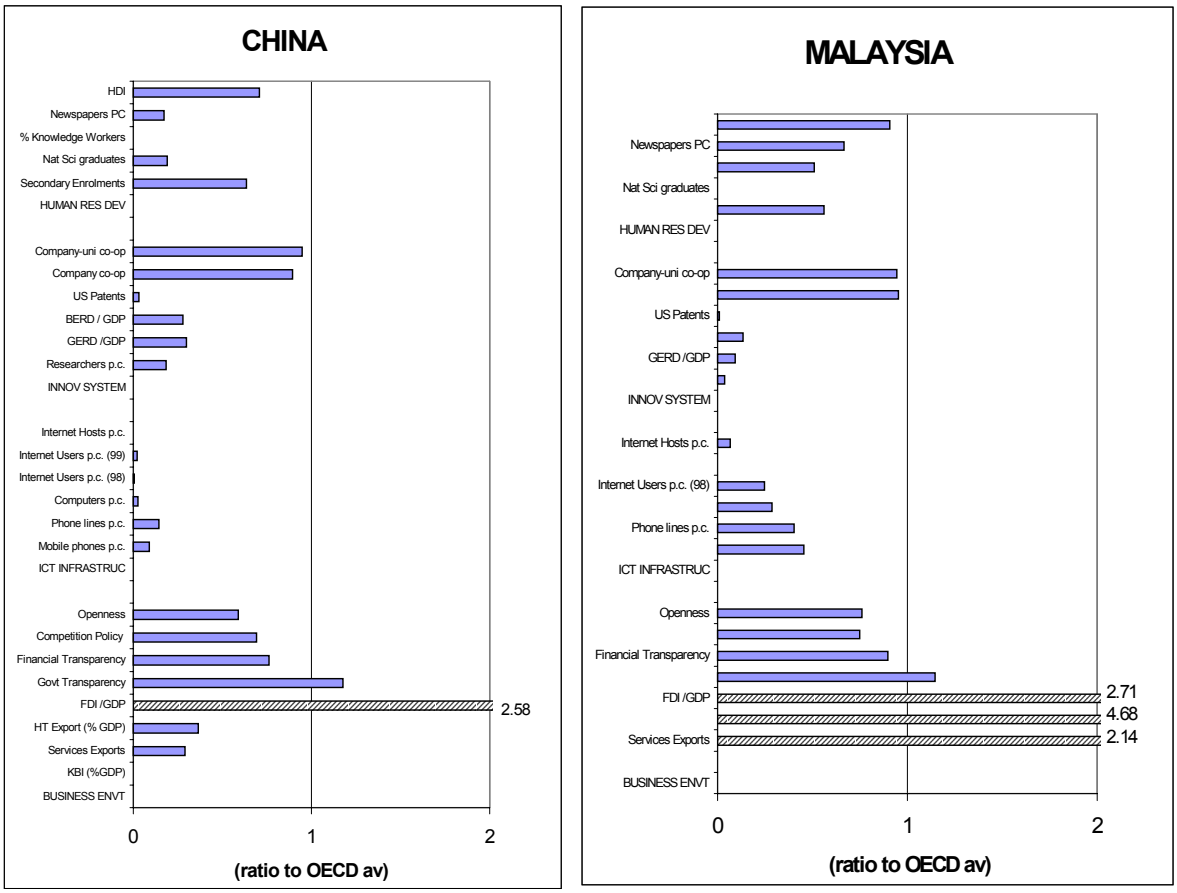
Figure I-6-1
Indicators for the Philippines and Thailand



The Philippines witnessed impressive economic progress in the 1990s. By 1996, GDP growth had accelerated to around 6%. A key factor has been the continued expansion of the manufacturing sector and the consequent rapid growth in exports. However, the increasing importance of the electronics export industry has highlighted the lack of R&D manpower as manufacturing is predominantly labour-intensive rather than skill- or technology-intensive (see Figure 6.1). Lack of investment in R&D inhibits the development of technological capability to adopt and utilise advanced technologies, and thus hinders the ability to "catch-up". While education standards are quite high, an education "mismatch" is apparent with the low level of technical graduates and the increasing demand for technical expertise to support local industry. Reforms to the

educational system are critical to solve this problem. Notwithstanding the relatively high investment in telecommunications, general investment in the Philippine ICT infrastructure remains low. While the Philippine government recognises the need for reform in these areas, the lack of coordination between budgetary constraints and achievable goals limits the viability of Philippine aspirations to become "the knowledge centre in Asia".

Figure I- 6-2
Indicators for China and Malaysia



The indicators for Malaysia and China (Figure I-6-2) are broadly similar to those for Thailand and the Philippines (Figure I-6-1). However, Malaysia's performance in ICT is significantly better than the other countries charted, and is expected to improve further under a "Knowledge-Economy Master Plan" currently being developed. China's R&D expenditure is significant, perhaps reflecting its history of military development.[53] China's performance in information and communications technology infrastructure is quite poor. This has particular significance for the development of Internet technology in China. While various analysts are predicting that by 2005, more people will be online in China than in the whole of America,[54] infrastructural difficulties may impede such progress. Recognising the importance of Internet technology for China's economy, the Chinese Government has invested heavily in its information technology sector, providing $50 billion so far in telecommunications and data-processing hardware. In 1990, there were fewer than 10 million telephone lines in China. Today there are 125 million lines, with more than 2 million being laid every month (The Economist 22 July 2000: 22). Growth in Internet usage has been similarly rapid, with fewer than 50,000 Internet users in 1995, expanding to 8.9 million by the end of 1999.[55]

Such growth has attracted an impressive amount of FDI[56], which has stimulated the rapid growth of exports. Given China's vast labour supply, it can be expected that the country will continue to specialise in labour-intensive manufacturing as the main driver of its export growth. However, similar to other developing economies in this group, China will have to move steadily beyond simple labour-intensive products towards areas of higher technological sophistication. Whether it will successfully do so greatly depends upon the capacity of China's own science and technology establishment to utilise and adapt these advanced technologies. Recent initiatives of the Chinese Government indicates its awareness of this issue and establishes preliminary steps towards addressing it.[56]

Generally, the indicators tend to confirm that much of the analysis of the case study economies (Thailand and the Philippines) is likely to apply to other economies in the Asian Fast-Growing Economies group. Some of the conclusions drawn from this analysis may likewise be considered applicable.

7. LATIN AMERICAN ECONOMIES

7.1 Introduction

The APEC member countries of Latin America are Chile, Mexico and Peru. These economies represent the "middle-ground" between the high performing Asian economies and the longer developed economies of Canada and Australia in terms of economic growth rates, but are less developed as knowledge-based economies.

Chile has been selected as the Latin American case study for this chapter due to its sustained high economic growth. This has averaged 6.5% per annum over the last 15 years. The economic success of Chile can be ascribed to the return of the economy to democracy, a stable macroeconomic climate and increasing copper export earnings. A strong free trading and competitive environment has helped build this success through high foreign investment levels. At a micro level, the application of technology and knowledge, and government regulatory reforms, have accelerated recovery from a deep policy-induced recession.

7.2 Business Environment

7.2.1 Macroeconomic Overview and Historical Context

Chile has undergone a lengthy economic adjustment process over the last half century. In the 1950s and 1960s, Chile followed isolationist and protectionist policies, and had chronic inflation, low growth and frequent economic crises. In the early 1970s, the Allende government pursued a socialist reform programme approving large nominal pay rate rises, and the nationalisation of industry, banking, and mining. This resulted in a short economic boom, closely followed by hyperinflation, an extreme balance of payments crisis, and huge losses in state enterprises (Bosworth, Dornbusch and Laban 1994: 5).

From 1973 to 1983, the Chilean government pursued a rapid liberal market-based adjustment programme. The budget deficit was cut in two years to 1% of GDP, and tariffs were scaled back from over 100% to 10% (EIU 1999: 4). The government also quickly privatised state-owned businesses. This had an economy-wide impact given the size and scope of these businesses. Of 850 government business enterprises, only 45 were left in

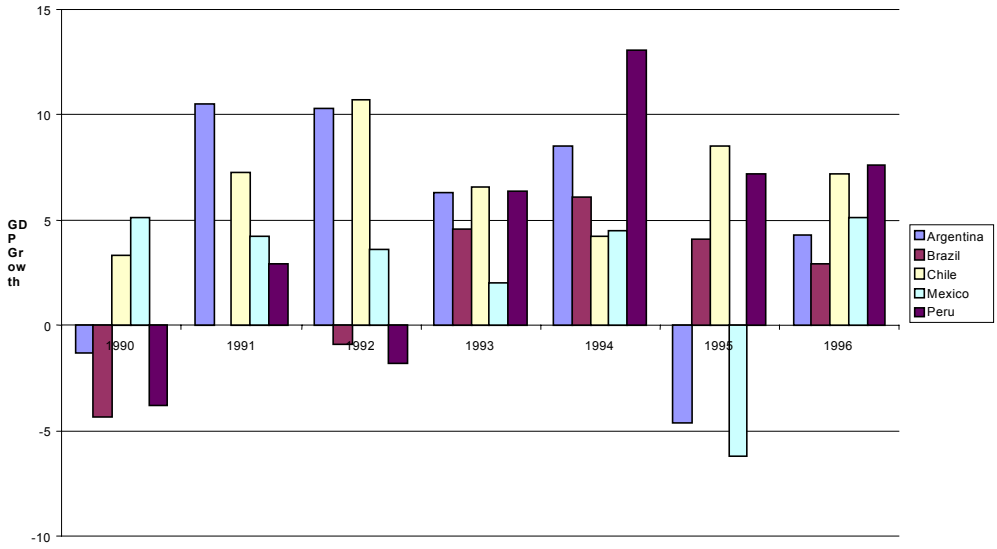
public hands by 1980 (Bosworth, Dornbusch and Laban 1994: 5). In doing so, however, it did not establish a financial market supervision system comparable to developed economies, and paid little attention to the concentration of ownership of newly privatised firms. Privatisation usually provides its biggest boost to growth if done in a way that encourages competition rather than impeding it. The benefits of these micro reforms appear only to have accrued following the introduction of strong anti-trust laws and greater competition in the early 1990s.

A fixed exchange rate policy in the 1970s dramatically overvalued the peso, encouraging unsustainable levels of imports and foreign borrowing. This, coupled with full wage indexation, created extreme inflationary pressures. Inflation ranged from 350% to 75% during the 1970s. Up to 15% of the workforce was unemployed. By the mid-1980s, Chile's foreign debt was 120% of GDP (Bosworth, Dornbusch and Laban 1994: 9). Foreign banks cut off credit to Chile in the early 1980s, and the government reinstated tariff barriers to stop the flow of imports. An economic crisis ensued and a large number of bankrupt firms were taken over by the government.

The past decade has witnessed a remarkable recovery in the Chilean economy from the economic crash of the early 1980s. The government reversed tariff increases, improved the education system, rebuilt the financial system emphasising strong Central Bank control, instituted competition laws, and cut back public and defence spending.

Chile has registered strong stable economic growth, on average at 6.5% per annum over the 1990s, with declining inflation, fiscal surpluses, solid external accounts and improved social conditions (IMF 1998: 4). The policy environment has remained stable and the government continues to aim at fostering sustained growth with a gradual but steady decline in inflation, and the maintenance of a manageable external current account deficit. Chile's efforts at stabilising the economy and attaining high growth in the 1990s have coincided with a large increase in the price of copper and the volume of production and exports from the mid-1980s, and stable high prices to the mid-1990s (Perry and Leipziger 1999: 31). After 18 consecutive years of positive growth, per capita income has more than doubled.

Figure I-7-1
Economic Growth Rates - selected Latin American Economies



Source: Various Issues of IMF International Financial Statistics - World Economic Outlook

Financial System

Chile's capital markets have also developed over the last 15 years, fuelled both by domestic savings and foreign investment interests. The development of Chile's financial markets has been characterised by the rise of institutional investors with long-range goals, a stabilising influence many other Latin American economies have not enjoyed to the same extent. Integration into the global economy has also pressured Chile's domestic capital markets, by increasing demands to lower traditional capital restraints and capital gains tax rates.

Chile's government aims for the capital Santiago to become a regional financial centre. Its principal stock markets are technologically advanced and operate effectively. International ratings firms and local companies offer good market intelligence on corporate health, financial outlook, and the quality of new financial opportunities.

One of the primary supports of Chile's financial markets system is the strong domestic banking system. Facing collapse in 1982, the system was reorganised and re-financed with the support of the Central Bank.

Competition Policy

Chile is an ardent exponent of market-driven competition. It was the first Latin American economy to scale back tariff and quota barriers, and it does not subsidise targeted production sectors. Chile currently has a 9% applied flat tariff which will be reduced to zero by 2010 for all countries that do not already have a free trading agreement. There are no market access restrictions or quantitative restrictions on trade, with the exception of the importation of used motor vehicles due to pollution problems. Chile also has strong anti-trust laws to encourage free and open competition.

Privatisation of energy plants, ports, social security services, and water systems is continuing, with government regulatory intervention more heavily focused on monopoly restriction, and environmental/consumer protection. There also appears to be a broad consensus across the political spectrum not to involve the state to a large degree in productive activities. The largest company in the economy, the copper mining giant Codelco, remains in state hands. Codelco's earnings are a significant source of government revenue.

The economy appears to have benefited from its pro-competition stance through improved incentives for domestic firm-level productivity, and the transfer of new forms of business, organisational and product knowledge.

Transparency in Corporate Governance

The accuracy, reliability and availability of information on the management of firms, the economy, and the government is an important element of a knowledge-based economy. In terms of transparency in corporate governance, Chile is rated extremely highly by the World Competitiveness Yearbook 1999.

Under guidelines issued by the securities commission, corporations that sell public shares must publish annual financial statements and comprehensive directors' reports. Bribery

and other corrupt practices are illegal in Chile.

The public administration of Chile appears on the whole to be efficient and free of corruption, with well-qualified, competent and resourceful employees.

7.2.2 Structure of the Economy

Chile's economy has traditionally been based on the export of minerals and mining. It is the world's largest producer of copper and iodine, and a growing source of gold and non-metallic minerals. These sectors generate around half of Chile's export earnings.

Since the 1970s, the economy has diversified into non-traditional sectors. Forestry, wood products, fresh fruit, processed foods, fishmeal, and other manufactured products comprise an increasing share of exports. In the 1950s and 1960s, Chile was a net importer of agricultural products and is now a net exporter. Exports of agricultural exports were US$1.2 billion in 1996.

The services sector represents a high proportion of GDP, and generates approximately 20% of total exports. From 1996, the services sector has attracted higher amounts of foreign investment than the mining sector (DFAT country profile 1997: 21).

Chile's manufacturing sector (which includes minerals as a substantial component of mineral processing) is broadly based but has had variable sectoral performance. Ceramics, leather and textile production has contracted due to cheap imports. Over the last three years, growth areas have been non-electrical machinery, printing and plastics manufacturing.

Chile's productive capacity is shifting to more knowledge-intensive activities such as IT services, biotechnology, and banking, and to more knowledge-intensive forms of mining and agricultural production. The level of uptake and use of technology and knowledge will, however, need to be accelerated for Chile to fully reap the benefits of growth in the new knowledge-based economy.

Trade Exposure

Chile has high trade exposure. In 1999, exports reached US$15.6 and imports US$13.9 with exports accounting for 42% of GDP (in real terms). As Chile is the world's largest copper producer, its economy is susceptible to cyclical fluctuations in commodity prices.

Foreign Direct Investment

For Chile, foreign investment has played a central role in diversifying the risk of low copper commodity prices. It has been an important source of hard currency and a key economic growth driver which can stimulate knowledge flows and new business operations.

Chile abolished its fixed interest rate regime in the mid-1980s, and established strong investment laws which provide international companies with the same rights and duties as indigenous companies and contractual guarantees regarding investment terms and

conditions. This, combined with low corporate tax rates, has led to a situation where Chile has more foreign firms participating in its economy than any other Latin American economy.

In 1997-1998, foreign investment was 64% of total capital inflows into the country and more than 6% of GDP, one of the highest percentages in the world. Much of this is longer-term productive investment, with over half going into the mining sector.

Table I-7-1
Structure of the Chilean Economy

% of GDP	1992	1993	1994	1995	1996
Agriculture and forestry	7.3	6.9	7.1	6.9	6.5
Fishing	1.1	1.1	1.2	1.2	1.2
Mining	8.6	8.2	8.0	7.9	8.3
Manufacturing	17.6	17.4	17.1	16.8	16.2
Electricity, gas and water	2.8	2.7	2.7	2.7	2.6
Construction	5.3	5.6	5.5	5.5	5.6
Commerce	16.7	17.0	17.0	17.3	17.8
Transport, storage and communications	7.3	7.4	7.8	8.0	8.2
Financial and other services	33.4	33.6	33.5	33.7	33.6

Source: IMF Staff Country Report 98/26 - April 1998.

Growth in Trade

Trade is also an important factor in the knowledge-based economy as it promotes openness to new ideas, cooperation, knowledge, and products. Chile has experienced strong growth in trade over the last few years. From 1975 to 1995, real exports have grown at a rate of 8.8% per annum from just under 10% of GDP to the current 29% (Bosworth, Dornbush and Laban: 185).

Chile has established free trading agreements with Mexico and Canada among other American countries, and is currently negotiating an agreement with the European Union and Korea. It is also working actively in the negotiation on the Free Trade Area of the Americas. Within the economy there are also two free trading ports.

The economy has benefited from associate membership status in the South American Common Market, known as the MERCOSUR. MERCOSUR is a Customs Union with no tariff or non-tariff barriers for reciprocal trade between member states, and a common external tariff for third party countries. The Customs Union has operated since 1995 and includes Argentina, Brazil, Paraguay, and Uruguay. Chile and Bolivia became associate members in 1996 and 1997 respectively. MERCOSUR is the fastest growing trading bloc in the world, with a trade growth of 400% in the period 1990-1997. Further growth can be expected as full Customs Union is planned for 2005 (http://www.mercosurinvestment.com/).

Knowledge-Based Industry

Chile does not have highly developed knowledge-based industries (those which are defined as relatively intensive in their inputs of technology or high quality human capital). High technology exports make up only 19% of manufactured exports, the lowest out of all the APEC sample economies.

Mining, agriculture, and fishing industries have dramatically improved productivity through the application of knowledge, and the use of new technology.

7.3 Innovation System

7.3.1 Science and Technology Base

Chile has a small science base and research community in absolute terms and as a percentage of the labour force. At present, there are only 1.2 researchers per 1,000 of the labour force, and the total stock of researchers is 6,400.

The government has conducted a number of reviews to assess the state of the Chilean science base. In 1998, the National Commission for Science and Technology noted that human capital formation in science was slow, and international scientific links poor. It argued that science education needed to be strengthened at all levels, that more teachers, engineers, technicians and postgraduate scientists were required as a matter of priority, and science expenditure needed to be better targeted in areas of national comparative advantage. In addition, linkages between the science community and industry needed to be strengthened to enable better productive outcomes. The identified strengths of Chile's science system are astronomy, biological research, and mining.

Chile is addressing these areas by participating in the World Bank's Millennium Research Institute programme with Argentina and Brazil. It has established five research institutes which aim to facilitate knowledge sharing, cooperative research efforts, connectedness to the private sector, and integration into global knowledge networks.

Another emerging problem is the age distribution of scientists. Only 25% of scientists are less than 43 years old, which may affect the economy’s ability to assimilate scientific knowledge over the next ten to fifteen years. This may also be an indicator of a limited number of scholarships and jobs in science, an area for stronger government involvement.

Chile has policies for technology diffusion which are pursued by INTEC, an independent agency funded by Chile's Economic Development Agency CORFO.

7.3.2 R&D Intensity

Research and development expenditure is a proxy measure of innovative capacity and the creation of new knowledge. It can also promote understanding of and the effective use of knowledge in productive activities.

In Chile, most R&D is conducted in the university sector. The level of public expenditure of R&D is low at 0.64% of GDP in 1998, and is mostly concentrated in mining, agriculture, fishing, and electricity, gas and water sectors. Annual per capita expenditure

on R&D is low at US$32 (www.conicyt.cl). R&D expenditure has increased from virtually zero 25 years ago, but is still much lower than in more developed economies which is on average between 2% and 3% of GDP. As a result, Chile has the lowest level of US patent applications of any of the APEC sample economies.

Enterprise level or business expenditure on R&D is particularly low at 0.1% of GDP only around one-fifth of total R&D spending, indicating reliance on foreign know-how and research. Chile has the highest foreign business presence of any Latin American economy. Multinationals operating in Chile conduct much of their research in more developed economies, an area which might become a policy issue in future across a number of APEC economies.

Both the private sector and industrial state enterprises conduct little research in support of advanced technologies (International Advisory group on Science and Technology, Conference, 4-5 June, Santiago, Chile, 1998).

The Chilean Economic Development Agency (CORFO) operates two technological funds to improve innovation linkages, product development, and R&D. These funds co-finance technological development, technology transfer or modernisation projects. Resources are allocated through an open bidding process to projects with the highest social or industry benefits.

7.3.3 Innovative Enterprises

In a knowledge-based economy, enterprises that form dynamic strategic alliances and share knowledge can improve management, develop better products, generate efficiencies, and compete more effectively.

Although Chilean enterprises do not conduct a significant level of their own R&D, they have some innovative entrepreneurial traits. Exports from Chile have grown from just under 10% of output 25 years ago to 29% today. This is not only limited to the primary export sectors, as the economy exports 3,600 merchandise items to 170 economies.

The government is involved in improving enterprise-based innovation. The Economic Development Agency CORFO supports enterprise associations in forming strategic alliances to compete and improve software quality. In 1997 it established SPIN-CHILE, a software improvement network of enterprises, universities and consulting firms interested in the interchange of knowledge in the field of software process improvement (SPI). This is an initiative likely to pay dividends in a connected knowledge-based economy.

The ability of the productive sector to adapt to change is a key competitive factor for knowledge-based economies. Innovation and technological development are the foundation for increasing business productivity, and are crucial to better satisfying client needs. In Chile, the government has established a Technological Innovation Programme (Programa de Innovación Tecnológica) designed to support efforts in this area. To meet these needs, CORFO has created two Technological Funds: the National Fund for Technological and Productive Development (FONTEC), and the Development and Innovation Fund (FDI). The government also has a five-year innovation plan.

7.4 Human Resource Development

Chile's evolution toward a knowledge-based economy depends to a large extent on it developing world-class human resources. Progress is being made in this area, as the government is significantly increasing educational expenditure, but it faces many challenges. Chile has a very small indigenous research and science base, especially outside the geosciences, and low levels of research and development activity.
The process of strengthening the productivity of Chile's human capital and building information infrastructure also has the potential to assist the economy's economic stability as well as drive growth, given a high reliance on commodity exports.

7.4.1 Education and Training Systems

Chile has a strong education system relative to other Latin American countries. Its public investment in education at 3.1% of GDP is much lower than that of more developed economies. However, inter-country comparisons of education systems are complicated by the fact that over 40% of Chile's school system is privately operated.

The educational system has been reformed and expanded significantly over the last 30 years. In the 1980s, Chile's military government decentralised school administration, and used legal and market incentives (a voucher system) to spur the growth of state- funded private schools. These reforms focused primarily on efficiency measures not only through the introduction of competition for student intakes (Perry and Leipziger, World Bank 1999: 152), but also by modernising the teaching curricula, and bringing technical secondary education closer to industry.

Following the economic crisis of the early 1980s, total government spending in education declined by almost 20%. Between 1985 and 1990, it fell from 4.0% to 2.5% of GNP. At the same time, private provision of education was expanded from just below 25% to 40.1% in 1990. Learning outcomes appear to have improved over this period (Perry and Leipziger, World Bank 1999: 176).
In the 1990s Chile's centre left governments further reformed the education system, focusing on public investments in the quality and equity of education, the nature of educational opportunities, learning context, and outcomes.

In Chile, the school day has recently been lengthened to a single eight-hour shift, recognising a need to build knowledge quickly and learn faster than competitors.

Tertiary Education System

Chile has 67 Universities (25 state-funded), some 70 professional institutes, and 120 technical training centres, with a total enrolment of about 344,000 students comprising about 2.4% of the population. The university system issues approximately 6,000 post-graduate degrees per year (http://www.conicyt.cl). It has expanded reasonably rapidly over the last twenty years. In 1980, there were 1,305 tertiary students per 100,000 inhabitants; by 1996, this had grown to 2,546. This level of participation in tertiary education is still around half the rate of longer developed economies (UNESCO 1998 Statistical Yearbook).

Educational Outcomes

Chile has recently achieved high literacy and retention rates from its educational reforms. The average time spent in schooling by the economically active population doubled to 9.25 years between 1960 and 1992, and the economy's illiteracy rate fell from 16.4% to 4.2% over the same period (Chilean Ministry of Education, Compendio de Information Estadica 1998). Literacy rates are slightly higher than the Latin American average of 90%. There will, however, be a lag between achievement of improved educational outcomes and economy-wide productivity gains.

The government increased the portion of the budget allocated to education from 4.9% in 1994 to a planned 7.5% by 2000. This appears to be delivering outcomes as basic education has achieved universal coverage with 76% of pupils now completing high school, and 20% going on to university. At present 7.2% of the total population over 25 have tertiary qualifications.

Vocational Education

Vocational education is offered in Chile at both secondary and post-secondary levels. Technical and vocational education is offered by technical training centres, professional institutes, and universities, all of which are regarded as higher education institutions.

7.5 ICT Infrastructure

Chile is engaged in building information and communications technology infrastructures. It has a modern digital telecommunications system, but underdeveloped computing and Internet infrastructures.

Table I-7-2
Information Infrastructure Indicators

INDICATORS	**1990**	**1994**	**1997**
1. Information Technology			
Computers per 100 inhabitants	1.0	2.6	4.5
Total computers (thousands)	123	369	653
2. Telecommunications			
Fixed telephone lines per 100 inhabitants	6.5	11.6	18.2
Mobile telephone subscriptions per 100 inhabitants	-	0.8	2.8
3. Internet			
Internet servers per 100 inhabitants	-	0.01	0.13
Total Internet servers	-	1,703	19,128
4. Population (millions)	13.1	14.0	14.6

Source: Presidential Commission, "The New Information and Communication Technologies", 1999.

The economy has a highly unequal territorial and social distribution of information infrastructure. Networked and personal computers are mainly concentrated among inhabitants of Santiago, large companies and institutions of the central government, and the wealthiest 10% of the population. Firms also are slow to integrate computing assets into wider information networks, which lack quality and breadth of content, especially the Internet.

Chile has, however, made progress in the computerisation of its businesses and, to a lesser extent, of homes. The number of computers per 100 persons multiplied six-fold from 1990 to 1998 to 4.5, which is almost on par with the world average of five per 100. This is an indicator of the increasing importance of knowledge-based work, and has been assisted by the duty-free status of computing equipment. However, the number of computers per 100 persons is significantly lower than the more developed economies with around 30 computers per 100 persons (see Appendix 1).

As an indicator of the IT literacy, in 1998, 19% of the country's employees worked with computers, and nearly 11% of households included a computer (Presidential Commission 1999: 21). According to World Competitiveness Index surveys, Chile is also rated as having a strong and high quality IT skills base.

At the government level, a number of publicly funded programmes are being established to build information kiosks and multi-purpose Internet telecentres in all Chilean towns, and expand university and educational networks. In addition, the government has signed an international cooperation agreement with the US on developing a regulatory framework to encourage the uptake of electronic commerce technology.

Existence of a domestic information technology industry can also assist in the diffusion of technical knowledge. Chile's information technology industry is small and domestically focused. Its main activity is computer assembly, and the development of tailored economy-specific software products for the banking, finance, and mining sectors. The government is currently developing strategies to pursue international information and communication technology investments.

7.5.1 The Internet

The Internet is an important enabling technology for the knowledge-based economy which is transforming and improving the efficiency of production processes. Ensuring universal access to this technology is the best path to constructing an economy in which knowledge is the main factor of production.

Internet technology diffusion is very low in Chile relative to longer developed economies, although it has the largest number of Internet servers by unit of population in Latin America. Competition is lowering prices and improving accessability,

7.5.2 Telecommunications

In 1989, Chile pioneered the privatisation of telecommunications through sale of the state monopoly CTC. The system was then completely deregulated in 1994 to promote

competition between multiple carriers. This resulted in international and domestic call costs, which are low by international standards, falling by between 30% and 40% (www.gurukul).

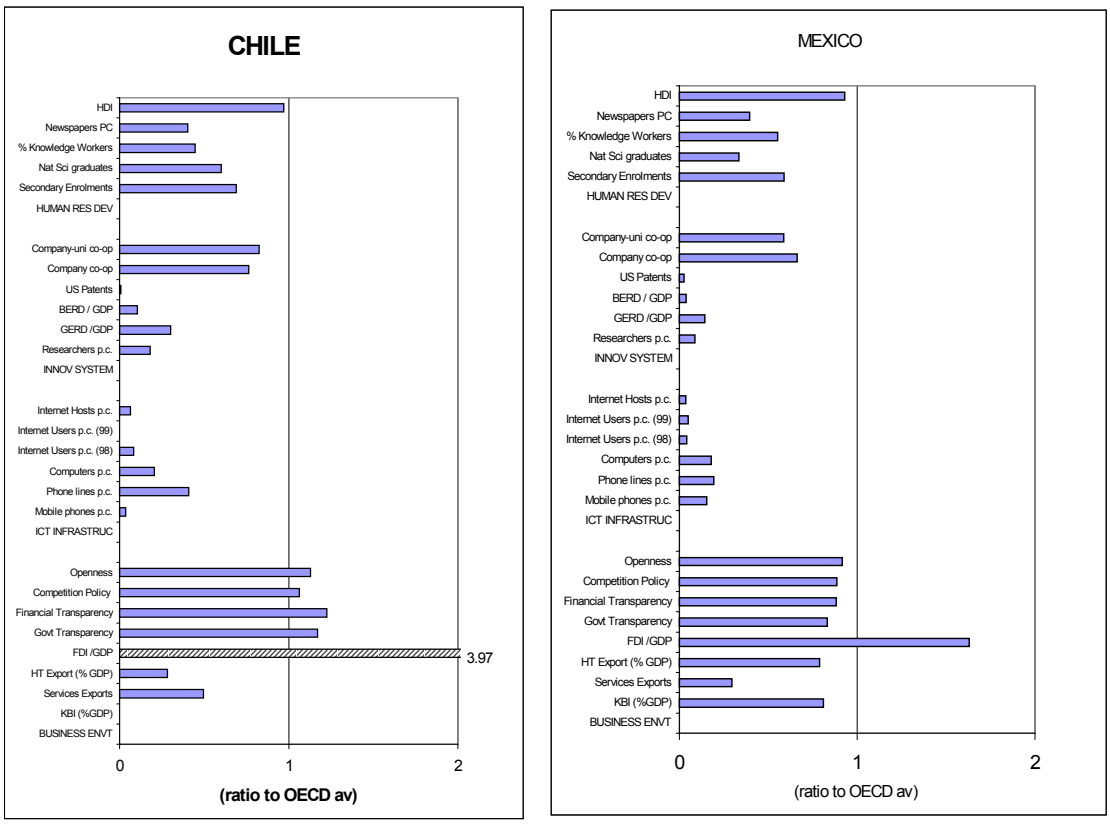
The fixed telephone system is also fully digital and one of the most modern in the world. The number of fixed lines is expected to reach 4.7 million by 2001, and the system is growing at a rate of 14% per annum.

Chilean telecommunications infrastructure is better than most other Latin American economies, but still lags behind that of longer developed economies. Firms operating in Chile initially invested in relatively inexpensive copper fixed telephone networks, but are now concentrating on increasing the capacity of higher bandwidth fibre optics, cellular networks, and satellite systems.

Government competition policies for the telecommunications sector, and establishment of a special fund to subsidise telephone services to remote and small locales has been particularly successful. These initiatives combined have delivered telecommunications access to 97% of Chileans.

7.6 Comparisons with Other APEC Economies in Latin America

Figure I-7-2
KBE Indicators for Chile and Mexico 1997[57]



(Scale: 1.00 = OECD average for that indicator)

This chapter has focused on analysing the status of Chile as a knowledge-based economy. However, the KBE indicators shown in Figure I-7-2 for Mexico have a very similar pattern to those for Chile, although Mexico's Business Environment ratings are lower with respect to openness and competition policy. This suggests that lessons learnt and policy prescriptions for Chile may be applicable to other economies in the region.

It is, however, faced with a number of challenges in terms of its development as a knowledge-based economy. Chile has deficiencies in the national knowledge base, low levels of research and development activity, and underdeveloped ICT infrastructure compared to longer developed economies. Nevertheless, prospects for Chile appear promising as the government is actively pursuing policies to reduce poverty and improve the quality of productive assets through investment in human resources, education, and technical infrastructure. The government is committed to increasing expenditure on education, and has commissioned high-level reviews on the benefits of information and communication technology, and improving the national science base. The economy's modern digital telecommunications system will also aid its competitiveness.

The priority area for Chile's progression to a knowledge-based economy would appear to be an expansion of the national knowledge base through wider education, and an expansion of tertiary scholarship opportunities, especially for science-based PhDs. This will require building educational attainment, especially at a tertiary level, and improving human resource formation in key areas of science and information technology.

Similarly, to compete with longer developed economies in the emerging global KBE, Chile would need to further expand and accelerate the use of enabling information and communications technology infrastructure, particularly the Internet. To capture the wider knowledge diffusion and productivity benefits of Internet technologies, Chile could also investigate further development of language skills and/or bilingual Internet content.

8. COMPARISONS AND CONCLUSIONS

8.1 Introduction

This chapter brings together summary indicators from each of the earlier chapters, relating to the 4 groups of APEC economies studied, namely the:

- Most Developed Economies;
- High Performing Asian Economies;
- Asian Fast-Growing Economies; and
- Latin American Economies.

By comparing and contrasting these, a fairly consistent story emerges about how far each group has already progressed towards a KBE, and the extent to which the various economies have put in place the preparations necessary to move towards a KBE. The first aspect is shown most clearly by two of the indicators discussed in Chapter 3, namely the proportion that “knowledge-based industries” currently contribute to GDP, and the proportion of “knowledge workers” currently in the labour force. The second aspect is shown by other indicators of the four groups of characteristics studied in each case study, namely: innovation system, human resource development, information and communication technology infrastructure, and business environment.

By analysing which of these groups of characteristics are most unfavourable in each group of economies, both in comparison with other real economies and with Nikuda, we begin to identify for each group of economies the characteristics that most need to be addressed if those economies are to move closer to being KBEs.

8.2 Status of APEC Economies as KBEs

Figure I-8-1 shows how each of the case study economies measures on the two principal indicators of status as a KBE. At this stage, the contribution of "knowledge-based industries" to GDP is available for only the OECD countries and Singapore. It is over 40% for all of these economies, which supports the general impression that these economies are already, to a considerable extent, knowledge-based economies. This impression is confirmed by the other main indicator, the proportion of "knowledge workers" in the labour force, which is over 30% in all the most developed economies. For the Latin American Economies and the Asian Fast-Growing Economies, the proportion of "knowledge workers" lies between 10% and 20% of the labour force.[58] This correctly suggests that all the APEC economies are already to some degree knowledge-based - which is consistent with the broad definition of knowledge used in most of this report - but that these two groups are significantly further away from being fully developed KBEs than are the Most Developed Economies.

Figure I-8-1
Main Indicators of KBE Current Status for Selected APEC Economies

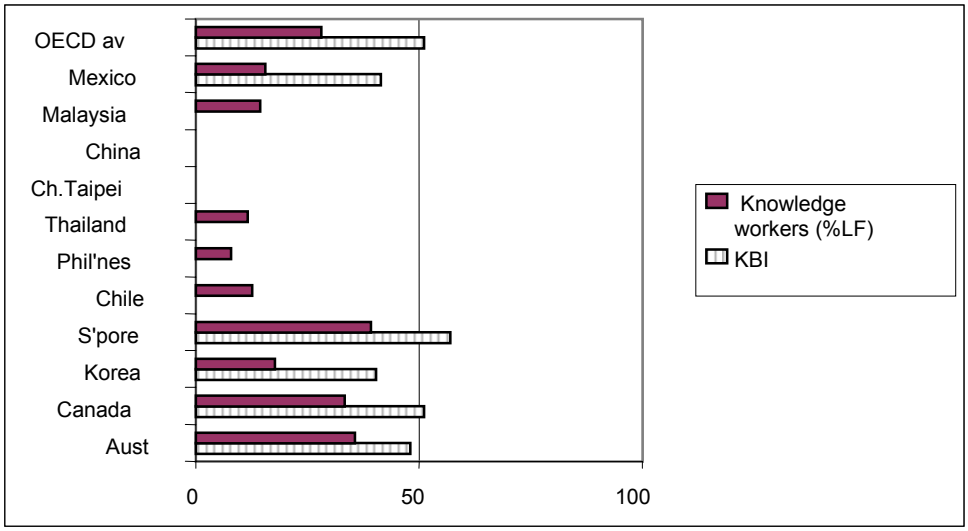
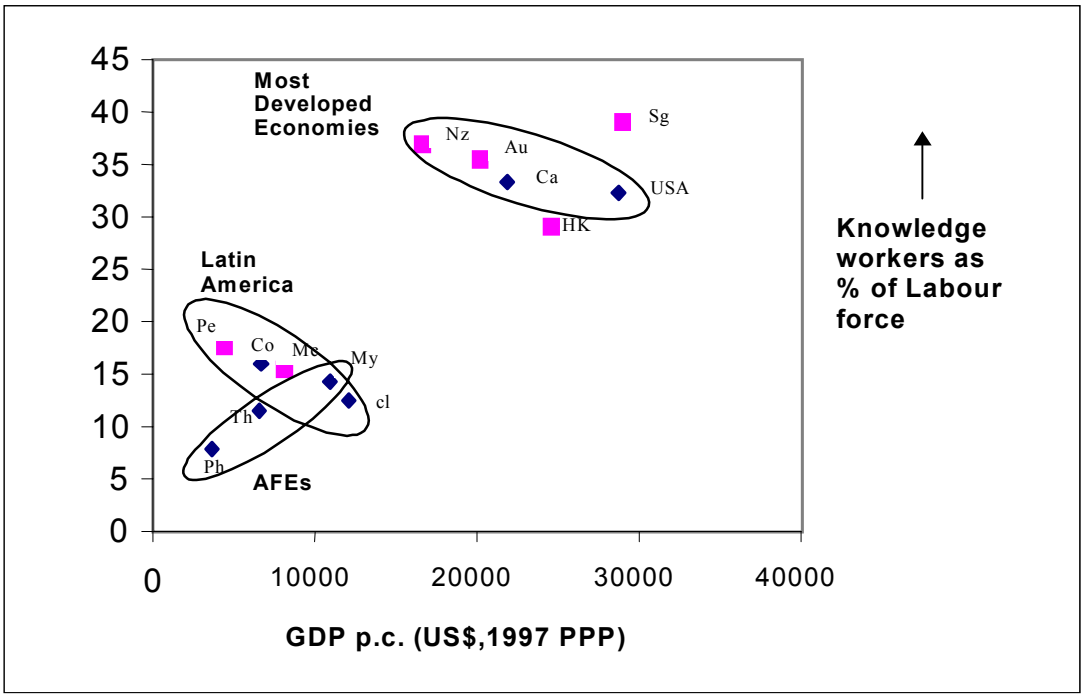


Figure I-8-2 plots the primary conventional indicator of economic development status (GDP per capita) against the most widely available indicator of KBE status, namely percentage of knowledge workers. The plot shows all the APEC economies for which both indicators are available.

Figure I-8-2
Economic Status and KBE Status of APEC Economies. Symbols Refer to whether the Data have Been Calculated from ILO Occupational Data Reported in "ISCO-88" Classification (squares) or in the Older "ISCO-68" Classification (diamonds)



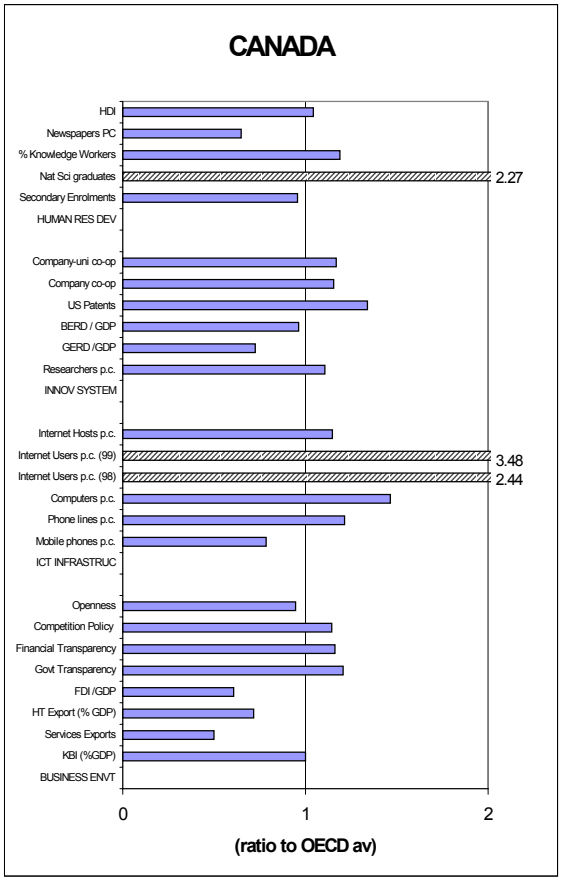
Though there is clearly a broad correlation between economic status and KBE status, the correlation is fairly weak (correlation coefficient of 0.66).[59] Three of the four groups of economies based on GDP per capita cluster fairly tightly and recognisably as shown on the figure, namely the Most Developed Economies, the Latin American Economies, and the Asian Fast-Growing Economies. This indicates that these groupings remain useful for analysing KBE characteristics, and suggests that discussion focused on selected case studies chosen from within each group should cast some light on the other members of the group.

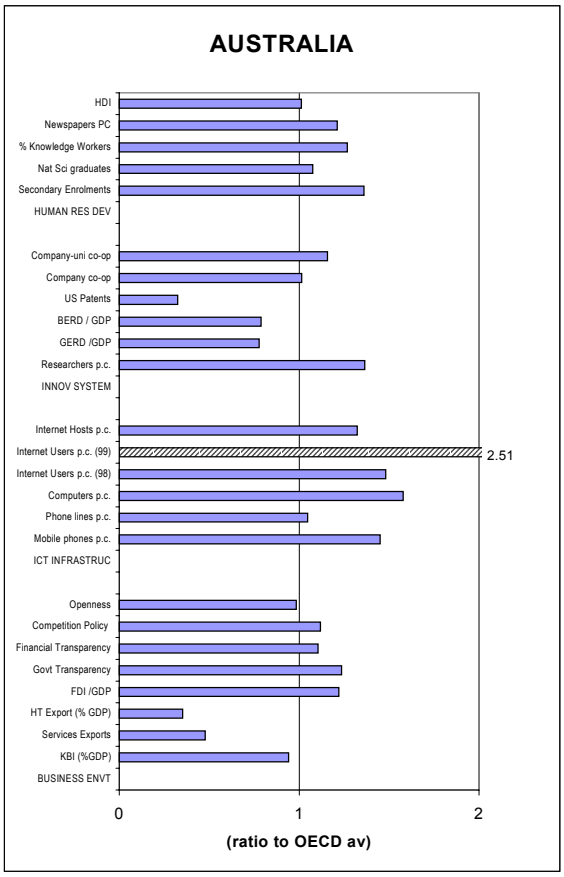
8.3 Preparation by APEC Economies to Move towards a KBE

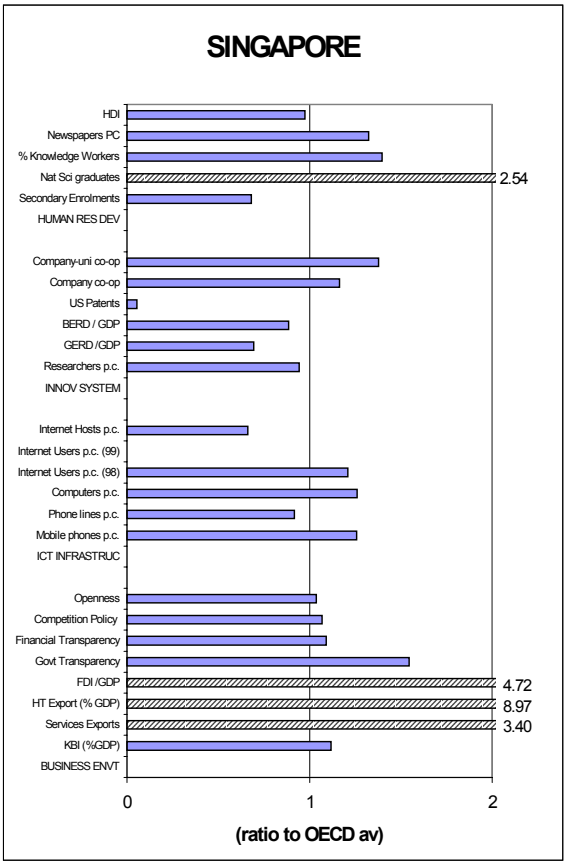
Figure I-8-3 shows, for each of the case study economies, four groups of indicators, namely: Business Environment, Innovation System, Human Resource Development, and Information and Communications Technology Infrastructure**.**

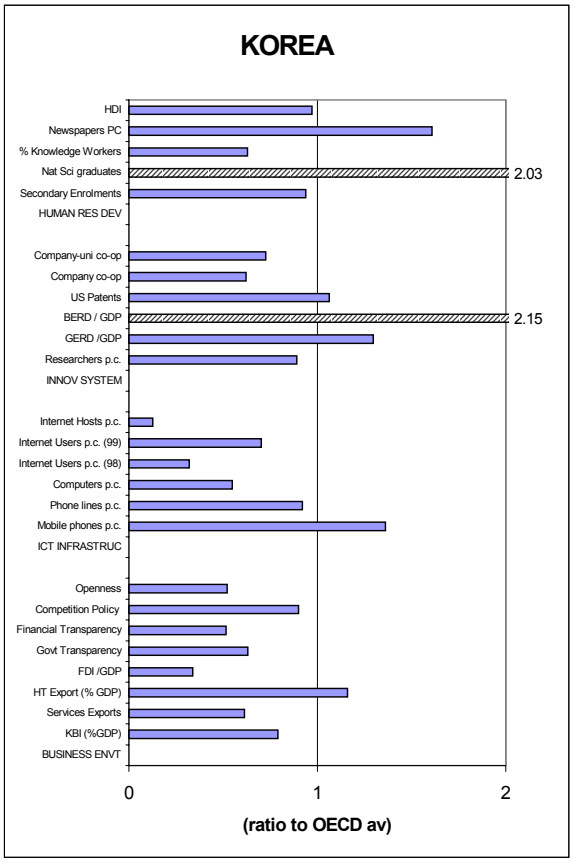
These groups of indicators as a whole relate more to whether an economy has laid, or is laying, the foundation for a transition to a KBE rather than the extent to which it is already a KBE (unlike the structural indicators just discussed). For example, current annual expenditure on R&D indicates an economy's commitment to generating new knowledge, but not so much about the cumulative knowledge base and infrastructure which it has built up.

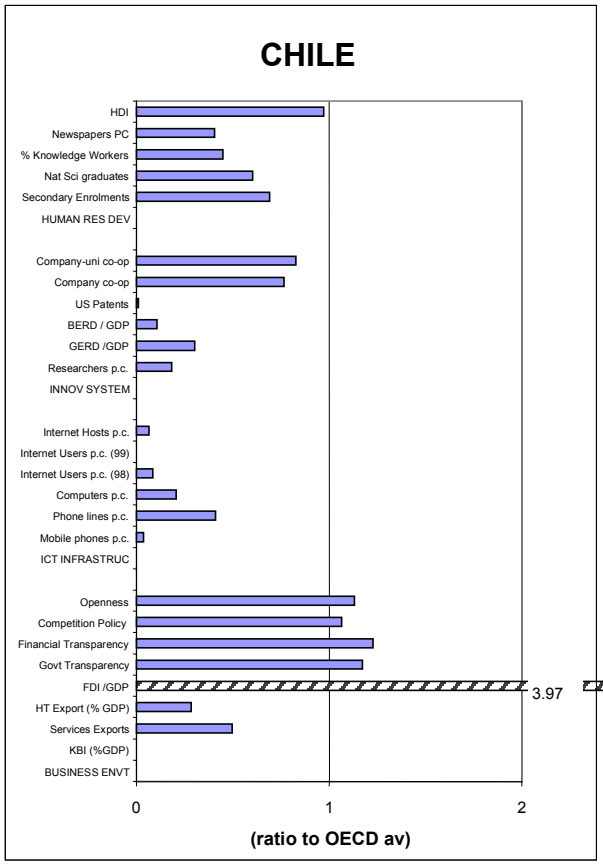
Figure I-8-3
Indicators of Preparation by Selected APEC Economies to Move to a KBE

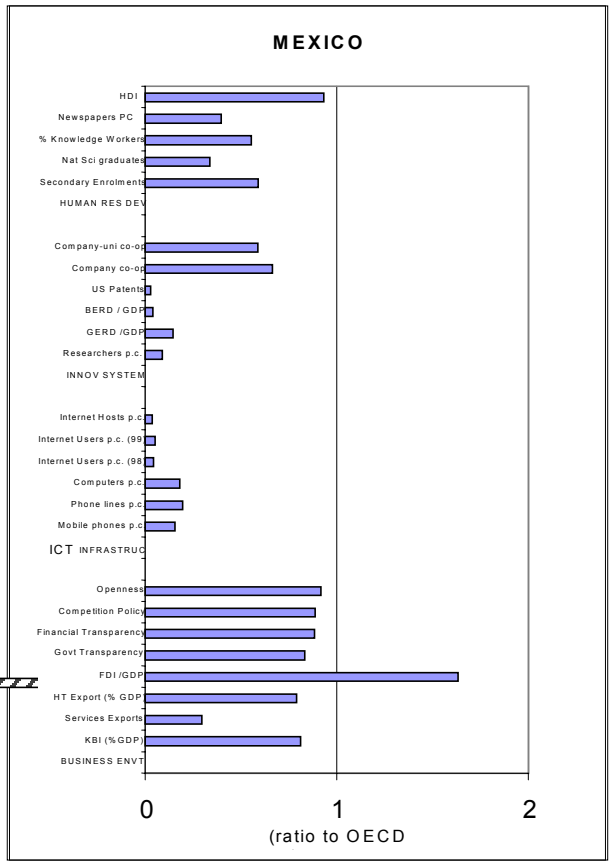


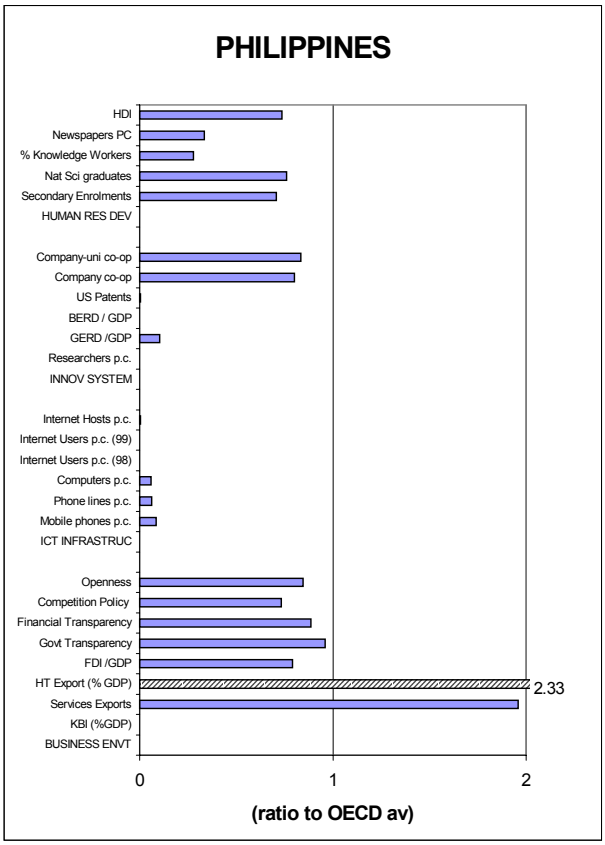


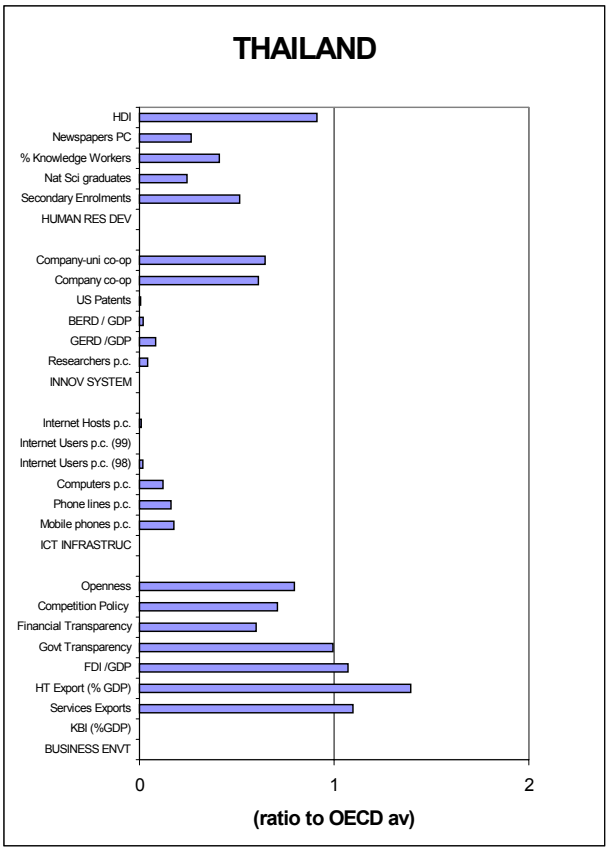


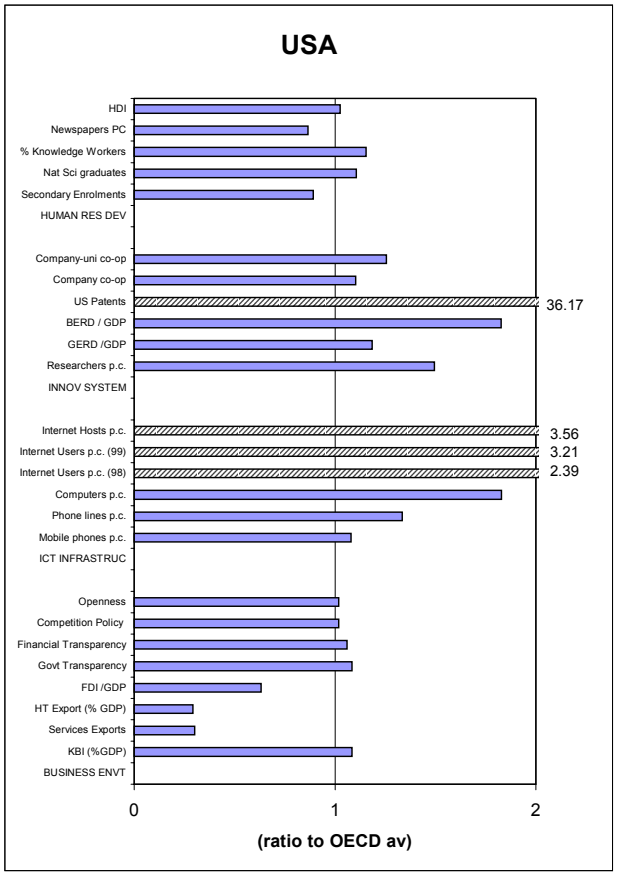


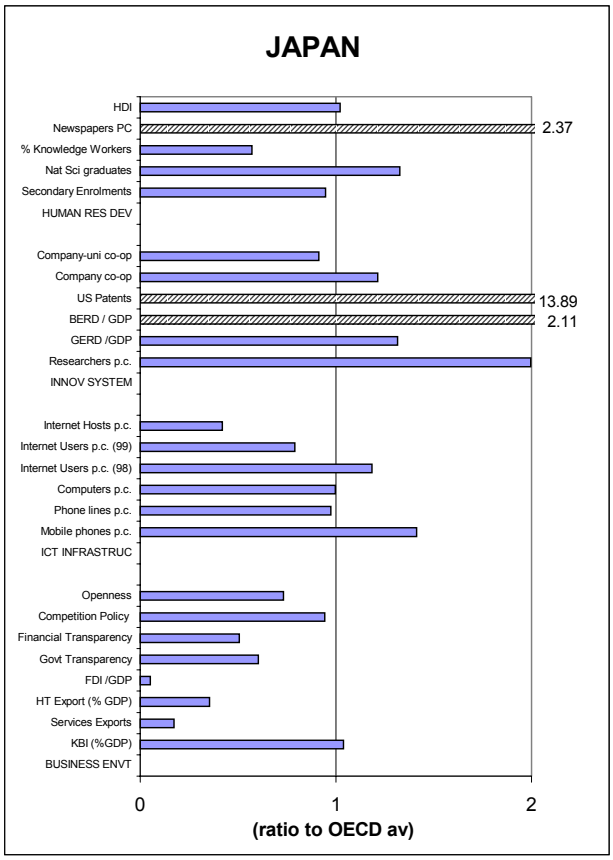

CHILE
HDI
Newspapers PC
% Knowledge Workers
Nat Sci graduates
Secondary Enrolments
HUMAN RES DEV
Company-uni co-op
Company co-op
US Patents
BERD / GDP
GERD /GDP
Researchers p.c.
INNOV SYSTEM
Internet Hosts p.c.
Internet Users p.c. (99)
Internet Users p.c. (98)
Computers p.c.
Phone lines p.c.
Mobile phones p.c.
ICT INFRASTRUC
Openness
Competition Policy
Financial Transparency
Govt Transparency
FDI /GDP
HT Export (% GDP)
Services Exports
KBI (%GDP)
BUSINESS ENVT
3.97
0
1
2
(ratio to OECD av)

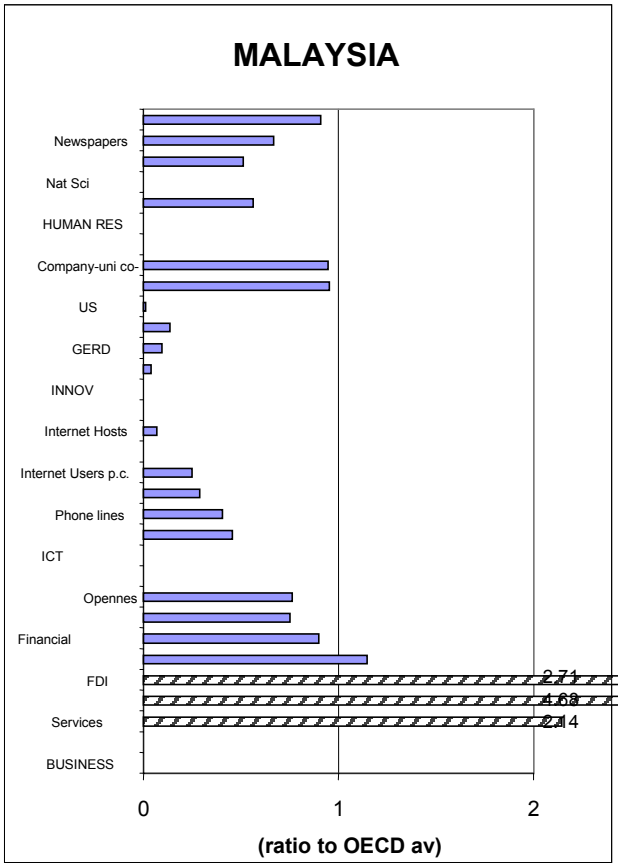

MEXICO
HDI
Newspapers PC
% Knowledge Workers
Nat Sci graduates
Secondary Enrolments
HUMAN RES DEV
Company-uni co-op
Company co-op
US Patents
BERD / GDP
GERD /GDP
Researchers p.c.
INNOV SYSTEM
Internet Hosts p.c.
Internet Users p.c. (99
Internet Users p.c. (98
Computers p.c.
Phone lines p.c.
Mobile phones p.c.
ICT INFRASTRUC
Openness
Competition Policy
Financial Transparency
Govt Transparency
FDI /GDP
HT Export (% GDP
Services Exports
KBI (%GDP)
BUSINESS ENVT
0
1
2
(ratio to OECD

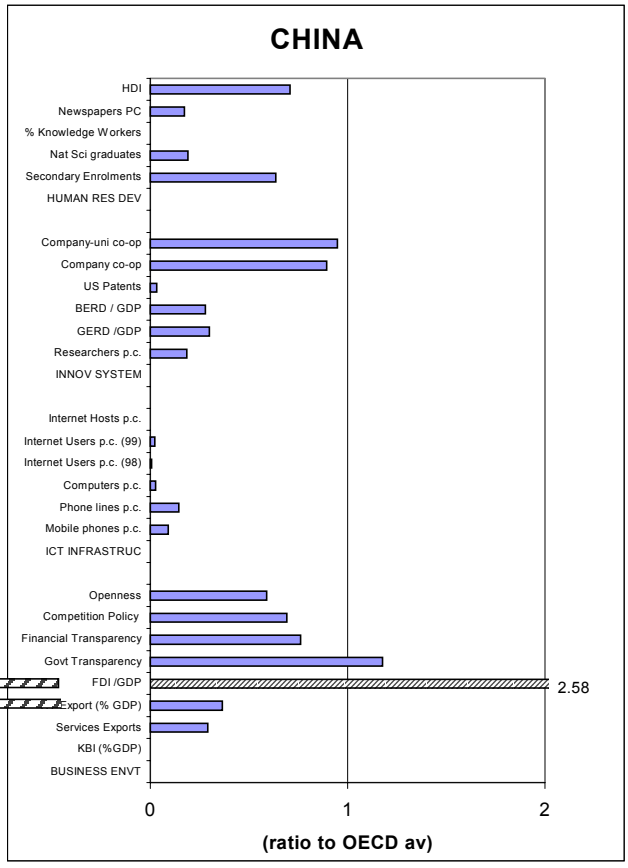

PHILIPPINES
HDI
Newspapers PC
% Knowledge Workers
Nat Sci graduates
Secondary Enrolments
HUMAN RES DEV
Company-uni co-op
Company co-op
US Patents
BERD / GDP
GERD /GDP
Researchers p.c.
INNOV SYSTEM
Internet Hosts p.c.
Internet Users p.c. (99)
Internet Users p.c. (98)
Computers p.c.
Phone lines p.c.
Mobile phones p.c.
ICT INFRASTRUC
Openness
Competition Policy
Financial Transparency
Govt Transparency
FDI /GDP
HT Export (% GDP)
Services Exports
KBI (%GDP)
BUSINESS ENVT
2.33
0
1
2
(ratio to OECD av)


THAILAND
HDI
Newspapers PC
% Knowledge Workers
Nat Sci graduates
Secondary Enrolments
HUMAN RES DEV
Company-uni co-op
Company co-op
US Patents
BERD / GDP
GERD /GDP
Researchers p.c.
INNOV SYSTEM
Internet Hosts p.c.
Internet Users p.c. (99)
Internet Users p.c. (98)
Computers p.c.
Phone lines p.c.
Mobile phones p.c.
ICT INFRASTRUC
Openness
Competition Policy
Financial Transparency
Govt Transparency
FDI /GDP
HT Export (% GDP)
Services Exports
KBI (%GDP)
BUSINESS ENVT
0
1
2
(ratio to OECD av)


USA
HDI
Newspapers PC
% Knowledge Workers
Nat Sci graduates
Secondary Enrolments
HUMAN RES DEV
Company-uni co-op
Company co-op
US Patents
BERD / GDP
GERD /GDP
Researchers p.c.
INNOV SYSTEM
Internet Hosts p.c.
Internet Users p.c. (99)
Internet Users p.c. (98)
Computers p.c.
Phone lines p.c.
Mobile phones p.c.
ICT INFRASTRUC
Openness
Competition Policy
Financial Transparency
Govt Transparency
FDI /GDP
HT Export (% GDP)
Services Exports
KBI (%GDP)
BUSINESS ENVT
36.17
3.56
3.21
2.39
0
1
2
(ratio to OECD av)


JAPAN
HDI
Newspapers PC
% Knowledge Workers
Nat Sci graduates
Secondary Enrolments
HUMAN RES DEV
Company-uni co-op
Company co-op
US Patents
BERD / GDP
GERD /GDP
Researchers p.c.
INNOV SYSTEM
Internet Hosts p.c.
Internet Users p.c. (99)
Internet Users p.c. (98)
Computers p.c.
Phone lines p.c.
Mobile phones p.c.
ICT INFRASTRUC
Openness
Competition Policy
Financial Transparency
Govt Transparency
FDI /GDP
HT Export (% GDP)
Services Exports
KBI (%GDP)
BUSINESS ENVT
2.37
13.89
2.11
0
1
2
(ratio to OECD av)


MALAYSIA
Newspapers
Nat Sci
HUMAN RES
Company-uni co-
US
GERD
INNOV
Internet Hosts
Internet Users p.c.
Phone lines
ICT
Opennes
Financial
FDI
Services
BUSINESS
2.71
4.69
2.14
0
1
2
(ratio to OECD av)


CHINA
HDI
Newspapers PC
% Knowledge Workers
Nat Sci graduates
Secondary Enrolments
HUMAN RES DEV
Company-uni co-op
Company co-op
US Patents
BERD / GDP
GERD /GDP
Researchers p.c.
INNOV SYSTEM
Internet Hosts p.c.
Internet Users p.c. (99)
Internet Users p.c. (98)
Computers p.c.
Phone lines p.c.
Mobile phones p.c.
ICT INFRASTRUC
Openness
Competition Policy
Financial Transparency
Govt Transparency
FDI /GDP
Export (% GDP)
Services Exports
KBI (%GDP)
BUSINESS ENVT
2.58
0
1
2
(ratio to OECD av)

This presentation emphasises the overall message of a group of related complementary indicators, such as those on innovation system. While each indicator in the group gives only a partial impression of the innovation system, the group as a whole gives an overall impression. This is appropriate for the qualitative comparison between groups of economies, which is the focus of this study.

The bulk of data are for 1997; only the ICT indicators are likely to have changed qualitatively since then. For each indicator, higher values are "better", that is, more like those in a fully developed KBE.

Longitudinal indicator data from 1992 were assessed. There was marked growth in the uptake of computing, Internet, and mobile telephone technology for the average OECD economy. Other structural changes involved growth in GERD, US patenting activity, foreign direct investment, and service exports. Similar trends were apparent in the APEC sample economies (see Table SA-4 for details).

From Figure I-8-3 we see that all the indicators for Canada and Australia cluster around the OECD average (that is, a value of 1.0 on the scale used). This is not surprising as both are mid-range OECD economies in terms of most economic and social indicators, that is, typical of long industrialised economies. However, both are relatively strong in ICT infrastructure.

The indicators for both Korea and Singapore are similar to those for Australia and Canada, which suggests that the High Performing Asian Economies are comparable to the Most Developed Economies in APEC in their movement towards a KBE. This is closely related to the explicit and well-resourced national strategies of both Korea and Singapore to become KBEs, a "natural" evolution from the industrial strategies they have successfully pursued. Although Figure I-8-3 suggests Korea lags behind some of its competitors in ICT infrastructure, Korea has been devoting much resources to improving this aspect since 1997. Both Korea and Singapore have already committed substantial resources to building their base in education, science, and ICT infrastructure, and this shows up in the indicators. The relatively low score for patents from Singapore and the relatively high score for BERD in Korea reflect the differing approaches these economies have taken to the acquisition of new technology, with Singapore drawing more on multinational companies. The profile for Chinese Taipei shown in Figure I-8-3 appears to be broadly similar to the other High Performing Asian Economies, although there are gaps in our data.

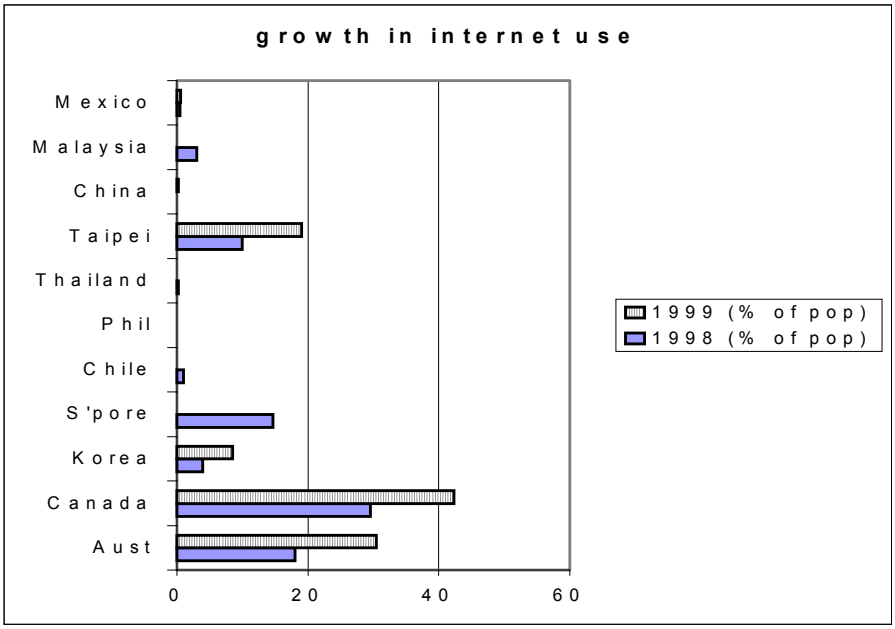
The Latin American economies of Chile and Mexico have indicator profiles in Figure I-8-3 which are similar to each other, but markedly different from the Most Developed Economies and the High Performing Asian Economies. In particular, they lag significantly in ICT infrastructure, innovation system, and human resource development. From the case study of Chile, it appears that liberalisation of the telecommunications sector is leading to increased uptake of ICT, but that science and technology, and innovation efforts still need much upgrading, especially in relation to business culture. School enrolment rates are still relatively low. The experience of the High Performing Asian Economies suggests that wider and deeper education is the key precondition before the other aspects can take off.

Consistent with the overlap between them in Figure I-8-2, the indicator profiles of the Asian Fast-Growing Economies and the Latin American Economies in Figure 8.3 are not dissimilar. However, secondary enrolment would appear to be somewhat higher in the Asian group while GERD/ GDP appears to be lower (except in China, where the figure is probably raised by former defence R&D and by a relatively low GDP denominator). Malaysia's ICT indicators are conspicuously higher than any other economy in either group, reflecting its strong policy thrust in this field.

Many of the indicators of the business environment are ratings from the World Competitiveness Yearbook, based on surveys of businesses operating in the economy concerned. It is notable that these ratings - of openness, competition policy, financial and government transparency - vary much less between the four groups of economies than do the other groups of indicators. In part this is because of the nature of the indicators (respondents to surveys doing a ranking of 1 to 10 usually avoid the extremes), and partly because of APEC's expectation that its members will have fairly liberal and transparent trade and regulatory policies. However, the data strongly suggest that several of the Asian economies in particular have room for improvement in corporate financial transparency, and in openness to domestic and international competition.

The indicator "Exports of high technology products" gives a measure of the knowledge-intensity and size of the manufacturing sector. This latter indicator is particularly high for Malaysia, Thailand, Philippines, Singapore, and Korea, but this is a little deceptive, since only in the latter two economies is substantial value added to the electronic products in question. Foreign direct investment (FDI) is particularly high in both Singapore and Chile, as a consequence of conscious policy decisions. By making considerable effort, as discussed in Chapter 5, Singapore has gained considerable new technology from this source, and has used it to build industries with a strong local technological base. However, many other countries have had less success in fully acquiring knowledge from this source.

Figure I-8-4
Growth in Internet Usage Typifies the Rapid Rate of Change of ICT Indicators



The rapid rate of change in some ICT indicators is illustrated in Figure I-8-4. The change in Internet usage from 1998 to 1999 was over 30% for all economies for which we have data. However, Internet usage remains relatively low in most of the Asian Fast-Growing Economies and Latin American Economies.

8.4 Conclusions

Basic education is a long-term investment without which a KBE is unsustainable. In a fully developed KBE, high quality education services that are both widely available and widely used are a major priority for the economy and society. Without this background it is virtually impossible to build the other aspects of the national knowledge base (such as R&D) to the level needed by a KBE. A major responsibility of government is therefore to ensure that such education services are in place. Secondary enrolment in both the Asian Fast-Growing Economies and the Latin American Economies fall well short of this precondition for a KBE, though some of those economies are making serious efforts to improve this. Even in the Most Developed Economies there is a need to improve educational performance, and to give greater attention to promoting lifelong learning.

ICT can be seen as an enabling technology for a KBE. Advanced information systems bring down the cost of information, facilitate access to wider pools of information, and promote the spread of ideas. Accordingly, a fully developed KBE has an advanced communications network, and a policy and regulatory framework that supports the development and use of information hardware and applications. Because of the centrality of digitised information in a KBE, the telecommunications infrastructure in Nikuda is not restricted to low-bandwidth media (such as voice and text email) but encompasses also higher bandwidth communication (which allow the possibility of online video, and health and education services). The Most Developed Economies and the High Performing Asian Economies have the requisite policy framework in place, but continuing substantial investment is still needed to bring these goals to fruition (for example, Internet penetration is still below 50% in all the case study economies). A few of the other APEC economies have appropriate policies in place, but have a long way to go in implementing them.

Because ICT technology is evolving, the infrastructure has to be renewed and upgraded decade by decade. This opens up the possibility for an economy to save on the cost of investment in one level of technology and go directly to a more advanced level (for example, going directly to mobile telephones or digital networks). Chile and Thailand appear to have pursued this route.

No nation has a monopoly on good ideas. The growth of a nation's knowledge base - including its widening into new fields - depends critically on its culture being open to new ideas, and especially to new ideas from outside. This is a precondition for a KBE.

A KBE can flourish only if the social, political, economic and legal framework of the economy - in other words, its business environment in a broad sense - is conducive to the development of the characteristics described above.

This entails a commitment to the development and productive use of new knowledge, broadly defined. Large markets and an open trade environment help create an incentive for innovation and allow for the implementation of technologies involving significant scale economies. A significant effort is made to ensure that technology brought into the

economy through foreign investment becomes a real and active part of the local knowledge base, through conscious adaptation and technology transfer. (Singapore has been conspicuously successful at this, but many other economies less so, in part because of their lower initial skill base.) At the same time, support is available to encourage research into more general areas of knowledge development where intellectual property rights cannot reasonably be established and enforced. The policy and institutional environment also promotes the beneficial spillover from encouraging interaction and cooperation among researchers in different institutions, disciplines, and industries. These latter aspects of knowledge creation and diffusion likewise presuppose an adequate education and skill base.

It also entails a policy and social framework which is attractive for investment in the future. This covers such aspects as a competitive but fair regulatory environment for business, transparency of government and company reporting, an accepted rule of law, and reasonably low inflation and interest rates. All of these are necessary for a prosperous economy of any kind, whether knowledge-based or not. While all APEC economies perform at least moderately well on these aspects, the data suggest that several of the Asian economies in particular have room for improvement in corporate financial transparency, and in openness to domestic and international competition.

The development of a KBE is a cumulative and evolutionary process. Arguably, no KBE can be exactly like any other nor developed in the same manner as in another country. The successful transition to a knowledge-based society is necessarily shaped and determined by local circumstances, tacit knowledge, and technological traditions.

ENDNOTES FOR PART 1

INTRODUCTION

[1] *Innovation* is an expression of the productive use of knowledge. More formally it has been defined as "the application in any organisation of ideas new to it, whether they are embodied in products, processes, services, or in the systems of management and marketing through which the organisation operates" (Maguire, Kazlauskas and Weir 1994). Many alternative, though more or less equivalent, definitions are in the literature. The present definition emphasises (1) the distinction between "invention" (that is, the discovery of a new idea) and innovation (that is, actually bringing an idea into practice) and (2) that innovation does not refer only to "hard" technology but also to "soft" practices.

CHAPTER TWO

[2] *Nikuda* is literally a Russian word for "nowhere".
[3] See chapter 3 for a more detailed discussion of what constitutes a "knowledge-based industry".
[4] The Seoul summary list includes "ceramics" as a clear-cut KBI, but this presumably refers to high-tech new materials, since it is hard to think of brick-making as necessarily being a KBI.
[5] In some countries, major banks have been part of closely linked aggregations of companies spanning many sectors. If you are a potential competitor of (say) a telecommunications company linked by mutual shareholdings et cetera to a particular bank, it will be difficult for you to get funds from that bank.
[6] Source: *Making transparency transparent*, Australian Treasury paper (1999). This is one of many such papers produced by various countries at the behest of the IMF following the Asian economic crisis of 1997/1998.
[7] There is a contrary argument that low inflation is a *consequence* of the enhanced productivity associated with movement towards a KBE, as this puts downward pressure on wages (Sheehan 1999).
[8] Rooney and Mandeville (1998: 458) argue similarly that "cultural diversity provides nations with the stuff for successful adaptation to a changing environment".
[9] An example in Australia is general practitioners in remote areas sending radiographs online to metropolitan specialists for diagnosis and advice, without moving the patient. For a review of the technical possibilities see "High-speed data races home", *Scientific American*, October 1999: 94-99.

CHAPTER THREE

[10] See Appendix 2 (technical notes) for a table listing the primary and secondary sources of data used in the tables.
[11] These lists of manufacturing and service KBIs are taken from the summary of the Seoul 1999 workshop, p.3. They are not identical with those used by the OECD.
[12] OECD *STI scoreboard* (1999) gives the list and the percentage cutoffs used for 1990 data. According to that source, using ISIC 4-digit classifications, high technology manufactures are aircraft, office and computing equipment, drugs and medicines, and radio, TV and communications equipment. MHT manufactures are "professional goods", motor vehicles, electrical machinery, chemicals, other transport, and non-electrical machinery.
[13] Note that some earlier OECD publications use a narrower definition of KBIs. The "narrow" OECD definition (used in 1998 *STI outlook*) includes high-tech manufacturing, communications services and finance and business services; the OECD wide definition (used in *STI scoreboard* 1999) includes also social services and med-high-tech manufacturing.
[14] Some earlier analysts have grouped clerical workers together with managers, professionals and associate professionals as "primary information workers". Despite the long-standing popular image of "industry" as the manufacturing industry and the typical worker as a factory hand, over 40% of the workforce in the US consisted of "primary information workers" even in the 1970s (Porat 1977). "Primary information occupations" are those where the workers are primarily engaged in the manipulation of symbols, either at a high intellectual content (such as authors and students!) or at a more routine level (such as bank tellers). Porat distinguished them from other service workers (about 25% of the US workforce at that time), though the distinction is one of degree since services generally are increasingly dependent on the rapid collection and processing of information, whether in tourist bookings or supermarket sales. The pioneering work on this topic is Fritz Machlup's (1962) seminal analysis of the US economy.

[15] The "OECD average" shown on the charts is the simple (unweighted) average across all (or most) OECD countries, not only those which are also members of APEC. It is intended as a reference value, which is independent of the sample set.

CHAPTER FOUR

[16] Some economists (for example, Sheehan 1999) argue that low inflation in the Most Developed Economies is not so much a result of national policy, but rather a consequence of the trend towards a global KBE - characterised by improved productivity and global trade competition.
[17] http://www.isr.gov.au/industry/summit
[18] For a report of the Canadian summit see http://www.innovationcanada.org/e-home.html
[19] In Korea, private payments for education are nearly 3% of GDP - mostly for tertiary education (OECD 2000e).
[20] Source: OECD (2000e) *Education at a glance- OECD indicators,* p34
[21] Most of these have a capacity of around 1 Mb/s, and can offer a range of telecommunications services including the Internet. They are similar in concept (including charges) to the Singapore-ONE network.
[22] For details see http://cap.ic.gc.ca/english/3000.htm
[23] The "OECD average" shown on the charts is the simple (unweighted) average across all (or most) OECD countries, not only those which are also members of APEC. It is intended as a reference value, which is independent of the sample set.

CHAPTER FIVE

[24] For example: World Bank (1993) *The East Asian Economic Miracle: economic growth and public policy*. Some analysts (for example, Krugman *Foreign Affairs*, 1994) have maintained that the high rates of growth in the HPAEs were due to little more than high savings and investment ratios, which were typically around 30%. However, a review in World Bank *Knowledge for Development* (1998: 18-22) (from which Dahlman's Seoul paper derives) suggests that such analyses underplayed the (educational) knowledge embedded in "labour inputs", and the knowledge required to invest the large savings efficiently (compare this with the centrally planned economies of the time which had high savings but low growth).
[25] This chapter draws heavily from papers at the 1999 *APEC Seoul workshop* on KBEs (Hong's paper on Korea and Toh's paper on Singapore), the respective government websites, and the Country Economic Briefs by the Australian Department of Foreign Affairs and Trade. The occasional interspersed material on Chinese Taipei comes mainly from an unpublished paper by Sun Chen (Chair of the Industrial Technology Research Institute) on *Taiwan's experience in the development of S&T-based industries*.
[26] Summaries of most of these initiatives can be found from the Singapore Government website http://www.gov.sg/, including under various statutory boards. The rash of such plans for the new millennium followed the PAP's re-election in 1997. It seems that the "Competitiveness" report was the first of these to explicitly refer to the "knowledge-based economy" - a theme that runs through all these "-21" plans.
[27] Source: statement by the Minister for Finance and Economy, April 1999.
[28] Speech by Finance Minister, Lee-Huan-jai, reported in *The Korea Herald*, 1 April 2000.
[29] Calculated from World Bank Figure for "high-tech exports" (see Chapter 3 for definitions).
[30] Estimates are clouded by cross-holdings and internal sales within each group. The low estimate is from Korea Centre for Free Enterprise (an institute run by the *chaebol*), reported in *Korea Economic Weekly* 20 Dec 1999; the high estimate (which includes some internal sales) from Hagemeister (1999). If overseas sales by the various groups were also included, gross sales by the top four *chaebol* would probably exceed 100% of Korea's gross domestic product.
[31] 1997 report by US embassy, cited by *Far Eastern Economic Review* 24 Dec 1998, p12.
[32] The "narrow" OECD definition (used in 1998 *STI outlook*) includes high-tech manufacturing, communications services and finance and business services; the OECD "wide" definition (used in *STI scoreboard* 1999) includes also social services and med-high-tech manufacturing. The OECD, for example, classifies as "high technology" those manufacturing industries where R&D/production exceeds 15%, and as "medium-high-technology" (MHT) those manufacturing industries where it lies between 4% and 15%. OECD *STI scoreboard* (1999) gives the list and the percentage cutoffs used for 1990 data. According to that source, using ISIC 4-digit classifications, high-technology manufactures are aircraft, office and computing equipment, drugs and medicines, and radio, TV and communications equipment. MHT manufactures are "professional goods", motor vehicles, electrical machinery, chemicals, other transport, and non-electrical machinery. See Chapter 3 of this paper for further discussion of what constitutes a KBI.

[33] The Bank of Korea released a report on the role of KBIs in the Korean economy on 3 April 2000, but used the OECD "narrow" definition of a KBI. According to the report, the average annual growth rate of KBIs has been recorded at 13.7% from 1991-1999. See Bank of Korea (2000), *Role of Knowledge-based Industries in the Korean Economy* (Korea) - in Korean.
[34] Sources: LG Economic Research Institute and Korea Institute for Industrial Economics and Trade, as reported in *Korea Herald* 1 Dec 99 and *Korea Times* 3 Dec 99. These sources use the OECD "wide" definition of KBI.
[35] Korea from Hong's paper, Singapore from National Statistics, and OECD average from WCY, 1997 figures.
[36] http://www.sipa.gov.tw
[37] World Bank, *World Development Report,* 1999/2000, 1996 figures.
[38] Singapore figure from *UNESCO Statistical Yearbook*, 1998, 1996 figure, in gross enrolment rates. Korean figures from World Bank, *World Development Report,* 1999/2000, p 241, 1996 figure.
[39] *UNESCO Statistical Yearbook*, 1998, Table 1.3. 1995 figures. Average determined from 12 of the 29 OECD nations.
[40] First figure is ISCO-88 categories 1+2+3; figure in brackets includes all of categories 1-4. Category 1 is government, 2 is professional workers, 3 is "associate professionals", 4 is clerks as explained in Appendix 4. This crude classification of "knowledge workers" excludes group 7 "craft and related trade workers" who are particularly numerous in Korea (15% of workforce).
[41] Sources: Toh (1999) and World Bank (1998).
[42] Source: *OECD STI scoreboard* 1999 giving data for 1997. Australian Embassy reports 21 million mobile phone subscribers in Korea in Oct 1999, that is, 46% of the population, which though much higher than 15%, is actually consistent with the previous growth rate!
[43] Source: websites: http://www.scv.com.sg and http://www.1-net.com.sg
[44] The rapidity of change in this area is illustrated by the take-up of mobile phones in Korea, which has risen from 3 per 100 people in 1995 to 46 in 1999.

CHAPTER SIX

[45] Significant reforms include financial sector restructuring and the introduction of new laws relating to bankruptcy and foreclosure; the easing of legislative restrictions governing foreign participation in the economy; and various initiatives to improve governmental accountability and transparency, such as the establishment of the National Counter Corruption Commission, the Office of the Auditor General, Administrative Courts, and an Ombudsman. For detailed analysis, see East Asia Analytical Unit (2000), *Transforming Thailand: Choices for the New Millennium*, Canberra: Department of Foreign Affairs and Trade.
[46] The text of these documents can be accessed at http://www.neda.gov.ph/
[47] As stated by Dr Filemon A Uriarte, Secretary of the Philippine Department of Science and Technology (DOST) in "IT Directions of the Estrada Administration", *S&T Post* (September 1999). The text can be accessed at http://www.stii.dost.gov.ph/
[48] Available at http://dirp4.pids.gov.ph/
[49] See M.L. Canieso-Doronila and J.E. Acuna, *Learning from Life: An ethnographic study of Functional Literacy in Fourteen Philippine Communities*, Vol. 1, Bureau of Non-Formal Education, Department of Education, Culture and Sports, 1994, p. 80.
[50] *Ibid*.
[51] Concessions have been granted to two firms - Thailand Telephone and Telecommunications (TT&T, which is 20% owned by Japan's NTT) and TelecomAsia, a subsidiary of the Thai agro-industry conglomerate CP Group. 25-year concessions were awarded to construct a fixed line telecommunications network in Bangkok on the basis of "Build-Transfer-Operate", whereby the firms would build the facilities, then immediately transfer the assets to TOT and then operate the network for the remainder of the concession period. In the case of TelecomAsia, its return from participating in the project will be 84% of revenues, with the remaining 16% due to TOT. Also see Ryan, D.J. *Privatisation and Competition in Telecommunications: international developments* (Wesport, Conn., 1997).
[52] Notably, R&D intensity is highest in China in two areas - aerospace and shipbuilding. R&D intensity in aerospace, at 10% of GDP, is very much higher than for any other Chinese industry. See P. Sheehan (1999) p. 16.
[53] Reported in "China Dot Communism", available at http://www.abc.net.au/rn/talks/bbing/s133606.htm

[54] Statistics from the state China Internet Network Information Centre, reported in *The Economist*, 22 July 2000: 22.

55 Some $150 million of foreign investment has gone into Chinese dot.com companies, mainly Internet content providers and e-commerce start-ups

[56] China's recognition of the importance of a knowledge-based economy for its future development has been indicated by the hosting of a symposium in Beijing (8-10 July 1999) called "The Knowledge Economy and China's Development Conference". The symposium was sponsored by AusAID through the Australia-China International Links Programme. Sponsoring Chinese organisations included the Ministry of Science and Technology (MOST), Quinghua University, and the State Information Centre of the People's Republic of China. The proceedings of the conference (in English) are due for publication in late 2000.

CHAPTER SEVEN

[57] Indicators groups are business environment, innovation system, human resource development, and information and communications technology infrastructure. The value of 1 is the OECD average for each indicator. See chapter 3 for further explanation.

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[58] Except for the Philippines, which is just below 10%. Again, see Chapter 3 and Appendix 2 for details of how this indicator is calculated.

[59] One indication of the weakness of the correlation of GDP per capita with the proportion of "knowledge workers" is that within the Latin American countries, as GDP increases, the percentage of knowledge workers decreases! This may reflect data inadequacies, or it may reflect differing economic structures within the group (for example, with Chile's GDP having a disproportionately high contribution from its mineral resources).

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PART II

POLICIES FOR PROMOTING THE DEVELOPMENT OF KBEs

1. INTRODUCTION AND POLICY FRAMEWORK

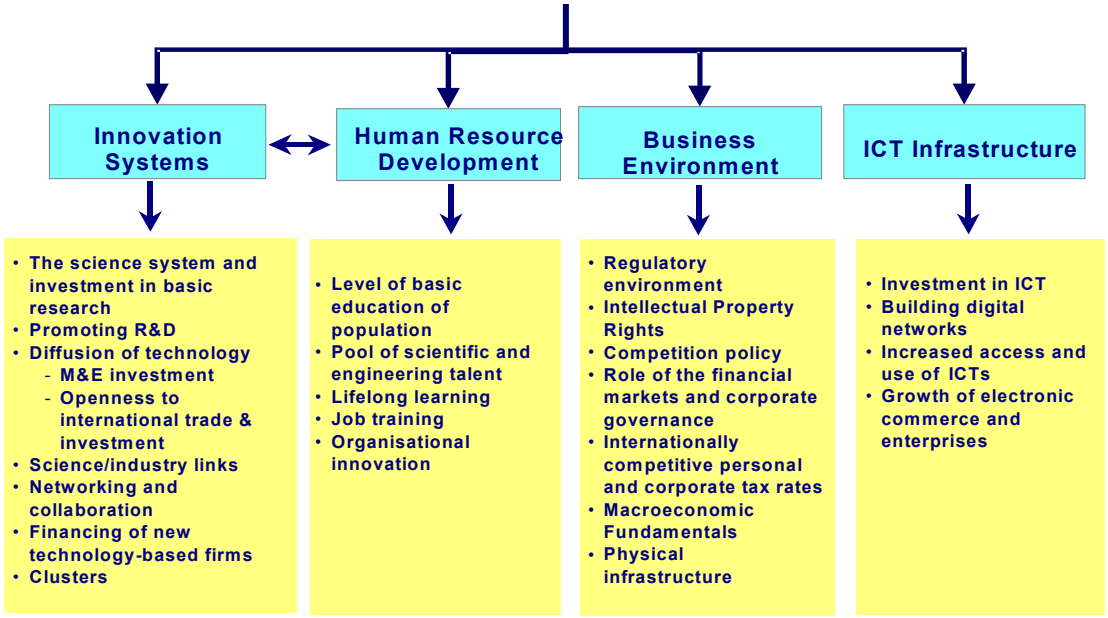
What types of policies are likely to facilitate economies' progress as KBEs? This section attempts to shed light on this question by drawing on the experience of APEC member economies. The efforts of member economies to build their capacity to create, acquire, and effectively utilise knowledge is reviewed with a view to identifying: (i) interesting and potentially exemplary policy initiatives; and (ii) major policy challenges that must still be addressed as part of APEC members' efforts to create a policy environment that is conducive to the development of KBEs.

The discussion distinguishes between APEC economies at different stages of development - that is, the Most Developed Economies, the High Performing Asian Economies, the Asian Fast-Growing Economies, and the Latin American Economies. For each of these groups, policymakers face distinct challenges in overcoming the obstacles impeding their economy's progress as a KBE. But while there are some commonalities, there are also some important differences among the countries within each category. Some of the more important differences among the economies at the same stage of development will be flagged in the discussion. It is also important to note that in some cases, the policies being examined offer a learning experience for all APEC economies, regardless of their stage of development. The efforts of the most developed economies to develop mechanisms that strengthen science/industry links, for example, should be instructive for all member economies.

The discussion builds on the framework in Part I. Our focus in Part II, however, is on the role of government policy. Recognising that it is firms and workers who will be the key actors in a KBE, we ask what actions governments can take to help firms and workers more effectively develop, acquire and utilise knowledge. Our interest is in both codified knowledge that is relatively easy to communicate, and tacit knowledge that is difficult to transfer and tends to be gained through experience. Our understanding of the policies that influence an economy’s progress towards a KBE is set out in Figure II-1. A policy environment designed to facilitate knowledge-based growth would give recognition to the importance of building the economy’s innovative capacity, developing human resources, encouraging investment and entrepreneurship, and strengthening the economy’s information and communications technology (ICT) infrastructure.

In applying this policy framework, our approach is necessarily selective. The intention is not to compile a comprehensive reference to what member economies are doing - or not doing - to strengthen the different planks of their KBE policy framework. Rather, the focus is on identifying major policy gaps and singling out particularly interesting and informative examples of how governments are attempting to address these challenges and foster the development of innovative, knowledge-based enterprises.

Figure II-1
Policy Framework to Facilitate the Progress Towards a KBE



The rest of the Part II is organised as follows: Chapter 2 focuses on the Most Developed Economies (with Australia and Canada as case studies); Chapter 3 considers the High Performing Asian Economies (with Singapore, Korea and Chinese Taipei as case studies); Chapter 4 discusses the Asian Fast-Growing Economies (with Malaysia, Thailand, and the Philippines as case studies); and Chapter 5 examines the Latin American Economies (with Chile and Mexico as case studies). Finally, the conclusions are presented in Chapter 6.

2. MOST DEVELOPED ECONOMIES

2.1 Introduction

For those APEC economies with the highest per capita incomes, the challenge is how to improve upon a base of policies and related institutions that have provided a firm foundation for these economies' high levels of prosperity. The Most Developed Economies have addressed many of the fundamental infrastructural needs of a KBE. Through existing policies, they have achieved high rates of primary, secondary and tertiary educational enrolment; they have created legal frameworks (including competition laws, corporate governance legislation, and consumer protection regulations) that support fair and efficient market exchange; they have largely opened their economies to the benefits of foreign trade and investment; over the past few decades, they have eliminated many of the most costly regulatory impediments to market competition; and they have achieved a degree of macroeconomic stability that compares favourably with developed and other major industrial economies. The most developed economies have introduced a range of policies to strengthen their national innovation systems, and they are all implementing strategies to promote the development and use of information and communication technologies (ICTs).

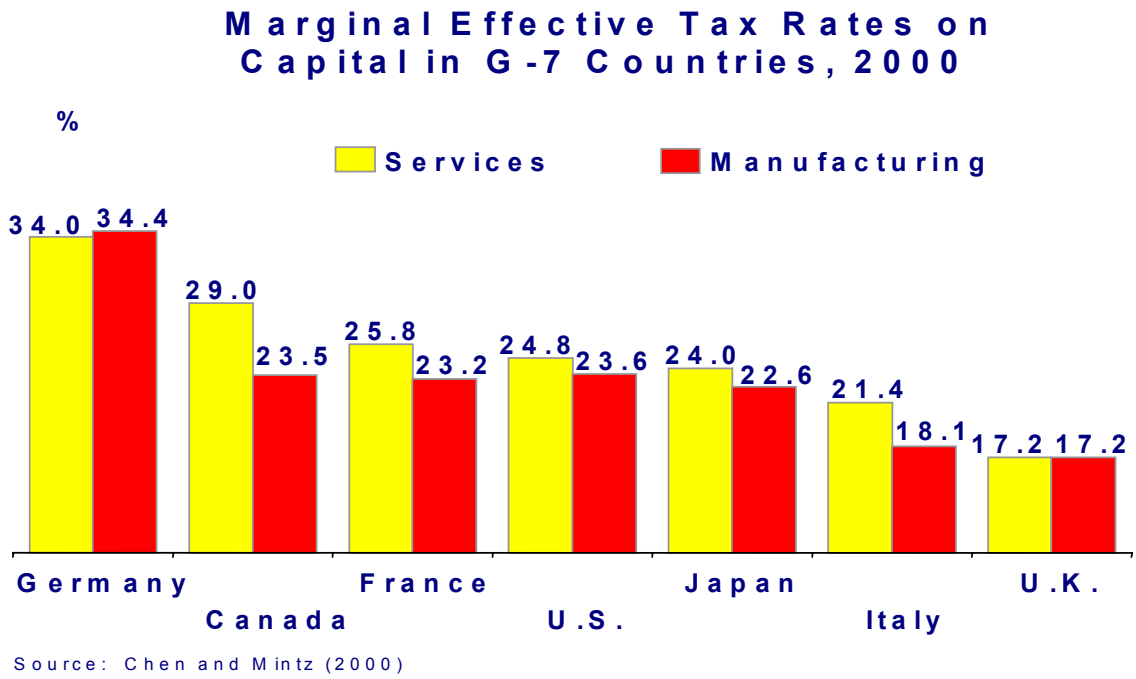
There are some important differences between highly developed APEC economies. One of the most important distinctions is between the US and Japan, which have relatively low ratios of trade and foreign direct investment to GDP, and smaller industrial economies, such as Canada and Australia that are much more outward-oriented and much more dependent on information inflows from abroad. The pre-eminent position of the US as a creator of new knowledge is reflected in various indicators of research output (publications, citations) and innovation (patents, patent citations). Some favourable historical factors (including a large domestic market in the 19th century that encouraged US firms to engage in inventive activities ahead of other countries) such as a strong university research system, and substantial and sustained public sector support for research (channelled through the Department of Defense, and such agencies as the National Aeronautics and Space Administration, and the National Institutes of Health) have all contributed to the strong innovative capacity of the US economy. By contrast, Canada and Australia, which have a high proportion of small firms with limited research capacity and a relatively modest university and public sector research capacity, benefit more significantly from the foreign technology that comes by way of machinery and equipment imports, the investment of foreign-based multinationals, the use of foreign consultants, and the hiring of foreign experts.

Despite their differences, the most developed economies face some similar challenges in upgrading their innovation infrastructure to meet the needs of the new knowledge-based economic environment. They all need to: (i) address a number of human capital needs that extend beyond the establishment of an extensive system of formal schooling; (ii) create a more favourable business environment by filling in some outstanding gaps in their framework policies; (iii) facilitate broad access to the most modern information technologies; and (iv) ensure that they have implemented technology policies that adequately address market failures in technology markets and that realise the potential gains from well-developed innovation systems. Below, drawing on the experience of Canada and Australia, we elaborate on these issues and identify some promising initiatives that have been introduced to meet these challenges.

2.2 Business Environment: Improving Tax Policies

Taxes affect the environment for knowledge-based activities in a number of important ways. They influence incentives for savings, investment, and labour activity. They influence investment spending choices. They also affect an economy's ability to compete for foreign investment and for highly skilled labour. In Canada and Australia, there have been concerns that corporate and personal tax systems that have evolved on a largely ad hoc basis over the years are adversely affecting the growth prospects of these economies. In terms of the efforts of these economies to accelerate their transition to KBEs, concerns centre particularly on their marginal effective personal tax rates, which have been among the highest in the OECD, and the lack of neutrality in their business taxes (Figure II-2). Non-neutral systems lead to distortions in the choice of inputs and in the allocation of investment spending.

Figure II-2



Source: Chen and Mintz (2000)

Recent policy reforms have addressed a number of these problems. In Australia, a comprehensive package of reforms introduced in 1998 included measures to lower the economy's excessively high marginal effective personal income tax rates. They also reduced the distortionary effects of Australia's system of indirect taxation. Further reforms being introduced in 2000 will result in the replacement of the wholesale sales tax with a more uniform and efficient goods and services tax; additional reductions in the marginal rates of personal income tax; and improvements in Australia's business tax arrangements - including, the establishment of a lower company tax in place of accelerated depreciation allowances. In Canada, the federal budget introduced in February 2000 proposes a significant reduction in personal and some corporate income taxes over a five-year period. The budget measures will reduce Canada's high taxes on non-manufacturing income and eliminate the bias in the current structure against service and high technology firms that are among the most important knowledge-based sectors of the Canadian economy. Canada's general corporate income tax rate, which currently exceeds 43%, will fall to 36% by 2004, where it will still exceed the OECD average (34%) but be slightly below the current US rate.

2.3 Innovation Systems

While, in the current environment, all industrial economies are being challenged to find new science and technology policies that will improve innovative performance, this challenge poses special issues for smaller industrial economies, such as Australia and Canada, with limited resources to commit to the development of new knowledge and technologies. These economies face especially strong pressures to maximise the return from a limited overall investment in innovative activities. Accordingly, policymakers have given considerable thought to the development of measures that improve the capacity of firms to adopt technology developed abroad, promote collaboration among researchers, facilitate cost- and risk-sharing in the development of new technologies, and promote the dissemination of knowledge and the rapid diffusion of new technology. Recent policies to promote information flows and strengthen innovation networks represent an important addition to Australia's and Canada's traditional programmes of technology support.[1]

The latter includes relatively generous fiscal incentives for R&D, which has long been an important component of science and technology policy in Canada and Australia. Although R&D is an investment intended to generate future returns, Canadian and Australian companies are allowed to write off both current and capital expenditures on R&D as current expenditures. The favourable tax treatment of R&D in Canada and, to a lesser extent Australia, can be seen in Tables II-1 and II-2. Based on the B-index, a measure of the present value of the before-tax income a firm needs to generate to cover the cost of an R&D investment and pay applicable income taxes, Canada has significantly more generous incentives than most other major industrial economies.

Table II-1
Comparison of Country Tax Incentives for a Large Manufacturing Company, 1998

Country	B-Index	ATC
Canada-QC.	0.699	0.482
Canada-ON	0.787	0.507
US-CA	0.879	0.521
Australia	0.890	0.570
France	0.914	0.533
Korea	0.918	0.635
Mexico	0.969	0.640
UK	1.000	0.690
Japan	1.010	0.525
Sweden	1.015	0.731
Italy	1.027	0.647
Germany	1.051	0.456

B-Index = ATC/(1-corporate income tax rate); ATC = after tax cost of $1 of R&D investment
Notes: 1) California's tax system is used for US
2) The proportion of R&D expenditure is assumed to be 90% for current expenses, 5% for M&E and 5% for buildings and structures.
3) A discount rate of 10% was used in calculating present values of depreciation allowances and incremental tax incentives.
Source: Jacek Warda, "Rating R&D tax Incentives", Conference Board of Canada, Members' Briefing 277-99, November 1999.

Studies suggest that such incentives, which reduce the effective cost of research activities, do stimulate additional R&D - the best estimate indicating that a dollar in tax credit stimulates about a dollar of additional R&D spending.[3] However, at least in the case of Canada, available research does not indicate that the social benefits are such as to justify a further enrichment of an already generous system of R&D tax credits.

Table II-2
Comparison of Country Tax Incentives for a Small Manufacturing Company, 1998

Country	B-Index	ATC
Canada-QC.*	0.369	0.288
Italy*	0.552	0.3677
Canada-ON*	0.591	0.464
Korea*	0.837	0.689
US-CA	0.879	0.521
Australia	0.890	0.570
France	0.914	0.533
Japan*	0.937	0.609
Mexico	0.969	0.640
UK	1.000	0.690
Sweden	1.015	0.731
Germany	1.051	0.456

* Countries providing special R&D treatment to small companies.
Notes: See Table 1.
Source: Jacek Warda, "Rating R&D tax Incentives", Conference Board of Canada, Members' Briefing 277-99, November 1999.

As distinct from Japan and the US, fiscal incentives account for the largest single component of government support for industrial technology in Australia and Canada (Figure II-3). In both Australia and Canada, however, governments also promote R&D through grants, mission-oriented contracts, and the funding of government laboratories and public research agencies. Institutes such as Australia's Commonwealth Scientific and Industrial Research Organisation and Canada's National Research Council have played an important role in developing generic technologies with application in a number of activities and industries. Besides encouraging innovation, public support for technology has contributed to the development of the competencies that are needed to identify promising technologies developed elsewhere and adapting them to domestic needs.

In recent years, the search for mechanisms that can strengthen links within the innovation system and enhance returns from investment in R&D has been a major focus of policymakers in Canada and Australia. Some recent initiatives offer instructive examples of what governments can do to leverage R&D investment and generally strengthen economies' innovation systems.

Encouraging Collaborative R&D Activities

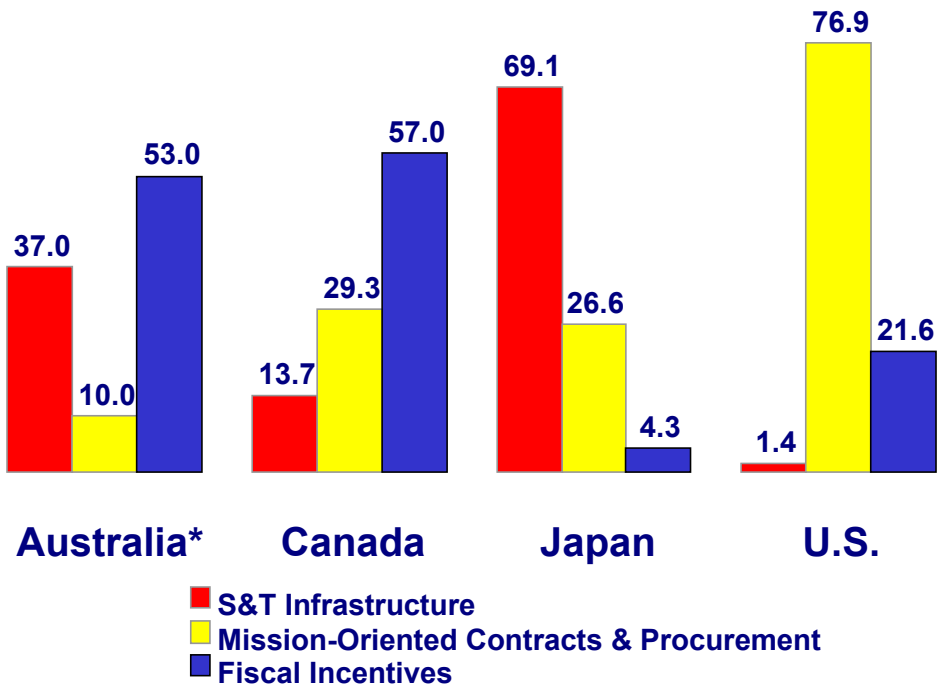
Through its *Cooperative Research Centre* (CRC) initiative, the Australian Government promotes collaborative research in the fields of natural science and engineering, with an

emphasis on projects having commercial and other applications. CRC links researchers from universities and government organisations with business and public sector research users.

Canada's *Networks Centres of Excellence (NCE)* programme facilitates collaboration among leading researchers in universities, industry, and government and helps accelerate the commercialisation of research. In 1997/1998, 463 companies, more than 100 provincial and federal government department and agencies, 44 hospitals, 61 universities, and more than 200 other organisations were involved in the NCE programme.

Figure II-3

Government Support for Industrial Technology, 1995 – (Percentage Shares)



Note: * data are for 1994
Source: OECD., Managing National Innovation Systems, 1999.

Promoting the Diffusion of Technology

Through the *Industrial Research Assistance Programme* (IRAP), which is administered by Canada's National Research Council, technology advisors are sent to help Canadian companies develop and exploit advanced technology. IRAP's network of 260 Advisors provide technical advice to over 10,000 companies per year. Information on new technologies is also disseminated through the federal government's *Strategies* web site (Box II-1).

Australia's *Technology Diffusion Programme* includes a number of forms of public support to facilitate research collaboration and the exchange of new findings on science and technology (Box II-2). An example of a more specific programme is Australia's *Energy Efficiency Best Practice Programme*, which uses benchmarking information,

good-practice guidelines, workshops, extension services and other vehicles to stimulate energy efficient practices among firms.

BOX II-1
Strategies

The STRATEGIS web site operated by Industry Canada contains a wide range of information and statistics on Canadian business and industry and is an important source of information on technology and business opportunities. It includes: the distCovery database which covers more than 35,000 licensable technologies from Canada and around the world; the Canadian Technology Gateway which lists science and technology activities and capabilities in Canada; and Trans-Forum, a technology transfer tool for universities and colleges. The web site reports on the results of government-industry efforts to develop technology roadmaps in a number of sectors. It contains programme descriptions and policy research reports, and provides links to the sites of other government departments, agencies and private sector groups offering technological support.

BOX II-2
Australia's Technology Diffusion Programme

This programme, which is aimed at helping industry and researchers access new and leading-edge technologies developed in Australia and overseas, has two components. The *Technology Alliances* component offers a number of different types of support – including travel grants, international fellowship and exchange grants, and international conference funding - to help Australian researchers forge international links. The *Technology Transfer* component provides support for demonstration and related projects designed to facilitate the uptake of new process and technologies by Australian firms, including especially small and medium enterprises.

Helping to Finance New Knowledge-based Enterprises

Australia's *Innovation Investment Fund* (IIF) helps small, technology-based firms that are commercialising technology access venture capital for growth and expansion. Private and public sector funding of the IIF programme now amounts to about $350 million. In addition, to encourage "patient" equity investment in small and medium enterprises (SMEs), the Australian Government provides tax concessions to eligible venture capital companies or *Pooled Development Funds* (PDFs) and their shareholders.

The *Business Development Bank of Canada* (BDC), a federal institution that was created to address the unmet financial needs of SMEs, has recently launched a number of new initiatives to help technology-based start-ups. Under its Venture Loan programme, companies can obtain financing without giving up equity by instead committing to a combination of interest payments and royalties on sales. The BDC Patient Capital programme offers quasi-equity loans, in which repayment can be postponed for up to three years, to new businesses with favourable prospects but insufficient profits to retire debt in the normal course of business.

2.4 Human Resources Development

As noted in previous sections, there is considerable evidence of the important influence of human capital on an economy's innovative capacity. While there are a number of dimensions to human capital, a strong educational and training system is a core part of an infrastructure designed to meet the needs of a KBE. Workers must be equipped with basic skills they need to function effectively in a knowledge-based environment, and they must have access to the resources they need to upgrade their skills and adjust to changing market requirements.

In all economies, policymakers must determine how they can best allocate scarce public funds to strengthen the educational and training infrastructure. In the case of formal education, the highly developed economies have invested heavily in primary and secondary schooling, where there are especially large positive spillovers, and developed support programmes to help post-secondary students overcome income constraints and capital markets imperfections that limit their access to credit. Under the Canadian Opportunities Strategy, for example, Canadian families can save for their children's education in tax-sheltered registered education savings plans. One of the most interesting approaches to assisting post-secondary students is the programme of income-contingent loans introduced in Australia in 1989 and, in modified form, in New Zealand in 1992 (Box II-3).

BOX II-3
Income-contingent Loans in Australia and New Zealand

Under the Higher Education Contribution Scheme introduced in Australia in 1989, students contribute to the costs of their university studies. Students can apply for an income-contingent loan from the government and defer repayment until their earnings reach a threshold, usually after graduation. Repayments are then calculated as a percentage of their income. The principal is indexed to the consumer price index, but the real interest rate is zero, thereby subsidising those who require more time to repay the loan.

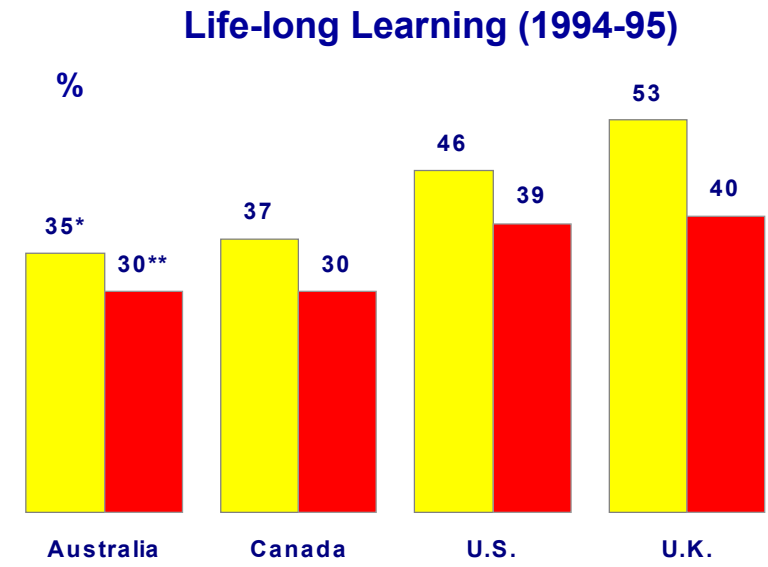
In 1992, New Zealand introduced a modified version of this programme. Repayment is not required until student earnings reach a threshold level, with payments then being set at a fixed percentage of above-threshold earnings that is the same for all borrowers. The interest rate subsidy is lower in New Zealand, with the rate being equated to the government borrowing rate for those individuals that are deemed able to afford it.

Advanced information technologies can help maximise the return from educational spending, and the most developed APEC economies have been attempting to take advantage of this. Information technology is being used within public schools to enhance classroom education and to reach out to students requiring distant education. Governments are also encouraging firms to integrate computer-based learning systems into their workplaces, given evidence of the substantial gains, in terms of lower training costs and increased productivity, that can be achieved. Canada's *SchoolNet* programme is one of the most ambitious initiatives to promote use of ICTs in education. Through a partnership

between federal, provincial and territorial governments, school boards and private sector participants, Canada successfully linked all Canadian schools, including First Nations schools and libraries, to the Internet by 31 March 1999. Under the second phase, the federal government is working with the provinces and private sector to extend connectivity from schools to classrooms.

While the most developed economies have achieved high levels of educational attainment, there remain some significant weaknesses in their education and training infrastructures. The high educational spending of these economies has not been fully reflected in student performance as measured in international tests of verbal and quantitative skills. Canada, for example, has a surprisingly high proportion of individuals with poor literacy skills, with over 40% of the population scoring at literacy levels 2 or less in the latest International Adult Literacy Survey. Skill shortages have been reported in some fast-growing sectors (ICT, bio-tech, aerospace) and there are indications that skill gaps have impeded the adoption of advanced technologies by Canadian firms. The percentage of the employed population participating in continuing education and training is much lower in Australia (35%) and Canada (37%) than countries such as the UK (53%) and the US (46%) (Figure II-4). This is related to the finding that Canada and Australia rank poorly in terms of employer-sponsored training[4] - again, well below the UK and the US. Studies have also pointed to the relatively low investment of Canadian and Australian firms in developing and adopting innovative workplace practices.[5] In both countries, studies have pointed to the need for greater attention to "soft technologies", including changes in organisational structures and compensation systems, that can help firms more fully realise the opportunities created by new information and communications technologies.

Figure II-4



*Percentage of population 25-64 years, participating in continuing education and training
**Percentage of population 25-64 years, participating in job related continuing education and training.
"Continuing education and training" includes formal university education and technical and further education (TAFE) courses and vocational training.
Source: ISR, Measuring the Knowledge-Based Economy

In training, as with post-secondary education, there is a need for policymakers to come up with programmes to help individuals overcome market failures - including both those that limit their ability to borrow against their "human capital", and those that discourage employers from investing in worker training. This could involve special loan programmes or tax credits. A potentially attractive option is the system of *Individual Learning Accounts* being explored in the UK. The programme allows individuals to accumulate savings for education in special accounts, which are eligible for public subsidies and tax-free support from individuals' employers.

There is also a need for systems of competency testing that will promote higher and more uniform standards of education and training. The disappointing achievement of industrial economies in international education tests is partly due to the lower educational spending of certain regions within these economies. Agreed standards can help remove these disparities. Similarly, national competency testing in various technical fields can address concerns about inequalities in publicly funded training in economies, such as Canada, where training policy has been decentralised.

A further aspect of human resource development is the establishment of conditions that will help attract and retain the highly educated and skilled workers that are needed in a successful KBE. Beyond establishing a favourable business framework (which we discussed above), governments may need to introduce special measures to compete more effectively for valued knowledge workers. Concerns about the ability of its universities to compete against well-endowed US institutions for leading researchers has prompted the Canadian Government to allot $900 million over five years to fund 2,000 Canada Research Chairs. This programme is directed at helping universities across the country attract established world-class researchers, along with younger researchers who have demonstrated the potential to become leaders in their fields. It is hoped that the programme will build the critical mass of world-class researchers that are needed for Canadian universities to achieve research excellence.

2.5 Supporting the Use of ICTs

The most developed APEC economies have given importance to facilitating and promoting the use of information and communications technologies. They have all attempted to create conditions that are favourable to private initiatives to build high quality broadband facilities, and to develop innovative new ICT applications. The importance of competition as a means of ensuring low-cost, high quality telecommunications services has been recognised in all the economies. Governments are in the process of extending their framework laws to the world of digital transactions. They are also all very much engaged in the process of integrating advanced technologies into their operations to increase efficiency and improve their delivery of government services.

In both Canada and Australia, telecommunications firms are gradually extending their fibre optic networks to homes and businesses in major cities. In Australia, the Commonwealth government has established the Regional Telecommunications Infrastructure Fund, with a budget of about $500 million over five years, to support infrastructure development and service delivery in non-urban areas. In Canada, urban communities and all remote and rural communities with populations of more than 400 are

being brought online through the federal government's *Community Access Programme.* Up to 10,000 public access centres will be established under this programme by 31 March 2001. The Canadian Government is helping schools become connected through SchoolNet and also through the *Computers for Schools* programme, which is aimed at delivering 250,000 computers to schools and libraries by 31 March 2001.

All of the most developed APEC economies are taking steps to ensure that their economies are in a position to benefit from the explosive growth that is expected in electronic commerce. In September 1998, the Canadian federal government introduced the *Canadian Electronic Strategy*, a broad policy framework aimed at building trust in the digital marketplace, clarifying marketplace rules, strengthening the information infrastructure, and realising the benefits from market development. As part of its efforts to strengthen public confidence in electronic transactions, the government has developed legislation to protect personal information used in commercial or federal government activities.[6] The establishment of a public key infrastructure (GOC PKI) to support privacy, the integrity of messages, and authentication is facilitating the electronic delivery of federal services. The government is examining the adequacy of existing consumer protection legislation, including provisions under the Competition Act governing deceptive trade practices and misleading advertising. At the same time, however, the federal strategy recognises that business solutions are most appropriate in some areas. Support is being given to private sector efforts to establish voluntary codes of conduct and to develop technological solutions, such as encryption and digital watermarking, to protect content.

In Australia, recent legislation (the *Electronics Transactions Act 1999*) provides a light-handed legal framework to support and encourage business and consumer confidence in the use of electronic commerce. The Act represents a significant step towards the government's commitment to having all appropriate government services online by 2001. Other steps being taken to establish an improved regime include: introducing new privacy legislation (being considered by Parliament in 2000); contributing to the improved administration of the domain name system worldwide; and reviewing Australia's copyright laws to ensure they adequately address electronic content.

Both the Canadian and Australian governments give importance to the development of new ICT applications. In Australia, *Information Technology Online*, one of the programmes administered by the *National Office for the Information Economy* (NOIE), supports collaborative projects aimed at accelerating the adoption of new and innovative online applications that improve the competitiveness of Australian businesses. In Canada, *CANARIE Inc*., a private, not-for-profit organisation supported by industry Canada and other government and private sector organisations, aims at facilitating the development of Canada's communications infrastructure and stimulating the development of next-generation products, applications and services.

2.6 Concluding Remarks

In responding to the challenges of a knowledge-based environment, the most developed APEC economies have a well-developed policy base upon which to build. Through their support for education, marketplace policies, macroeconomic and technology policies, they have addressed many of the most important issues that are involved in building a high quality innovation infrastructure. Among the more important continuing challenges these

economies face are:

- the implementation of improved personal and corporate tax regimes that support saving, investment, and work activity, and that promote the efficient allocation of resources;
- the creation of innovation systems that foster the realisation of synergies in R&D and promote the distribution of knowledge and the diffusion of technology;

- the development of policies that encourage worker training and support lifelong learning; and
- the establishment of an overall policy framework that is conducive to the use of ICTs and the growth of electronic commerce

Australia and Canada, the two economies examined in this section, have made a significant start in tackling these issues. Their recent experience in developing policies to foster the use of ICTs and to strengthen their innovation systems is potentially instructive to APEC economies at all stages of development.

3. HIGH PERFORMING ASIAN ECONOMIES

3.1 Introduction

The success of the high performing Asian economies (HPAEs) owes much to their governments' ability to create conditions that were conducive to the acquisition and use of knowledge. Some significant cracks have recently become evident, however, in the policy and institutional foundations that have been built. In addition, the High Performing Asian Economies need to ensure that their human capital, science and technology, and infrastructure policies continue to leave them well positioned for success in an increasingly competitive, global environment.

These challenges raise somewhat different issues within Korea, Chinese Taipei and Singapore. While these economies all have a number of the attributes of rapidly growing economies - including strongly rising educational attainment, growing rates of R&D, a well-developed physical infrastructure, and relatively high rates of capital investment - they also exhibit differences that reflect the distinct strategies the three economies have adopted to achieve rapid growth. In Singapore, the government has aggressively sought foreign direct investment, while adopting "market-leading" policies to promote investment in skill and technology-intensive activities. To attract multinationals, it has invested heavily in education, training and physical infrastructure, adopted liberal entry and ownership conditions, and introduced various targeted incentives. By contrast, Korea has used large, local private firms, the *chaebol*, to spearhead its industrialisation and export growth. Policies were directed towards building the economy's capacity to adapt promising foreign technologies and promoting technology acquisition through capital goods imports, technology licensing, and the hiring of foreign experts. Until recently, FDI was welcomed only when alternative means for accessing technology were not available.

Although Chinese Taipei did not impose the same barriers to inward FDI as Korea, its development path was also tilted in favour of alternative means of technology acquisition. Unlike Korea, however, policies were geared to fostering the development of small and medium-sized high technology enterprises. To support the technological activities of its

SMEs, the government has established a number of public research institutes, invested heavily in the development of the economy's education and physical infrastructure (including science-based parks such as Hsinchu park), and fostered the growth of the Industrial Technology Research Institute (ITRI) into an important vehicle for the adoption and creation of generic technologies.

To succeed as KBEs, these economies must address weaknesses in components of their framework policies, ensure that their human capital and infrastructure policies continue to lay a basis for strong economic performance, and adjust their technology policies to take account of new opportunities and new constraints.

3.2 Business Environment: Repairing Cracks in HPAEs' Framework Policies

3.2.1 Financial Sector Reform

A strong financial sector is important in encouraging investment and facilitating the flow of resources from less productive to more innovative and promising activities. Although governments in Singapore and Chinese Taipei have attempted to guide economic activity, it was primarily in Korea that government efforts to influence the allocation of resources that led to the development of a weak financial sector that was unable to effectively screen and monitor corporate borrowers. There is scope for financial reform in other HPAEs. In Singapore, domestic banks tend to be relatively small, and restrictions limiting foreign banks from owning more than 40% of any local bank's capital have reduced the prospects for efficiency-enhancing mergers. The most pressing need for financial sector reform, however, is in Korea.

Since the Asian financial crisis, Korea has made significant progress in restructuring its financial sector and strengthening prudential supervision. A new agency, the *Financial Supervisory Commission* (FSC), has been given responsibility for rigorous enforcement of prudential rules and the restructuring of financial institutions. In channelling funds, financial institutions are now to be guided by market opportunities and by rules of prudential soundness. Korean banks are advised to have a 10% capital adequacy ratio, and are required to comply with FSC rules regarding transparency and disclosure. A new system of deposit insurance has further helped build confidence in the banking system. Restructuring has involved the sale and closing of some firms and the injection of funds to recapitalise viable financial institutions. The process of financial sector reform is not yet complete. It will take some time to reduce government ownership in the banking sector and establish a strong market-based financial system. The comprehensive programme of reform instituted by Korea, however, offers an instructive example for other APEC economies that need to reform their financial systems.

3.2.2 Improving Corporate Governance

Along with highlighting the need for financial sector reform, the 1997 financial crisis exposed serious weaknesses in Korea's corporate governance framework. The concentration of corporate control in the founding families of the chaebols and the lack of rules to protect minority shareholders exacerbated the problems arising from lax financial sector controls. The government has also attempted to address this problem. Reforms have been introduced to: (i) improve transparency; (ii) strengthen minority shareholder rights; (iii) strengthen company boards; (iv) control intra-group dealings by chaebols; and (v)

improve insolvency procedures (Box II-4). The government has been encouraging companies to reduce debt and improve their financial structure. Corporate restructuring has been facilitated by a recent labour law revision, which allows layoffs for "urgent managerial reasons", including mergers and acquisitions. In addition, and perhaps most important, the ceiling on foreign shareholdings in individual companies has been abolished. Korean firms that are underperforming are now open to foreign mergers and acquisitions, including hostile takeovers.

It will take some time to bring about a transformation in corporate governance practices. Moreover, it is likely that further actions will be needed in some areas. The OECD has noted that most companies have not yet included cumulative voting (which is intended to allow minority shareholders to elect independent directors) in their charters, and pointed to the lack of clarity in the law regarding the role and responsibilities of company directors. Further improvements could include the development of a code of best practice based, for example, on the OECD Principles of Corporate Governance.

BOX II-4
Corporate Governance Reforms in Korea

(1) Transparency:
- Chaebols are required to prepare combined financial statements.
- External auditors and corporate accounting officers are subject to stiffer penalties.

(2) Shareholder Rights:
- Minority rights were strengthened by reducing the minimum ownership required to take various actions (for example, filing a derivative suit).

(3) Strengthening the Board:
- Listed companies are required to fill one-fourth of their board seats with outsiders.
- The fiduciary duty of corporate directors was introduced.
- *De facto* directors now face the same liability as elected directors.
- Minority shareholders can use cumulative voting to elect a director.

(4) Intra-group Relations:
- New debt guarantees between chaebol subsidiaries are prohibited.
- Holding companies are allowed subject to restrictive conditions.

(5) Insolvency Procedures:
- Economic criteria are to be used in evaluating applications for corporate reorganisation, and the process is to be subject to time limits.

Source: Based on OECD, *Economic Surveys: Korea, 1999.*

3.3 Innovation Systems

While the strategies the HPAEs have adopted to promote the acquisition and diffusion of advanced technologies have been highly effective, recent developments suggest that there may be a need for adjustments in these economies' technology policies. Significant recent developments include the establishment of new international rules to govern WTO members' support for science and technology. The "Agreement on Subsidies and Countervailing Measures" signed in Marrakech in 1994 sets limits on the support governments can provide to industrial and pre-competitive research. WTO members that exceed the prescribed limits may be subject to disciplinary action. In addition, changes in the global trading environment, including especially the increased pressure on firms to

come up with new and more innovative products and services, is affecting some of the HPAEs' traditional routes for acquiring new technology.

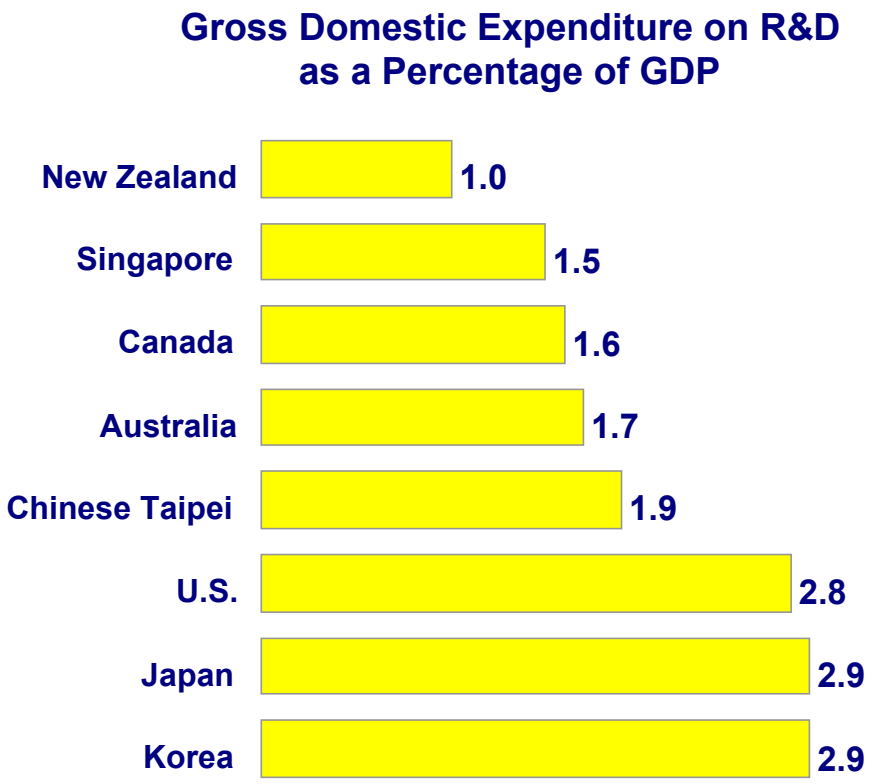
Korean firms are finding that technology licensing - which has been successfully used not only to acquire specific technologies but, in some cases, to gain access to the licensed technology's underlying design principles - is becoming more difficult. Foreign companies are reported to be less willing to sell technology to Korean firms, which are becoming major competitors in many fields.[7] Licensing and reverse engineering are also becoming less useful technology vehicles as industries progress towards the production of leading-edge products and the use of leading-edge process technologies.

The government has attempted to build Korea's indigenous capacity for innovation through R&D incentives, the most important of which allow firms to set aside 3% to 5% of operational revenues in any given year to finance R&D activities over the following three years. The government has also increased its spending on R&D. The Ministry of Science and Technology's MOST programme supports six categories of research, including the Highly Advanced National (HAN) project that was initiated in 1992 to develop product and fundamental technologies in designated areas. Government policies have contributed to a sharp growth in Korea's R&D spending, and, as a percentage of GDP, it is now close to the highest of all OECD countries (Figure II-5). Much of the growth in R&D, however, has occurred in the business sector. One of the challenges the government faces is to encourage greater R&D within universities and strengthen the economy's basic research capacity.

It has been suggested that the development of stronger links between industry and basic science in Korea could help address these concerns.[9] Some of the policies the most developed APEC economies have introduced to strengthen their innovation systems (and discussed above) may be instructive in this regard. Korea may also be able to draw some useful lessons from the successful experience of other HPAEs in developing research clusters that facilitate interaction among individuals working in related areas of activity. In addition, Korea could devote increased efforts to attracting FDI, a potentially important source of technology that has played a very small role in the economy's development. An important start has been made with the introduction in November 1998 of the Foreign Investment Promotion Act, which extends national treatment to foreign firms, offers a number of incentives to foreign investors, and establishes foreign investment zones to promote inward FDI.

Firms in Chinese Taipei are also encountering new constraints in accessing foreign technology as they approach the technological frontier in a number of sectors. The share of GDP devoted to R&D has grown in Chinese Taipei, but not nearly as strongly as in Korea. The need to strengthen the indigenous capacity for innovation raises special considerations in an economy that is heavy reliant on SMEs. While small firms are often the source of radically new technologies and have a flexibility that allows them to respond more promptly than large firms to new market conditions, they are less able to exploit the economies of scale associated with R&D. This is a potentially serious disadvantage in an economic environment where product life cycles are becoming shorter and the competitive pressure for technological improvements is intensifying.

Figure II-5



The comparisons were based on the most current data available for New Zealand, Singapore, and Chinese Taipei data based on 1995 figures; 1996 figures for Australia; 1997 figures for Japan and Korea; and 1998 figures were used for Canada and U.S.

Source: Compilations based on OECD Science, Technology and Industry Scoreboard, 1999; and Towards Information Society – Developments in APEC, APEC Economic Committee, October 1998

Chinese Taipei has attempted to address this issue in a number of ways. The government has promoted collaboration, which allows firms to share the costs and the risks of research and development. Strategic international alliances, which allow domestic firms to benefit from accessing the complementary knowledge and skills of foreign firms, are also being encouraged. ITRI, which has long played an important role in strengthening the economy's research capacity, continues to be a core component of technology policy. Recent ITRI initiatives include the "open laboratory programme", which promotes interaction between industry and ITRI researchers, and the "incubator programme", which offers assistance to innovators for the development of business plans and managerial training. The international division of ITRI has also increased in importance, reflecting the government's emphasis on strengthening international collaboration.

In Chinese Taipei, as in Korea, more can be done to take advantage of inward foreign direct investment as a mechanism of technology acquisition. Greater attention could also be given to policies that would help Chinese Taipei's SMEs restructure and realise available benefits from increased scale. Policies that enhance export opportunities and that facilitate outward direct investment could conceivably contribute to the development of larger scale enterprises with a greater innovative capacity.

Singapore, which also faces pressures to build the size and global competitiveness of its domestic enterprises, has made outward foreign direct investment an explicit policy objective. In connection with its *Industry 21* initiative to foster knowledge-based activities, Singapore has also given importance to promoting promising new ventures. Under *Technopreneurship 21*, about S$10 billion has been allotted for investment in private venture capital firms. Special support is available for "angel investors" through the Business Angel Fund, which will co-invest up to S$1 for S$1.50 invested by eligible Business Angels.

3.4 Human Resource Development

One of the major sources of the HPAEs' economic strength has been a well-educated workforce. Korea, for example, had achieved universal primary education by 1960, and by 1995 had attained secondary and tertiary enrolment that compared well with other OECD countries. Significantly, the private sector has been responsible for much of the strong increase in higher education. In 1995, private spending on tertiary education amounted to 6% of GDP, compared to 5% for the government. In addition, Koreans devote a significant share of spending (amounting to 2.7% of GDP) on private tutoring.

While tertiary enrolment rates have grown strongly in all HPAEs, they have not risen as high in Singapore as in Korea and Chinese Taipei. In addition, there are significant differences among HPAEs in terms of their emphasis on technical studies. The proportion of tertiary students in mathematics, computer science and engineering is lower in Korea than Chinese Taipei and lower still in Singapore. In comparison to the other HPAEs, however, Singapore excels in the provision of technical training, having created - in some cases, through government collaboration with multinational enterprises - a number of highly specialised training centres. Singapore has also benefited from its decision many years ago to liberalise immigration and work permit requirements for the professionals employed by foreign affiliates. As part of its Manpower 21 initiative, the Singapore Government has introduced a number of programmes (for example, the *Strategic Manpower Conversion Programme*) to encourage and facilitate training in leading-edge high growth industries, including one aimed at mature and laid-off workers (*Skills Redevelopment Programme).*

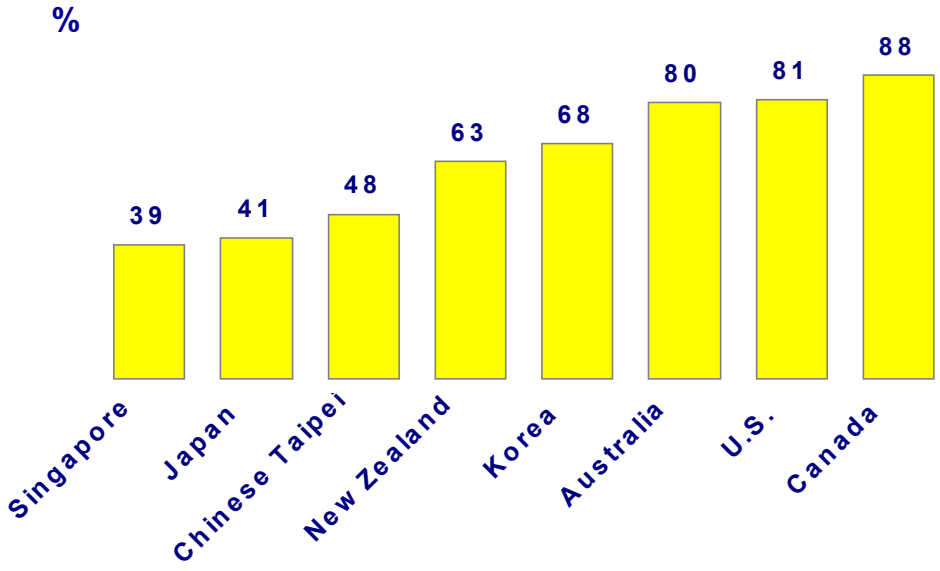
The HPAEs still have some distance to go to achieve the tertiary educational attainment rates of the most developed APEC economies (see Figure II-6). There is also scope within Singapore's and Korea's higher education systems for further concentration on those technical fields that tend to be associated with technological innovation. Primary attention, however, has been given to three human capital concerns. First, despite the favourable performance of the HPAEs on international tests (for example, the Third International Mathematics and Science Study), concerns have been raised about the quality of publicly provided education. In Korea, for example, a 1995 presidential commission criticised the emphasis on rote learning, arguing that the educational system needed to do more to build the creativity and initiative that are important to success in a highly competitive global economy.

Second, the loss of talented and skilled workers who emigrate abroad has been a concern. Some of these economies' best students go to other countries for graduate studies and remain there to pursue attractive research or job opportunities. Korea and Chinese Taipei have attempted to reverse the flow by offering significant financial and tax incentives to

those who return home to teach or work. A recent government programme has allowed many PhD graduates returning to Chinese Taipei to receive two-year postdoctoral appointments within high technology industries.

Figure II-6

Gross Tertiary Education Enrolment Rates, Selected APEC Member Economies



The comparisons were based on the most current data available for Japan 1994 figures; 1995 figures for Canada and U.S.; 1996 figures for Singapore; and 1997 figures for Australia, Korea and New Zealand.

Source: UNESCO, Statistical Yearbook, 1999; for Chinese Taipei, data are drawn from its Statistical Yearbook, 1996

In addition, Chinese Taipei has been successful in tapping the expertise of those nationals who remain abroad. The economy's successful semiconductor industry, for example, benefited from the input of foreign advisors who sat on the Science and Technology Advisory Group.

Third, the HPAEs have lagged behind in the development of retraining programmes and the creation of opportunities for lifelong education. Recent data indicate, for example, that the educational participation rate for those 25 to 64, which is around 35% in the US, is under 6% in Korea. Although this problem is more significant in the HPAEs than in the most developed APEC economies, the solution is likely to be found in the same areas. As in the case of the most developed economies, there is a need for support programmes which take account of employers' reluctance to provide general training, and employees' difficulties in accessing needed credit. Governments should also promote the use of computer-based learning materials, which offer an efficient and effective means to address many continuing education needs. To help give expression to the concept of a "School of Lifelong Learning", Singapore has developed a *National Skills Recognition System* which promotes skill development through the use of bite-size learning modules, including on-the-job training.

3.5 ICT Development

A well-developed physical infrastructure has been another factor supporting the strong economic performance of the HPAEs. It has facilitated the commercial activities of domestic firms and, in the case of Singapore, been a significant factor in its successful efforts to attract FDI. International firms have indicated that the presence of advanced infrastructure was the most important consideration in choosing to locate regional headquarters and service and sourcing operation in a country, and the second most important factor in siting production.[10] In the 1970s and 1980s, when multinational electronics firms were investing heavily in offshore production, the government of Singapore went after this activity by establishing specialised skill development programmes and developing a modern and highly efficient seaport, airport and telecommunications infrastructure.

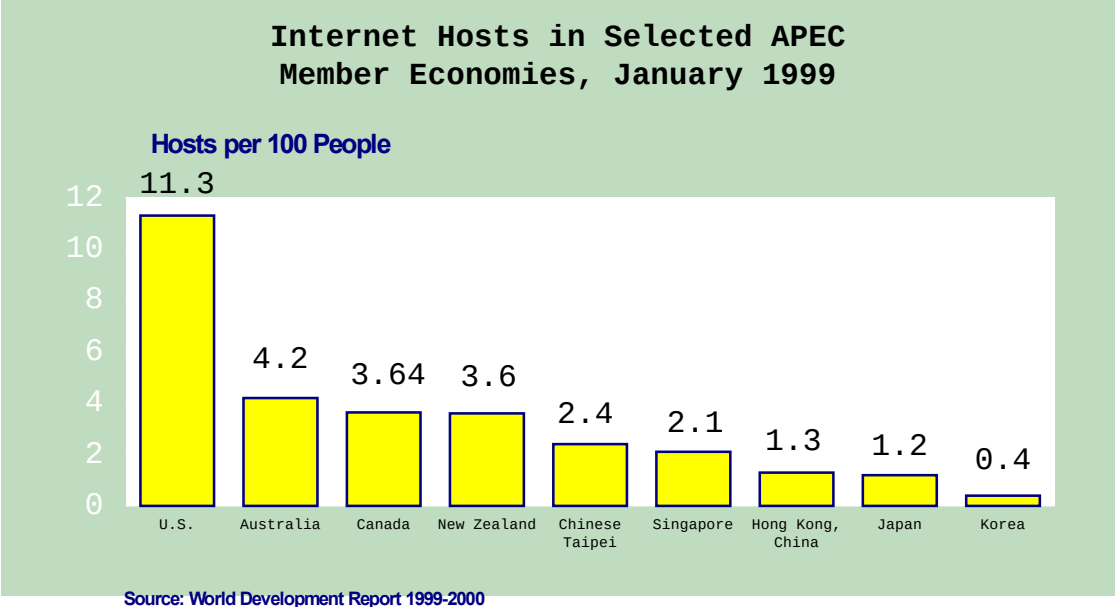
The critical infrastructure for knowledge-based economies consists of telecommunications facilities, along with the applications and institutional framework needed to support wide use of advanced information and communications technology. HPAEs must focus on these areas of development, if they are to continue to benefit from an infrastructure that facilitates strong economic performance. While they currently trail somewhat behind the most developed APEC economies in terms of ICT use, the HPAEs are all implementing ambitious plans for development of an advanced information infrastructure. The Korean Government, for example, is supporting private sector initiatives to construct a high-speed information network, and developing a high-speed government information network (KII-G) which will serve the public sector along with research institutions and universities. Financial and tax incentives are being provided to private firms in an effort to achieve a high-speed digital network that will link every household by 2002. As part of its *Cyber 21* programme, the Korean government is also installing high-speed network links in all primary, middle and high schools, and establishing Internet plazas where city residents can access the Internet.

Singapore has given particular importance to the development of an advanced information infrastructure. Rates of computer and Internet use are higher than in other HPAEs. Internet penetration in Singapore at 2.1 hosts per 100 people is higher than that of Japan and other HPAEs (Figure □-7). Singapore offers a number of instructive examples of how ICTs can be used to improve the delivery of public services. Tradenet, for example, is a networked information system (developed in Singapore and managed by Singapore Network Services) which allows traders to declare imports and exports for customs from their office computers, saving time and storage costs. The government's plan to create an "intelligent island" is intended to help establish Singapore as a regional financial and product design centre. Companies participating in the development of a broadband network that will provide the desired high-speed links to other economies, or developing products or services for the network, are eligible for income tax exemptions, R&D tax deductions, funding from the National Science and Technology Board, and preferential telecommunications tariffs. The development of a modern information infrastructure requires a policy framework that encourages ICT use by promoting service competition and protecting users from inappropriate and fraudulent practices. Policy changes are underway.

The Korean telecommunications market, which had been dominated by the government-run Korean Telecom (KT), began to be opened to competition in 1990 and is now served

by over 30 facility-based service providers. Chinese Taipei is undertaking a broad liberalisation of its telecommunications markets that has started with the mobile voice and data transmission segments, and will extend to fixed basic service within five years. Singapore is in the process of terminating the monopoly of its national carrier, P

Figure II-7



Note: The number for Chinese Taipei is drawn from NII Project, DOIT, MOEA, 2000.

TT, and introducing competition into telecommunications. The HPAEs are also addressing the need for framework laws that protect ICT users and build trust in digital transactions. An exemplary initiative in this area is Singapore's Electronic Transactions Act (Box II-5).

BOX II-5
Singapore's Electronic Transactions Act

The Electronic Transactions act, which came into force on 10 July 1998, establishes the legal framework to govern electronic transactions in Singapore. It covers the following issues:

-authentication of the identity of the originator of electronic records and messages;
-the legal recognition of electronic signatures;
-the retention of records by electronic means;
-the integrity of electronic records transmitted over networks;
-the legal responsibility of service providers;
-the formation and validity of electronic contracts;
-the legislative framework for certification authorities and digital signatures;
-cross-certification of foreign digital signatures;
-government use of electronic records and signatures; and
-miscellaneous enforcement and investigation powers tailored for electronic transactions.

Source: U.N., *Economic and Social Survey of Asia and the Pacific,* 1999.

3.6 Concluding Remarks

The strong economic performance of the HPAEs reflects their success in building efficient systems for acquiring and utilising technical knowledge. Central to the success of these economies was a strong commitment to increasing the educational attainment of their workers, and a sensitivity to the policies that facilitate the acquisition of foreign technologies. Recent developments, however, have highlighted some cracks in their market framework policies. They also point to the need for the HPAEs to foster indigenous innovative capacities that will allow them to remain competitive in leading-edge technologies.

The HPAEs are addressing these challenges, and their policy efforts may be instructive for other economies. Especially notable are:

- Korea's recent efforts to implement needed financial reforms and improve its corporate governance framework;
- Korea's successful use of incentives to raise private sector R&D;
- Chinese Taipei's effective promotion of industry clusters and research consortia;
- Singapore's technical training programmes developed in conjunction with MNEs and its current initiatives to train workers for leading-edge high growth industries;
- Chinese Taipei's policies to "bring home" foreign-trained scientists and engineers; and
- Singapore's focus on developing a ICT policy framework that will make it an "intelligent island"

4. ASIAN FAST-GROWING ECONOMIES

4.1 Introduction

As distinct from the most developed APEC economies and the High Performing Asian Economies, Indonesia, Malaysia, Thailand, and the Philippines are still in the process of developing much of the legal, institutional and physical capital that is needed to support a high level of industrial activity. These economies have followed a long-term growth path that compares favourably with developing economies in other parts of the world, owing in considerable part to their ability to benefit from the use of foreign technology. There are significant differences within the group, with Malaysia standing out both in terms of its openness to foreign technology - as indicated, for example, by its high share of inward FDI to GDP and the high ratio of its imports of capital and high technology goods to GDP - and its success in establishing the preconditions for sustained growth. The Asian Fast-Growing Economies (AFEs), however, are still at a relatively early stage in building an infrastructure that will leave them well positioned to participate in an era of global, increasingly knowledge-based activity.

The recent Asian financial crisis underscores one part of the challenge facing most of the economies in this group: the need to update and improve their marketplace laws so that they adequately address market gaps, and provide consumers and investors with assurance that market transactions will proceed fairly and efficiently. Beyond this, the AFEs need to focus on those policies that will help them compete more effectively for foreign investment and strengthen their capacity to acquire and adapt foreign technologies.

While the AFEs have experienced major structural shifts over the last few decades - first moving from agricultural towards manufacturing exports and then from labour-intensive to medium- to high-technology exports - the weaknesses in their innovative capacity (with the partial exception of Malaysia) are impeding their transformation into major producers of high value added, skill-intensive products. Thailand, for example, has seen a major growth in the importance of its medium- to high-technology exports, but its role has primarily been to serve as an assembly point for these products. The activities taking place in Thailand do not require a high-skilled labour force and as a consequence, the economy is vulnerable to increasing competition from low-wage Asian producers, such as Bangladesh, India and Viet Nam. Similarly, in the Philippines, electrical and electronic exports, which have grown rapidly, have very low value added. Moreover, over the past two decades, there has been no significant increase in the amount of local content in these exports. Weaknesses in the AFEs' innovative infrastructure are at the root of these issues. Along with improving their marketplace laws, the AFEs face the need to build their economy's skill base, further modernise their physical infrastructures and invest in strengthening their science and technological capabilities.

4.2 Business Environment

4.2.1 Marketplace Reforms

Banking and Capital Markets

The financial crisis that began in Thailand in 1997 has forced the AFEs to address deficiencies in their policies governing banks and other financial institutions. A number of important reforms have been introduced in the last few years. In Thailand, for example, the government has restructured the financial sector and established tighter controls on bank and finance company lending. The Financial Restructuring agency was created in October 1997 to oversee the rehabilitation of the financial sector, including the liquidation of unviable companies. Banks and the remaining finance companies were required to satisfy increased capital reserve requirements and prohibited from lending for nonproductive purposes, such as consumer spending and real estate development. Restrictions preventing foreigners from holding a controlling interest in banks were also lifted.

In the Philippines, there has been a recognition of the need to enhance the ability of the Central Bank and the Deposit Insurance Corporation to supervise the banks, and of the Securities and Exchange Commission to oversee the corporate sector. Reforms are being implemented to improve corporate governance by increasing transparency and increasing the rights of minority shareholders. The Securities and Exchange Commission is introducing increased corporate disclosure requirements and more effective bankruptcy procedures.

Among the AFEs, continued efforts are required to develop robust regulatory frameworks that support investment activity and contribute to efficient capital allocation. Since banks tend to account for a high share of total financial intermediation in these economies - substantially higher than in the most developed APEC economies[11] - a healthy banking sector is particularly important for long-term investment and growth. In the Most Developed Economies, supervisory bodies actively enforce regulations that specify the services banks can provide, the capital and reserves they must hold, the composition of

their portfolio, the terms for disclosing non-performing loans and other matters. These regulations build on a broader legal structure that helps provide a secure basis for banking operations. This structure includes laws which protect the rights of creditors, laws and institutions to efficiently resolve bankruptcies, and well-established accounting and auditing standards. Developing a solid institutional foundation takes time. The AFEs can accelerate the reform process by adopting and effectively enforcing widely accepted international banking standards. Allowing the entry of foreign banks, which can bring advanced skills and technologies, can also help speed up the modernisation of the banking sector.

Intellectual Property Regimes

Intellectual property laws strengthen the incentives within an economy for innovative activity, and also help economies participate in increasingly global technology networks. In the case of the AFEs, it is the latter which is of prime importance. The AFEs need to give attention to the contribution effective systems of patent and copyright protection can make to an economy's efforts to attract foreign direct investment, license foreign technology, and collaborate with other nations on R&D projects. Empirical studies suggest there is indeed reason for concern that inadequate intellectual property protection will discourage inward FDI and reduce an economy's ability to license foreign technology.[12]

The AFEs have been reforming their patent policies to meet WTO requirements emerging out of the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPs). Still, partly because monitoring and enforcement procedures differ, the strength of patent protection within some of the AFEs remains well below that of some of the most developed APEC economies. In one recent attempt to measure the strength of patent protection in 1995, for example, Thailand only scored 1.85 out of a maximum of 5, which was well below the US (4.52) and Japan (4.33), as well as Korea (4.05).[13] As part of their efforts to build an innovation infrastructure that facilitates knowledge acquisition and use, the AFEs should review the adequacy of their IP laws and institutions.

Competition Policy

The implementation of an effective competition policy can complement and support other initiatives the AFEs are taking to increase the role of market forces within their economies. The strengthening in market pressures that has resulted from recent policy reforms involving privatisation, deregulation, and the removal of many trade and investment barriers will contribute to the AFEs' development as KBEs. An effective competition policy can help to ensure that producers in all sectors are exposed to market discipline and that barriers that may prevent the emergence of innovative new firms or impede the growth of productive activities are eliminated. Competition policy plays an especially important role in preventing exclusionary and anti-competitive activities in untraded services and goods markets where policy or natural barriers continue to limit international competition.

It is only recently that the AFEs have turned their attention to the potential role of competition policy. Although Thailand has had an anti-monopoly statute since 1979, the Price Control and Anti-Monopoly Act was mainly used to control prices of essential commodities. The AFEs can usefully draw on the experience of the most developed APEC economies that have had a long time to refine their legislative frameworks and improve

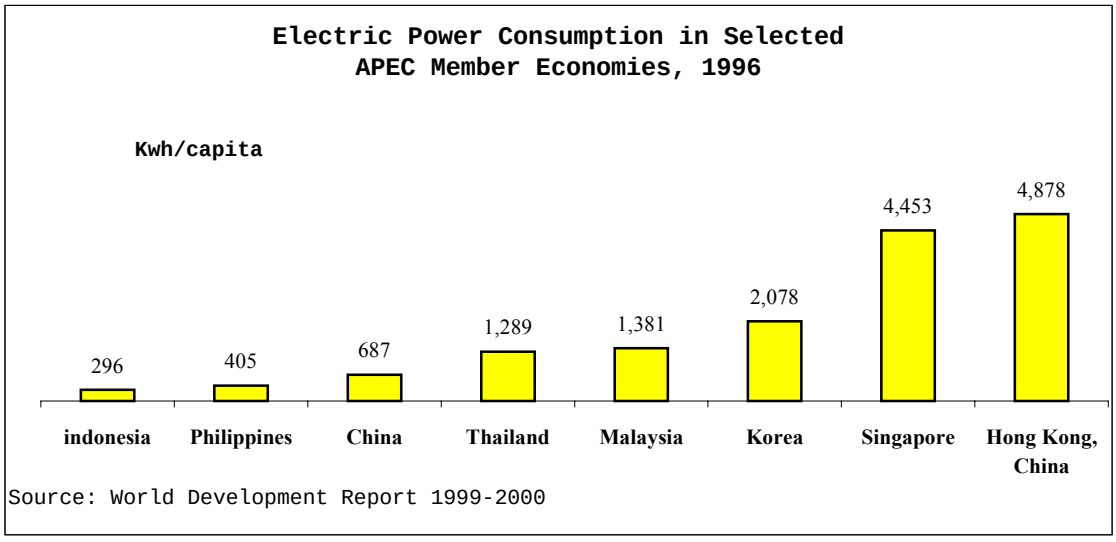
their administration and enforcement apparatus. As students of competition law have observed, however, the laws and institutions of advanced industrial economies cannot simply be transplanted to less developed economies. The emphasis should be on putting in place simple laws, which are easy to understand and can be effectively enforced.[14]

From this latter perspective, the AFEs may be well advised to ignore recent strands within competition policy literature and practice that argue for activities to be assessed in terms of their effects on welfare - so that activities which substantially lessen competition may be permissible if they give rise to more than offsetting gains in efficiency.[15] These theoretical refinements are difficult to effectively operationalise. Economies developing competition policy frameworks may, therefore, be better off following the more traditional approach which focused on safeguarding the competitive process. Although the overall objective of competition policy is to improve efficiency, that objective is most likely to be achieved by an approach that leads to effective policies to prevent major anti-trust practices, including conspiracies, bid rigging, and monopolies/abuses of dominant position.

4.2.2 Infrastructure

Inadequacies in communications infrastructure or in power, water, road or other basic facilities can hamper an economy's ability to attract investment, to introduce modern technologies and to build a dynamic, high value added export sector. The AFEs face the need for major investments in physical infrastructure in coming years. Concerns have been raised particularly about inadequacies in power supply that could create bottlenecks that will slow some of the AFEs' economic development.[16] Figure II-8 indicates that the supply of electric power is most limited in the AFE group of economies compared to the HPAEs. While recent declines in economic activity temporarily postponed the requirement for additional capacity, the need for large investments to prevent power shortages and adequately satisfy future needs is again becoming evident. There is also a need to upgrade water and sanitation services, which tend to be significantly below standard in the HPAEs. In Indonesia, in particular, major infrastructure spending is required to increase the proportion of the population that has access to safe water and adequate sanitation.

Figure II-8

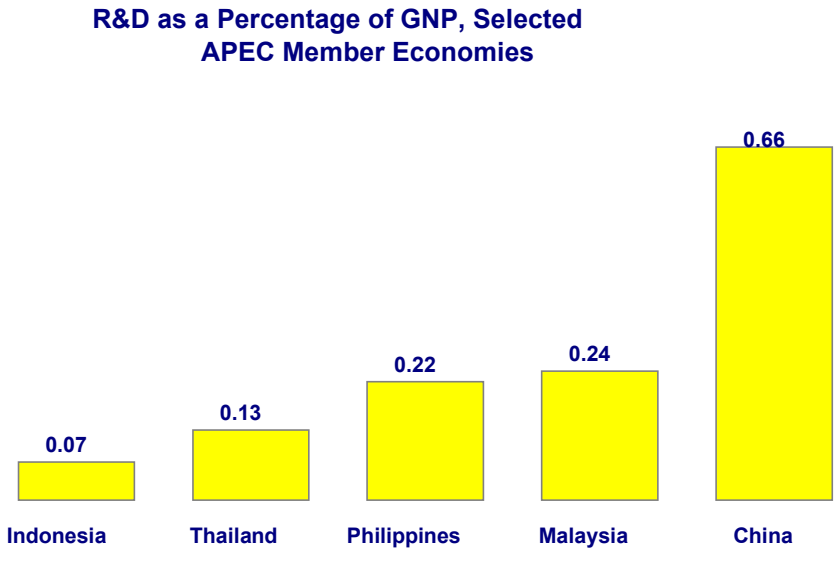


4.3 Innovation Systems

The AFEs' very low commitment of resources to R&D is a significant impediment to their development as KBEs (Figure II-9). For these economies, the objective is not to become significant sources of scientific and technical knowledge, but to develop the technological capabilities that are needed to efficiently adapt and assimilate technologies developed elsewhere. Studies have documented the significant influence that developing economies' technological capabilities have on their ability to benefit from the vast pool of global technical knowledge.[17] In economies with a significant domestic research capacity, firms are able to use imported equipment and technology more effectively, and also to engage in more informed negotiations for the purchase of foreign technology.

The AFEs are pursuing a variety of policies to strengthen their economies' technological capabilities. In Indonesia and Thailand, a major focus has been on reducing the heavy reliance on public sector R&D. Some 90% of Thailand's limited R&D is carried out by the public sector. Successive governments have focused on strengthening university-industry linkages as a means of building the economy's technological capabilities, but these initiatives have had little impact in raising overall private sector R&D, or in fostering the development of cooperative research ventures. In Indonesia, the problem created by the limited supply of skilled engineers and scientists has been exacerbated by the concentration of researchers in state-owned laboratories and public firms, in sectors such as aeronautics, shipbuilding and telecommunications. It has been recognised that there is a need to encourage the mobility of technical specialists and the transfer of technical knowledge to a broader range of productive enterprises.[18]

Figure II-9



The comparisons were based on the most current data available for Philippines 1992 figures; Indonesia 1994 figures; 1996 for Malaysia and Thailand; and 1997 for China.

Source: UNESCO, Statistical Yearbook, 1999

In the Philippines, a number of measures have been introduced to strengthen a research capacity that is modest even by the standards of developing economies. These include: a "Science and Education Project", in which scholarships are awarded to promising students in an attempt to increase the number of scientists and engineers; special tax relief for private sector R&D; and incentives to encourage academic experts to act as technical consultants to municipalities. While Malaysia has been more open to FDI than other AFEs, weaknesses in the economy's science and technology base have limited its ability to take advantage of the spillover from this inward investment. In its Seventh Plan (1996-2000), the government has given priority to substantially strengthening the economy's innovative capacity. Public sector research institutes are being encouraged to respond to business needs and to obtain a major share of their funding from the private sector. In keeping with the plan's emphasis on manufacturing, the government is voting a smaller share of support to agricultural research and a greater share to joint industry-university R&D projects. Recent data are not available, however, and it is not clear how close the economy has come to meeting the government's ambitious goal of increasing R&D from its low level of 0.4% of GDP in 1995 to 2% of GDP by the end of the Seventh Plan. The government is also giving importance to the promotion of industry and technology clusters that may enhance research collaboration and facilitate technology diffusion. In addition to the ambitious programme to establish a Multimedia Super Corridor, the government is building the Kulim Hi-Tech Industrial Park, which is being designed as a major centre of information technology research and production.

The weak science and technology infrastructure of the AFEs partly reflects their low levels of tertiary educational attainment and their difficulties in building a critical mass of skilled scientific and technical specialists. Technological capabilities will improve as the AFEs' higher educational systems are expanded and access to tertiary education is increased. Other policy initiatives will also have a significant influence on innovative activity. As foreign investment restrictions are removed, the AFEs will gain increased access to foreign technologies. At the same time, the dismantling of trade barriers and regulations will increase the pressure on firms in protected sectors to engage in innovative activities. In Indonesia, for example, one of the most significant impending developments is likely to be the privatisation of seven state-owned enterprises and five government-controlled enterprises, including those in steel, telecommunications, mining, agriculture, and infrastructure (airports and seaports).

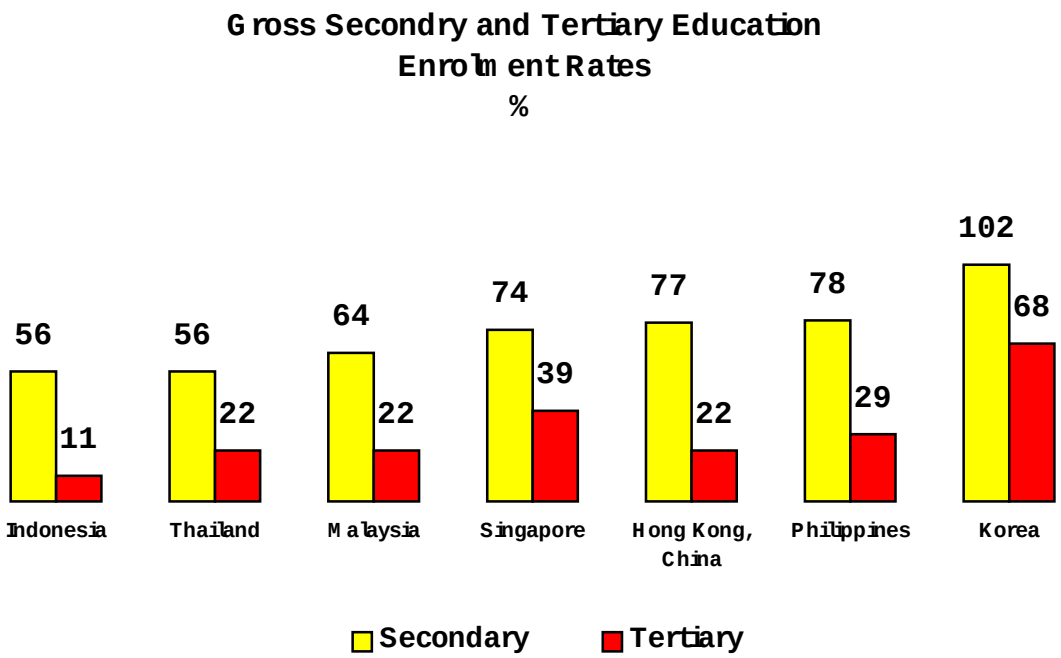
In developing technology policies, the AFEs can draw from the experience of the HPAEs, which also depended heavily on government to fund R&D at an earlier stage of their development. Public research institutes in Korea and Chinese Taipei, which work closely with industry, have been important vehicles for disseminating technical knowledge to the private sector. These economies have been successful in creating industrial clusters that enhance technology diffusion, and in promoting collaborative research projects that help to increase the returns from a limited investment in R&D. The AFEs can also usefully borrow from Canada's and Australia's efforts to create stronger innovation systems and to improve the speed at which new technology diffuses through their economies.

4.4 Human Resource Development

While the AFEs have been expanding their schooling systems and increasing educational access, secondary enrolment rates generally remain well below rates in the HPAEs, and tertiary enrolment tends to be very low (Figure II-10). At the same time, questions have

been raised about the quality of schooling in some economies. While, for example, secondary enrolment rates in the Philippines are much higher than in the other AFEs, the pupil/teacher ratio is more than twice that in economies such as Indonesia. There are important disparities as well within the economy, with, for example, primary school completion being close to 100% in Manila but only around 30% in the Philippines' poorer provinces.

Figure II-10



Secondary education enrollment comparisons were based on the most current data available
for Hong Kong 1995 figures were used; 1996 figures were used for Singapore, Ihdonesia,
Thailand, Mexico, Chile and Korea; 1997 figures were used for Malaysia and Pilippines.

Tertiary education enrollment comparisons were based on the most current data available

Part of the problem for developing economies, is that it takes a long period of time to substantially raise the educational attainment of the labour force. For example, in Thailand, which has been significantly expanding secondary schooling, and plans to raise compulsory schooling from 9 to 12 years by 2007, some 80% of the labour force have no formal schooling, or have only primary education. This lag, however, does not fully explain the economy's relatively weak human resource base. There remains the need for concerted efforts to increase access and improve the quality of schooling. At the tertiary level, there is a need to address the apparent bias in the system against basic and applied science. Thailand graduates proportionately fewer students in the applied sciences than less developed economies such as Bangladesh, and is reportedly producing less than half the number of engineers and scientists with undergraduate and graduate degrees that it requires.[22]

All the AFEs need to build their base of engineering, scientific, and technical skills. In Indonesia, the government employs the majority of scientists and engineers, but pay tends to be relatively poor and morale low.[23] A greater emphasis on basic and applied science and technology training is necessary if the AFEs are to build their export competitiveness

in higher value added manufacturing goods and services.

BOX II-6
The Penang Skills Development Centre

The PSDC was launched in 1989 as a cooperative venture by the federal and state government, the local university, and some US multinationals in the electronics sector. The government provided land and financial support. The companies provided trainers and equipment, and devised training programmes to meet evolving skill needs. Firms pay full cost for the training services they purchase. About 30 local firms and 50 foreign affiliates operating in the free trade zones and industrial estates in Penang (over half of which are in the semiconductor and electronics industries) are members of the PSDC. Since 1989, the PSDC has conducted roughly 2,000 courses and trained about 40,000 participants in its various training centres.

In Malaysia, a number of initiatives have been taken to address skill shortages. Industries and universities are working together to develop flexible training programmes that meet the need for specialised skills. For example, a part-time MSc programme in semiconductor packaging is offered by a university in cooperation with a major multinational, and a weekend course has been set up, allowing middle and senior managers to obtain a postgraduate degree in engineering management.[24] Following the success of the Penang Skills Development Centre (Box II-6), institutes have been established in most states to train shop floor workers. This training is funded by the Human Resource Development Fund (HRDF) which the government established in 1992. Manufacturing firms with more than 50 employees are required to register with the HRDF Council and pay a levy of one per cent of their monthly payroll. More recently, with the support of the Asian Development Bank, the Malaysian Government has introduced a Skills Development Programme Loan to help those needing assistance in financing their educational investments.

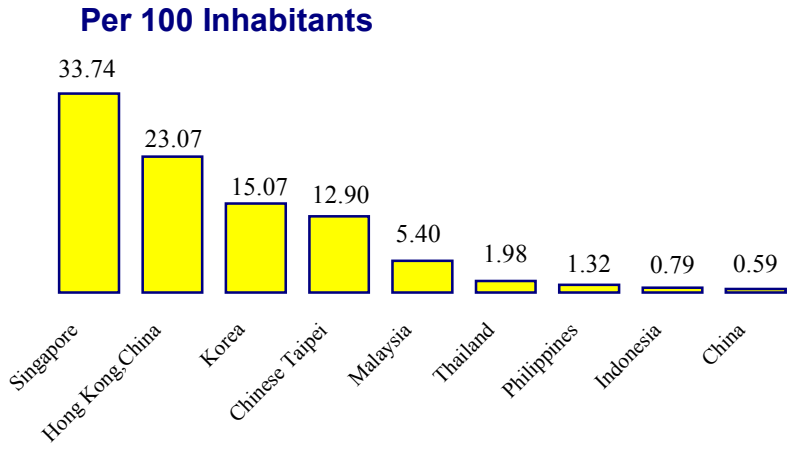
In the AFEs, as in other economies, it is important that governments make use of information technologies to enhance educational quality and improve educational access. There is also a need to remove any constraints limiting an increased private sector role in the provision of educational and training services. One possible strategy is to follow Korea's example in allowing the private sector to provide a major share of tertiary education and to target government support in providing scholarships and assistance for those confronting financial constraints. Governments need to look as well at the opportunities for increased partnering with private sector firms in the provision of training - an area where Malaysia's experience may be helpful.

4.5 ICT Policies

All the AFEs recognise the importance of developing a high quality information infrastructure that will allow them to harness the potential of new ICTs, but they are approaching this task from quite different positions. On the basis of major indicators, including telephone lines per 100 persons and rates of computer and Internet penetration, ICT use is much higher in Malaysia than the other AFEs. Figure II-11 shows that Malaysia enjoys much higher computer penetration rates than the rest of the AFEs. In the economy's latest development strategy, the Malaysian Government highlights the priority given to

objectives such as enhancing the population's awareness of new technologies, and promoting the widespread diffusion of ICTs. Malaysia's Multimedia Super Corridor (MSC) is being created to promote cooperation among government, business, and community groups in exploiting a number of particularly promising ICT applications. The MSC involves the creation of a cluster of ICT facilities and activities in a corridor about 15 kilometres wide and extending about 50 kilometres south from Kuala Lumpur. The MSC is expected to house R&D centres, a multimedia university, headquarters for MNEs, and a new intelligent city with a concentration of multimedia industries (Cyberjaya). To realise the vision embodied by the MSC, the government has addressed the need for minimum standards that will promote compatibility between different systems and processes[25], and for new regulations that will facilitate and protect electronic transactions.

Figure II-11
Computer Penetration Rates Selected APEC Member Economies, 1997



Source: ITU World Telecommunications Indicators Database

Note: The number for Chinese Taipei is drawn from MIC, III, 1997.

The percentage of households with wired telephone service (in 1995) drops from over 60% in Malaysia to under 20% in Thailand, and to under 7% in the Philippines and Indonesia.[26] The development of a basic telecommunications infrastructure in rural areas with sparse populations is an especially formidable challenge. In Thailand, for example, less than 40% of the telephone lines are in non-urban areas where over 80% of the population resides. As a result, in 1995, teledensity in urban areas was more than ten times that in rural areas (that is, 27 as compared to 2.6).[27]

To some extent, the provision of service is becoming easier because of the availability of new information and communications technologies. Wireless technologies that require less fixed investment have facilitated the extension of telecommunications services to remote communities. In the Philippines, for example, while telephone density in terms of mainlines per 100 residents is very low, the ratio of mobile phone subscribers to mainlines exceeds that of Japan, the UK, and the US. In Thailand, mobile users are growing at an average rate of almost 50% per year, over four times the rate of increase for fixed line subscribers. The AFEs are also taking advantage of new digital technologies, bypassing the older analog technology which continues to form the core of the networks in many of the most highly developed economies. Digitalisation is higher in Indonesia, Malaysia, and

Thailand than in Australia and the US.

While new technologies are making it possible to implement more cost-effective systems, governments are still facing the need for costly investments in new telecommunications facilities and services. Some AFEs are using private-public partnership arrangements to meet these needs. In Thailand, a number of agreements have been negotiated between private firms and the two state-owned operators, the Telecommunications Organisation of Thailand (TOT) and the Communications Authority of Thailand. "Build-Transfer-Operate' (BTO) contracts, in which private firms develop a facility on behalf of TOT and operate it over a specified period, enabled Thailand to raise its teledensity from 2.7% to 6% between 1991 and 1996. Indonesia used the Build/Transfer in 1990 to increase network capacity in Jakarta. In a more recent initiative, the KSO project, private firms have been brought in to help achieve an increase of over 60% in the economy's telephone network (Box II-7).

The AFEs are at different stages in implementing reforms to liberalise their telecommunications markets. The Philippines and Malaysia have had competition in their international telecommunications service markets since 1996. According to their commitments under the WTO Agreement on Basic Telecommunications Services, Indonesia is scheduled to open its long-distance market to competition in 2005, and Thailand in 2006. One of the effects of monopolistic international service markets is that leased-line prices for Internet services tend to be relatively high. This is especially the case in Thailand where Internet access providers must hand over 35% of their equity to the Communication Authority of Thailand in return for a license to operate.[28] The Thai Government plans to privatise TOT and CAT by 2006, allowing foreign investors to own up to 25% of the shares in the new entities.

BOX II-7
The KSO Project: A Public-Private Partnership to Develop Indonesia's Telecommunications Infrastructure

To fulfil the objective of Indonesia's sixth five-year plan, which called for the installation of at least five million new telephone access connections over 1994-1999, private investors were invited to participate in the construction and operation of access connections in territories known as "Kerja Sama Operasi" or KSO. In 1995, five joint venture companies, each consisting of at least one Indonesian company and one foreign telecommunications operator, were selected to develop and operate two million telephone access connections in the five designated KSO regions. The private companies entered into an agreement with the Indonesian national telephone company PT. Telekomunikasi Indonesia (PT) in which they undertook to plan, finance, and construct the telecommunications facilities, and operate them on behalf of PT for a term of 15 years. The private firms must meet specific performance targets or pay a penalty. The companies are entitled to telecommunications revenues from lines within their KSO region, but they have to provide PT with the revenue it is foregoing as well as a share of the additional net revenue being generated. The agreements give PT an option to purchase the installations at any time after 31 December 2005. Ownership and operations are to be automatically transferred to PT after the termination of the contract.

The removal of entry restrictions has tended to increase access to telecommunications services. In the Philippines, new entrants that have been awarded mobile cellular licenses and international gateway licenses have installed four million new lines, quadrupling the number of lines within the economy. In response to the competition, the incumbent Philippine Long Distance Telephone Company installed a further 800,000 lines between 1993 and 1996, more than doubling its own network size. Increased competition also tends to produce lower telecommunications costs and improved service quality. For the AFEs, regulatory reform is a necessary adjunct to network investments intended to facilitate and promote the use of modern communications technologies.

4.6 Concluding Remarks

While the AFEs have achieved a favourable rate of long-term growth, they are at a relatively early stage in developing an innovation infrastructure. Policymakers face a number of challenges in building the innovative capacity of these economies and facilitating their transformation into exporters of high value added, skill-intensive products. These include: the establishment of an improved regulatory and institutional framework that better ensures fair and efficient market exchange; the expansion and improvement of the economies' educational systems; the expansion of their power systems and the development of the physical and institutional components of a high quality information infrastructure; and the building of an improved technological capability that will allow the AFEs to more effectively acquire and adapt new technologies. The economies have made progress in reforming their banking and capital market policies, and they are upgrading their intellectual policies to meet WTO obligations. In many areas, however, progress is likely to require significant investments. An increased private sector role - as with tertiary education in Korea, and public-private partnership arrangements that reduce the financial burden on governments, and as with telecommunications developments in Thailand and Indonesia, and training programmes in Malaysia - is potentially appealing.

5. LATIN AMERICAN ECONOMIES

5.1 Introduction

Like the Asian Fast-Growing Economies, the Latin American Economies (LAEs) are still at an early stage in developing the foundation for knowledge-based growth. Although it has not nurtured knowledge-based activities, Chile is, however, a highly successful economy, enjoying rates of economic growth that are the envy of other Latin American economies. Chile’s strong performance owes much to its success in creating a highly favourable macroeconomic environment for business activity. Mexico has experienced more modest rates and a less stable pattern of economic growth. As with most of the AFEs, it is still very much involved in developing the legal framework, the physical infrastructure, and the human capital policies that will contribute to sustained improvements in living standards.

The LAEs have had previous experience grappling with currency and financial crises. Following the 1994 peso crisis, Mexico was forced to restructure its banking sector and review its regulatory framework. More instructive still is the comprehensive banking reforms Chile introduced based on the lessons drawn from its 1982-1983 financial and currency crisis. The LAEs offer lessons in other areas. Chile has been active in searching

for more effective forms of educational delivery. For over a decade, Mexico has been following a course of privatisation and liberalisation aimed at increasing opportunities for private enterprise.

The LAEs rank well below more developed APEC economies in terms of innovative capacity. The commitment to R&D is relatively low, and ICT utilisation is well below that of the HPAEs. Although the Chilean economy has become more diversified over the past few decades, about two-thirds of export revenue still comes from mining (especially copper), and agricultural and fishing products. The LAEs, like the AFEs, face the challenge of developing a policy framework that supports innovation, and that is conducive to high value added, skill-intensive activities.

5.2 Business Environment

5.2.1 Banking and Capital Markets

While Mexico was forced to restructure and strengthen its banking sector following the 1995 crisis, it is still in the process of implementing needed regulatory reforms and strengthening supervision. The government has provided much needed support to debtors and banks, with this extending to the takeover of poorly capitalised banks. In the recent period, the restrictions on foreign bank entry have been substantially eased as well. Banks with substantial foreign participation are estimated to hold almost two-thirds of total banking assets.[29] The entry of foreign banks has helped to improve capitalisation, and has injected increased competition into the market for banking services.

For economies striving to establish a strong financial sector, Chile's achievements warrant special attention. In contrast to Mexico, Korea, and the AFEs, Chile has experienced a high degree of financial stability in the period since 1985. One of the distinguishing features of Chile's recent performance has been the high degree of control over credit extended to private sector borrowers. Between the periods 1985-1990 and 1991-1996, credit as a percentage of GDP, which increased by more than 100% in Indonesia and 60% in Thailand, fell by nearly 15% in Chile. This result has been attributed to the Central Bank's "tough and pre-emptive monetary policy" and the effective regulatory and supervisory framework established in Chile's 1986 banking law.[30]

Among the notable features of Chile's banking regime are: (i) a limited deposit insurance scheme which protects the payments system but requires banks to maintain reserves amounting to 9% of deposits; (ii) a combination of self-regulation, with banks evaluating their own credit risk, and supervision by the Superintendency of Banks; (iii) stringent disclosure requirements that obligate the banks to share loan information among themselves and prohibit the Supervisor of banks from delaying the recognition of bank losses; (iv) strict limits on the amount banks may lend to individual customers; (v) various restrictions designed to limit interest rate and credit risk; and (vi) the establishment of clear procedures to be followed if banks exhibit liquidity or solvency problems.

5.2.2 Competition

Chile has long given importance to establishing a highly competitive market environment. The stage was set for an expansion in the role of market forces over the 1973-1980 period when the government sold all but 45 of 850 state-owned enterprises - one of the notable

exclusions being Codelco, the major copper-mining enterprise which remains in state hands. Chile introduced strong anti-trust laws in the early 1990s, and has been gradually reducing tariffs and trade restrictions..

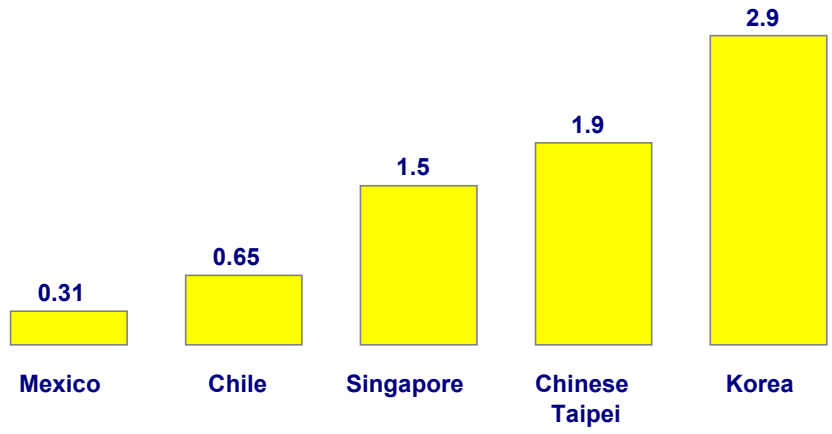
In Mexico, competition has significantly increased since trade was liberalised in the early 1990s. To strengthen competition in markets not exposed to foreign competition, the government introduced the Federal Law of Economic Competition at the end of 1992 and created the Federal Competition Commission. The government has also been steadily reducing the state's own role in the production of goods and services. Having largely completed its programme of privatisation by the early 1990s, the government has more recently been auctioning concessions as a way of introducing private sector activity into services traditionally provided by the state. Concessions have been allotted in rail transportation, long distance telecommunications service, and in energy. In the electricity sector, Mexico has followed the example of other countries in allowing private participation in generation but maintaining transmission and distribution in the hands of a public monopoly.

5.3 Innovation Systems

The LAEs benefit from the technology imports that accompany their substantial inflows of inward FDI. Like the AFEs, however, and in contrast to more developed economies, they are handicapped by their limited capacity to domestically generate and apply knowledge (see Figure II-12). Research is concentrated in universities and research institutes, and the linkages between these research centres and industry are not well developed.

Figure II-12

R&D as a Percentage of GDP, Selected APEC Member Economies



1995 figures for Meixico and 1996 for Chile

Source: UNESCO, Statistical Yearbook, 1999

In Chile, where most R&D is conducted by the university sector, the government has established five institutes to foster cooperative research initiatives by different organisations and sectors, and to promote knowledge sharing. The Chilean Economic Development Agency (CORFO) supports innovative activities that are expected to yield a significant social return. Much of the economy's stock of technological knowledge, however, is still a product of the research resident MNEs have conducted elsewhere. In its 1998 report, the National Commission for Science and Technology argued that Chile's science education system needed to be improved, that science expenditures needed to better targeted, and that linkages between the science community and industry needed to be strengthened.

Business, which accounts for about 60% of R&D on average in the OECD, accounts for under 10% of R&D spending in Mexico. This reflects the very slow nature of Mexico's shift towards high technology activities and the economy's technological dependence on multinational companies. The slow adoption of modern technology has also been a concern in Mexico. While multinational automobile producers and other major companies producing for export markets have put in place modern production systems, survey data indicate that smaller producers have been slow in adopting advanced technologies. A special agency was recently established to promote technology transfers from domestic and international research centres to industry. In addition, the National Council for Science and Technology (CONACYT) provides financial support to encourage joint R&D projects by firms, universities, and research centres.

5.4 Human Resource Development

To pave the way for the LAEs' transition to KBEs, one of the requirements is an expanded system of education and training. The secondary and post-secondary educational attainment rates of Chile and Mexico compare favourably with the AFEs', but they trail behind the rates of the more developed APEC economies (see Figure II-13). Within Latin America, Chile has achieved the better performance. Mexico spends a relatively large share of public resources on education, but, adjusted for the demographic structure of the economy, public spending relative to GDP is among the lowest in the OECD.[31] On this same basis, Chile ranks comparatively high in terms of public spending. In addition, there is a much higher degree of private spending on education in Chile.

Chile introduced a number of major educational reforms in the 1980s which included the transfer of administrative responsibilities to local municipalities, the establishment of a per student subsidy system that encouraged competition between schools, and the extension of subsidies to private providers to broaden the schooling options available to families. While these reforms expanded educational coverage and increased system efficiency, they did not lead to an improvement in learning outcomes.[32] The focus in the 1990s has been on improving educational quality, and on providing additional assistance for the most vulnerable groups. The government has succeeded in improving student achievement by investing in learning resources, providing additional support for teachers in poorer communities, funding school-proposed improvements, and setting up support mechanisms and networks. One of its more successful initiatives is the "900 Schools Programme", directed at the 10% of primary schools with the poorest performance (Box II-8).

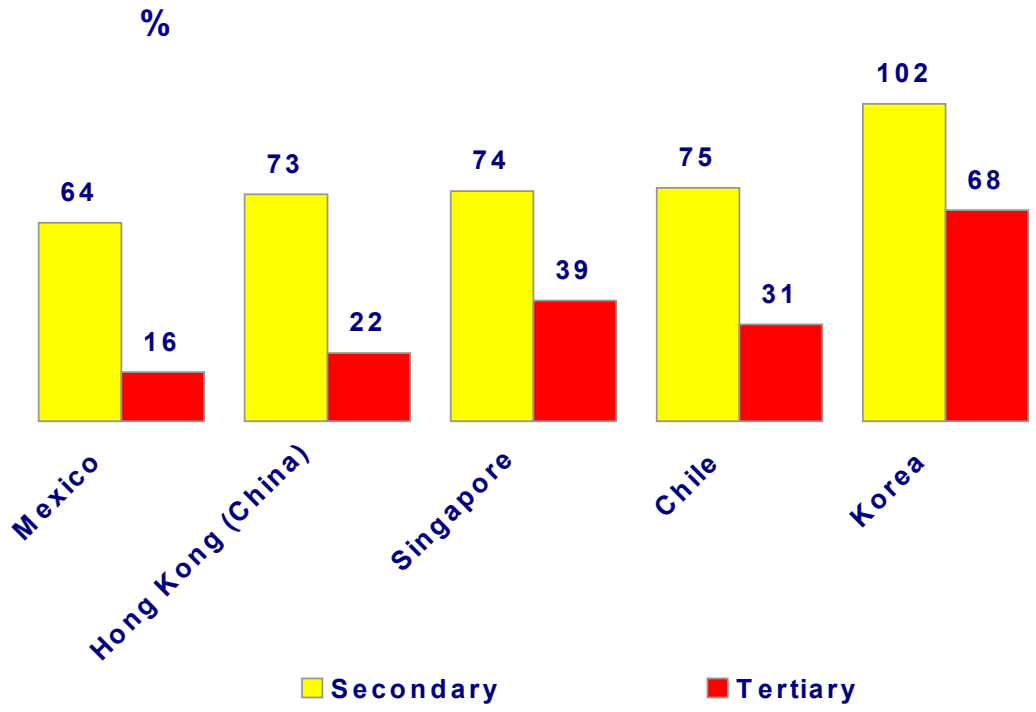
Mexico has been devoting increased resources to education and training in recent years. Recent initiatives have included the introduction of special programmes and the use of

tele-education to improve opportunities for marginal groups and students in remote areas. The government has also expanded two training schemes introduced in the late 1980s: PROBECAT, which offers short-term grants and training to the unemployed; and CIMO, which provides support for training in small and medium enterprises. Large companies have less need for government support and a number of major Mexican corporations, including multinationals and state-owned enterprises, have jointly created training centres to service their specific requirements.

One of Mexico's potentially most significant initiatives in the area of human resource development has been the establishment of a national system of competency standards and skill certification. Since the programme was introduced in 1995, committees, with business and labour representatives, have been defining the knowledge and skill requirements for a broad range of work functions. The establishment of technical norms is expected to improve training quality, increase flexibility in training and technical education, and enhance labour mobility.

Figure II-13

Gross Secondary and Tertiary Education Enrolment Rates



Secondary education enrollment comparisons were based on the most current data available for Hong Kong 1995 figures were used; 1996 figures were used for Singapore, Indonesia, Thailand, Mexico, Chile and Korea; 1997 figures were used for Malaysia and Philippines.

Tertiary education enrollment comparisons were based on the most current data available for Hong Kong 1993 figures were used; 1995 figures were used for Malaysia and Philippines; 1996 figures were used for Singapore, Indonesia, Thailand and Mexico; and 1997 figures were used for Korea

Source: UNESCO, Statistical Yearbook, 1999

BOX II-8
Chile's 900 Schools Programme

This programme, which was introduced in 1990, aims at improving reading, writing and mathematical skills, and enhancing the self-esteem and communication skills of pupils in the first four years of primary school. New teaching methods were introduced, supplementary tutoring was offered for slow learners, and new textbooks and instructional materials were purchased. The programme also offered funds for infrastructure repairs and technical support in the schools (initially 900 in number) that were targeted on the basis of their poor learning outcomes. Between 1990 and 1996, the average mathematical and Spanish scores on the SCME test given to fourth graders in the selected schools improved by 11.95 percentage points. This exceeded the increase reported by all state-supported schools (8.95 percentage points), suggesting there had been a significant narrowing in the quality gap between the lowest-ranking schools and the rest of the schools in the system over this period.

Source: C. Cox and M.J. Lemaitre (1999)

5.5 ICT Development

On measures of ICT access and use, Chile and Mexico rank well compared to the AFEs, but compare poorly with more developed APEC economies. The percentage of households with wired telephone service in 1995, for example, was 47% in Chile and 45% in Mexico, placing these economies below Malaysia, but far above the other AFEs. Both economies recognise the need to further upgrade their ICT infrastructure and promote the increased use of computer-based technologies.

Chile, which privatised its state-owned telecommunications company in 1989 and introduced long-distance competition in 1994, has benefited from more cost-competitive telecommunications rates and substantial private sector investment. The performance of Chile's telecommunications sector, as indicated by measures such as network investment, penetration, and service price levels, is better than the average of all OECD economies. In 1997, however, Chile had less than half as many computers per 100 inhabitants as Chinese Taipei, the least connected of the HPAEs. ICT penetration rates have been increasing at a significant pace, but among households, computer and Internet use remains concentrated around Santiago and among the wealthiest 10% of the population.

The performance of Mexico's telecommunications sector has lagged behind that of other OECD economies. Network investment has been relatively low, and rates for residential and business services have substantially exceeded rates in other OECD countries.[33] Mexico introduced competition into long-distance telecommunications at the beginning of 1997. Long-distance rates came down significantly, but because the national carrier, Telefonas de Mexico, was forced to eliminate the cross-subsidy to its basic service, local rates increased. More recently, the government has taken steps to open the local market to competition by auctioning licenses for the provision of wireless service. This process is expected to facilitate the expansion of the telecommunications system and to especially benefit rural communities that are under-equipped with traditional wire networks.

5.6 Concluding Remarks

The LAEs face some similar challenges to the AFEs, but they benefit from their openness and their favourable access to the foreign technology that is available through trade and investment. They are at an advantage in these respects compared to all the AFEs except Malaysia. Moreover, Chile has made significant progress in developing progressive human resource policies and in establishing a business environment that is conducive to private sector initiative. It has been successful in creating a stable macroeconomic environment and in developing a framework of marketplace laws that support fair and efficient market transactions. The LAEs must invest more heavily in developing their innovation systems and building their ICT infrastructures if they are improve their performance as KBEs. Both economies, but Mexico in particular, must invest in the development of a stronger education and training infrastructure. The LAEs could learn from the policies of the most developed APEC economies and the HPAEs, including the measures these economies have introduced to build their innovation systems and to promote the use of ICTs.

6. CONCLUSIONS

All APEC economies face the need to adapt their policies to a knowledge-based environment, but different challenges confront the most advanced APEC economies, the HPAEs, the AFEs, and the LAEs. Table II-3 summarises some of the main policy issues confronting economies at different stages of development. For the most advanced economies, the focus is primarily on extending a well-developed policy framework to address certain gaps and take account of new priorities, such as lifelong learning and the development of a high quality information infrastructure. The AFEs, and to a slightly lesser extent, the LAEs, are still involved in developing policies that adequately address the basic needs of an industrial economy. Along with meeting the newer challenges associated with ICTs, the AFEs must focus on fundamentals such as the modernisation of marketplace laws and institutions, the improvement of physical infrastructure, and the expansion of their secondary and tertiary education systems. Action is required in the AFEs and the LAEs to improve access to education and training, and to help reduce the "digital divide" that is emerging between the wealthier urban inhabitants of these economies and others. The HPAEs have made progress in addressing "marketplace fundamentals", and in creating a framework that fosters the acquisition and use of technology. Recent developments, however, have pointed to the need for some significant "repairs" to their marketplace policies, and for adjustments to bring their science and technology policies in line with changes in the HPAEs' industrial strategies.

In addressing these challenges, APEC economies have devised a variety of interesting and instructive approaches to supplying the policy components of an innovation infrastructure. Table II-4 reviews a number of the interesting policy initiatives discussed in Part II.

The experience of APEC economies can contribute to the design of policies for each major component of an economy's innovation infrastructure. In the case of human capital, economies might look, for example, at Australia's system of income-contingent help for post-secondary education, at Korea's experience in leveraging private sector investment in tertiary education, at Chile's use of educational vouchers combined with its introduction of special programmes to improve educational quality, and at Singapore's and Malaysia's experience in working with the private sector to develop specialised training programmes.

The most developed APEC economies have the most experience implementing financial sector policies, corporate governance laws, competition policy, and intellectual property and other marketplace laws; but there are important lessons in Chile's 1986 banking law reforms and Korea's recent efforts to strengthen its financial market regulations and corporate governance regime.

In responding to their economy's infrastructure needs, a number of governments are turning to "build-transfer-operate" and other private-public sector partnership arrangements. Indonesia and Thailand's experience shows how developing economies can use private sector investment to accelerate the pace of infrastructure development. Mexico is allowing private firms to bid for concessions to provide services traditionally dominated by public sector producers. In the case of information infrastructure, however, where the development of facilities must be accompanied by policies to promote the use of ICTs, there are also important lessons to be drawn from policy initiatives in Australia, Canada, and Singapore.

Table II-3
Major Policy Challenges

	Most Developed Economies	***HPAEs***	***AFEs***	***LAEs***
Business Environment	-establish more internationally competitive and efficient tax regimes	-establish strong capital market laws and institutions -establish sound corporate governance laws	-improve marketplace laws with regard to: banking, competition, intellectual property -modernise traditional infrastructure	-improve marketplace laws in Mexico
Innovation System	-increase R&D -strengthen domestic innovation systems	-improve domestic innovation capacity -increase access to FDI-related technology transfers	-improve capability to efficiently adapt and utilise modern technologies	-improve private sector innovation -strengthen innovation system
Human Resource Development	- improve schooling outcomes - expand job training - facilitate lifelong learning	-increase tertiary education attainment -raise quality of public education -increase adult educational opportunities	-increase secondary education attainment - expand science & technology education -increase worker training	-increase secondary education attainment - expand science & technology education -increase worker training
ICT	-complete fibre optic networks -promote use of ICTs	-build digital networks. -increase use of ICTs	-modernise telecommunication facilities -allow competition -promote ICT use	-modernise telecommunication facilities -promote ICT use

Technology policies have been a focus of attention in all APEC economies. Australia, Canada, Korea and Chinese Taipei have all given attention to designing incentives that will offset market failures reducing private sector R&D. While Canada stands out because of the generosity of its R&D tax incentives, Korea merits attention because of its success

in raising private sector R&D spending. Public research institutes are an element of technology policy in all economies, with Chinese Taipei's ITRI being an example of a particularly effective effort to acquire and broadly disseminate technical knowledge. Another emphasis of technology policy has been on building innovation systems which promote collaboration in R&D and facilitate the diffusion of technology. Chinese Taipei's experience in promoting the formation of industrial clusters and in building research consortia is instructive. APEC economies can learn as well from the technology policies Canada and Australia have implemented in the context of their recent efforts to strengthen their innovation systems.

Table II-4
Instructive Policy Initiatives

	Most Developed Economies	***HPAEs***	***AFEs***	***LAEs***
Business Environment	-banking laws and supervisory bodies -competition policies	-banking reforms (Korea)		-Chile's 1986 banking law -strict monetary policy
Innovation System	-Cooperative Research Centre (Australia) -Technology Diffusion Programme (Australia) - Industrial Research Assistance Programme (Canada) -Networks Centres of Excellence (Canada)	-Industrial Technology Research Institute (Chinese Taipei) - Technopreneurship 21 (Singapore)	-Multimedia Super Ccorridor (Malaysia)	
Human Resources	-the Canadian Opportunities Strategy -SchoolNet (Canada) - Higher Education Contribution Scheme (Australia)	-privately financed tertiary education (Korea) -Manpower 21 (Singapore)	-public/private training centres (Malaysia)	-school vouchers (Chile) and programmes to improve school outcomes (Chile) -establishment of competency standards and skill certification (Mexico)
ICT	-the Canadian Electronics Strategy -Australia's National Office for the Information Economy	-"Intelligent Island" initiatives (Singapore) -Cyber 21 (Korea)	-private-public partnerships to build telecom. Facilities (Thailand and Indonesia)	

End Notes

[1]The history of Canada's recent efforts to adapt its industrial and technology policies to the requirements of a competitive knowledge-based environment are described in a background Industry Canada paper entitled, "Policy Environment for Fostering Growth in the Knowledge-Based Economy".

[2] Brownwyn Hall and John van Reenen (1999).

[3] Brownwyn Hall and John van Reenen (1999).

[4]In Australia, this concern was highlighted in the *Karpin Report*. It is discussed in: Australia Department of Industry, Science and Resources,1999.

[5] The Canadian situation is discussed in: S. Gera, C. Lee-Sung and K. Newton in *Doing Business in the Knowledge-Based Economy: Facts and Policy Challenges* (forthcoming).

[6] Bill C-54, *The Personal Information Protection and Electronic Documents Act* is expected to be reinstated in the current session of Parliament.

[7] OECD, *Economic Surveys: Korea, 1998.*

[8] Ibid.

[9] Ibid.

[10] Reported in U.N. *World Development Report 1999/2000.*

[11] This is based on the ratio of the banking sector's assets to the assets of all financial institutions. In 1994, this ratio, which was under 25% in the US, was over 90% in Indonesia and over 75% in Thailand. U.N. *World Development Report 1999/2000*.

[12] For example; E. Mansfield, 1994; and G. Yang and K.E. Maskus, 1998.

[13] J. Girante and W.G. Park (1997).

[14] This draws on Derek Ireland, "Changing Approaches to and New Developments in Competition Policy: A Canadian Perspective," in F. Flatters and D. Gillen (eds.) *Competition and Regulation: Implications of Globalization for Malaysia and Thailand* (Kingston: JDInternational, Queen's Univ) 1997.

[15] This draws on Tim Hazeldine, "Modern competition Policy: Why and How." in Flatters and Gillen (eds.), ibid.

[16] U.N. Economic and Social Commission for Asia and the Pacific, *Infrastructure Development as Key to Economic Growth and Regional Economic Cooperation* (New York: U.N.) 1994.

[17] For example; R.E. Evenson and L. Singh (1997).

[18] This is discussed in UNESCO, *World Science Report, 1998.*

[19] Asian Development Bank, *Asian Development Outlook, 1998.*

[20] In the U.N. *World Science Report, 1998*, it is observed that "the shortage of skilled, motivated labour stems partly from the low morale among scientists, who earn less in the government sector than primary school teachers or company secretaries, for example,.."

[21] From UNESCO, *World Science Report, 1998.*

[22] Asian Development Bank, *Asian Development Outlook, 1998.*

[23] In the U.N. *World Science Report, 1998*, it is observed that "the shortage of skilled, motivated labour stems partly from the low morale among scientists, who earn less in the government sector than primary school teachers or company secretaries, for example,.."

[24] From UNESCO, *World Science Report, 1998.*

[25] Anuar Maarof, "Interoperability and Standards in the Multimedia Supercorridor," paper presented at the Expert Group Meeting of Trade Promotion Policy Experts, Bangkok, Dec. 1998.

[26] Data are for 1995. The source is Table 2.3 in International Telecommunications Union, *World Telecommunication Development Report 1998*.

[27] International Telecommunications Union, ibid.

[28] D. Nikomborirak and S. Tangkitvanich, "Internet Service By-Passing in ASEAN-5" in Flatters and Gillen (eds.), *Competition and Regulation*, op. cit.

[29] OECD, *Economic Surveys: Mexico, 1998 -1999.*

[30] N. Eyzaguirre and F. Lefort, " Capital Markets in Chiles, 1985-97: A Case of Successful International Financial Integration," in G. Perry and D.M. Leipziger (eds.), *Chile: Recent policy lessons and Emerging Challenges* (Washington, D.C.: The World Bank) 1999.

[31] OECD, *Economic Surveys: Mexico, 1997-1998***.**

[32]C. Cox and M.J. Lemaitre, "Market and State Principles of Reform in Chilean Education: Policies and Results," in G. Perry and D.M. Leipziger (eds.), *Chile: Recent policy lessons and Emerging Challenges* (Washington, D.C.: The World Bank) 1999.

[33] OECD, *Economic Surveys: Mexico, 1997-1998.*

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PART III

POTENTIAL FOR COOPERATION IN PROMOTING KBEs IN APEC

1. INTRODUCTION

To achieve APEC's goal of common prosperity for member economies, it is essential to understand the nature of the engine of growth in the new global economy. By now, it is not surprising to insist that economic growth is promoted mainly by knowledge and technology in the knowledge-based economy. The increasingly crucial role of knowledge in growth becomes more evident due to radical changes in the global economy as follows: the phenomenal growth in information and communication technologies; increased speed and diffusion of scientific and technological advances; the globalisation of the economy; and the growing awareness of the value of specialised knowledge embedded in organisational processes. The Asia-Pacific region is no exception to this general trend toward a KBE. In order to sustain the dynamics of rapid economic growth in the region, vitalisation and reshaping of the new engine of growth for a KBE is required.

On the other hand, knowledge may impose another, but totally different in its nature, impediment to cooperation among economies in the different stages of development. Due to the presence of increasing returns to scale in the creation and diffusion of knowledge, the knowledge gap between developed and developing economies may tend to diverge, rather than to converge (OECD 1996). Furthermore, the lack of the appropriate infrastructure for the deepening of knowledge will make the convergence more difficult. In this context, APEC needs to focus on cooperative potential and make concerted efforts for promoting KBEs in the region.

The previous two parts tried to identify key characteristics of the KBE and how the APEC economies meet these conditions with a specific emphasis on preconditions and policy environment for promotion of the KBE respectively. As pointed out by many scholars, the engine of the KBE is innovative enterprise. Meanwhile, it cannot grow without systematic support of its knowledge-oriented activities. Douglass North, the 1993 Nobel laureate, provides a convincing example from historic data: the slow and intermittent pace of developing new techniques. North attributes the cause to the fact that incentives for developing new techniques have occurred only sporadically. Typically, innovations could be copied by others at no cost and without any reward to the inventor or innovators. The failure to develop systematic property rights in innovation until recently was a major source of the slow pace of technological change (North 1981).

The preconditions for the KBE are composed of two categories concerning the player (entrepreneurs) and the stage (infrastructures). Accordingly, the policy environment may be divided into two fronts: creating the appropriate macroeconomic climate, and implementing a future-oriented microeconomic agenda for technology innovation. The major lessons from the APEC economies may be summarised as follows:

First, the key player in a KBE is no other than the innovative enterprise which actually uses knowledge productively. Entrepreneurs, seeking the fame and fortune which follow invention, create new ideas that drive technological progress. They sometimes acquire knowledge from outside forces through licensing or strategic alliances. In order to be an innovative enterprise, there are several prerequisites: the capacity to assimilate knowledge from outside forces, close relationships with other firms that possess complementary skills, a pro-innovation culture, and the effective management of knowledge. These conditions apply not only to multinational enterprises, but also to domestic small and medium enterprises.

Second, proper infrastructures such as knowledge bases, Information & Communication Technology (ICT) infrastructures, enterprise and innovation-friendly economic structures, and macroeconomic and legal frameworks should be provided for the KBE. While the entire list of factors is quite lengthy, it looks relatively similar to the key determinants for continuous growth in advanced economies.

Third, the government should provide framework policies to facilitate the transition towards an innovative and competitive KBE. Framework policies include supporting the key determinants of innovation, facilitating economic adjustment and change, and broadening framework laws to address the KBE.

Fourth, the government should pursue technological policies which are needed to deal with acquiring knowledge and adopting technologies, promoting R&D, and supporting the operation of the innovation system.

Drawing on the policy implications of the previous studies, we can identify cooperative potential for promoting the KBE in APEC. In order to draw specific policy recommendations for APEC, we focus on the four key dimensions related to promoting the KBE: business environment, innovation system, human resource development, and Information & Communication Technology (ICT). For each dimension, we identify potential areas of cooperation, related APEC activities, and impediments to cooperation. At the same time, directions of APEC actions for each dimension will be suggested that might be pursued through relevant APEC technical working groups and other forums.

First, a knowledge-friendly business environment is essential to promoting the KBE where the key players are entrepreneurs. In order to enhance the private sector's initiatives, it is important to have an open trade and investment system. Promotion of electronic commerce and coordination among governments also deserve due attention.

Second, innovation has become an increasingly important determinant of competitiveness in the KBE. Innovation relies on the interaction between the knowledge base and the business sector, and the innovation systems of national economies become closely interdependent. Thus it is important to cooperate in basic research, share best practices in strengthening innovation systems, or create an APEC system promoting transactions of knowledge.

Third, the demand for intellectual workers with professional knowledge and creative minds rapidly increases in the KBE. Thus, it is important to invest in human resources. APEC's cooperative actions in the area of HRD should be substantially reinforced.

Fourth, an ICT infrastructure is another essential pillar for the KBE. In order to close the knowledge gap among the APEC member economies, specific measures are to be taken, such as fostering human resources for telecommunications services and related network construction, or establishing an APEC cooperative mechanism for utilising the database and know-how of ICT-related knowledge.

In order to implement the aforementioned action plans for cooperation, it is necessary to prioritise them and maximise synergic effects through a well-designed time schedule.

In addition, it is important to coordinate a proportional progress on all of the four fronts. In the final chapter of this part, recommendations for APEC's actions are drawn, and their purposes, objectives, and scope of activities are discussed.

Our understanding of the KBE is limited. Furthermore, there is no royal road to achieving KBE development. Nonetheless, we believe that a good beginning is half the battle won. We do hope that our study will shed some light on drawing out the participatory efforts of the individual APEC member economies in promoting the KBE to its full bloom in the region.

2 COOPERATIVE POTENTIAL IN BUSINESS ENVIRONMENT FOR PROMOTING KBEs IN APEC

2.1 KBE and Business Environment

Economies in the APEC region face new challenges in the changing economic environment of increased competition, accelerated progress in technology, continued globalisation, and transition to a knowledge-based economy (KBE). It is an environment in which competitiveness is determined by knowledge and information. As the transition to such a knowledge-based economy is accelerating, the gap in knowledge among member economies is expected to become a key component of social and economic disparities.

In order to enhance cooperation among APEC member economies in the development of the KBE, private sector initiatives that recognise market mechanisms, improvement of related laws and regulations, and active responses to internal and external conditions are needed. However, given the enormous diversity of APEC membership, there are limitations to such cooperation as different economies are in different stages of KBE development. This will be a key challenge for APEC in presenting a balanced cooperation scheme in order to achieve shared prosperity in the region.

APEC has a significant role to play in establishing the foundations for devising cooperation strategies to address this issue. These strategies must reflect the needs of economies in the region, building upon existing work within APEC. As such, the analysis undertaken here on cooperative potential and policies in the business environment for promoting the KBE in APEC will cover three subjects: (1) trade, investment and legal systems; (2) electronic commerce; and (3) policy coordination among governments.

2.2 Potential Areas of Cooperation in Business Environment

2.2.1 Trade, Investment and Legal Systems

An open trade environment is a prerequisite for a KBE in that it helps create an incentive for innovation and allows for the implementation of technologies. Openness to trade often implies openness to new ideas, which is required by a KBE. There is clear evidence that outward, international orientation is linked to the process of economic growth and development. In a KBE, this international exposure is a means of communication and knowledge transfers. Openness to trade tends to go with other forms of openness that are required for a KBE, such as transparency. The role of open trade is to facilitate access to knowledge and create the necessary conditions for the adoption of new technologies. The importance of trade liberalisation lies not in the traded goods and services themselves, but

in the ability to learn from the activity. Since traded goods represent an applied knowledge, liberalised trade is an essential foundation for a KBE. As such, the trading environment has to be more conducive to the international flow of technology.

In this context, low tariffs and mutual recognition of standards that allow relatively free movement of goods is crucial in setting a favourable environment for a KBE. In addition, an active competition policy that discourages collusive and anti-competitive closed deals, and allows new and emerging firms to freely enter its markets is important in facilitating the flow of knowledge in an economy. At a more basic level, intellectual property laws must balance the need for good ideas to be actually used, against ensuring a fair return for inventors.

Along with open trade, foreign direct investment (FDI) can also be an important source of acquiring technology. Because multinational companies are leaders in innovation, their activities can be important in acquiring knowledge. Valuable technological spillover can occur through training of local staff, and through contacts with domestic suppliers, subcontractors, and buyers. In addition, there is an increasing tendency for the globalisation of R&D by multinational companies. Therefore, policies to attract the type of foreign direct investment that can contribute to local innovative activity are an important area for a KBE.[i]

In a KBE, a great amount of investment goes into the knowledge base and the associated infrastructure. This includes both public and private investment. Although this infrastructure is an essential part of the operation of a KBE, the cost of investing in it is not small. Therefore, governments need to ensure that this investment takes place. This does not mean that the government has to directly fund or build the infrastructures. On the contrary, opening the telecommunications sector to competition is one of the best ways to facilitate the necessary investment and to keep costs down.

In this context, potential areas of cooperation within APEC can be the improvement of investment procedures, identification and elimination of obstacles to investment, voluntary investment liberalisation based on mutual cooperation, and guarantee of transparency for investments. This will have the potential benefit of stimulating investments required in a KBE. Furthermore, it will induce industrial restructuring to a knowledge-based industrial structure, while promoting globalisation through the development of information technology and enhancing international strategic alliances among businesses across economies to enhance the flow of knowledge and technology.[ii]

An open trade and investment business environment cannot be attained without a solid regulatory/legal framework to facilitate knowledge flows. Appropriate legal systems have to be in place to administer such an environment. In addition, new legal systems that span not only the economy, but the society as well, are needed. One specific area of cooperation can be the introduction of laws and regulations for the KBE. Such laws include education laws for remote service provision, commercial laws and securities exchange regulations to expand e-commerce, customs laws for industrial development, construction-related laws to establish infrastructure such as a high-speed national communications network, consumer and privacy protection laws, intellectual property rights & copyright protection laws, and computer network expansion and utilisation laws.

2.2.2 Electronic Commerce

Electronic commerce (e-commerce) in a KBE is important in that it serves the function of information diffusion and utilisation. E-commerce provides new tools for improving the efficiency and profitability of business transactions via ICT networks. By its speed, reliability, and power, it enables some totally new forms of transactions to take place, especially business to business.

There are three potential areas of cooperation within APEC in promoting the KBE. First is cooperation in the establishment of an e-commerce-related infrastructure, such as development of hardware (PC, routers, servers), Internet content and substructures, which is needed to establish an e-commerce system. This would enable balanced development of hardware and software, and personnel exchanges between member economies in the region, which are the fundamental elements of e-commerce and a KBE.

Second, as the establishment of laws and regulations for e-commerce is urgently needed, emphasis must be given to cooperation to improve laws and regulations, taking into account international multilateral rules, electronic signatures, electronic authentication, consumer protection, privacy protection, intellectual property rights protection, and contents restrictions.

Finally, establishing and coordinating tax systems and introducing electronic payment mechanisms are also areas of cooperation needed to promote e-commerce in the region.[iii] This would require harmonisation of laws and regulations related to e-commerce.

2.2.3 Coordination among Governments

The key role of government in a KBE is as the provider of an environment that promotes less regulated product markets, freer trade and investment, and more effective incentive systems. That is, government in general needs to take a neutral approach to the development of knowledge-based industries (KBI) which would, in turn, allow an open market in ideas and investment to select the precise path forward within a broad framework set by government on behalf of society.

Despite the importance of individual governments in setting the right direction and framework for a KBE, such efforts would be incomplete if economies in the region were to lag behind or lack such initiatives. It must be kept in mind that a KBE, in its true sense, can only be complete with the participation of all economies. In this context, coordination of policy among governments is an essential aspect in realising the potentials of a KBE.

Devising a single objective policy related to a knowledge-based economy within APEC would be the fundamental starting point in the right direction. With the vast range of policies involved in setting the course for a KBE, a top-down approach to providing a political commitment for member economies is crucial.

Once a policy objective is in place, an exchange of related policies of APEC member economies to identify best practices with regard to the KBE will be useful. As different economies are at stages and levels of a KBE, no single model of policy will provide a

complete solution for all economies involved. As such, exchange of KBE-related policies so as to allow for economies to select a model that best suits their needs will be helpful in ultimately coordinating policy among governments.

Another area for possible cooperation among APEC member economies is the coordination of macroeconomic policies, which will have a favourable effect on the stability of financial markets. A predictable and stable regional capital market environment through policy coordination will provide a consistently transparent environment for businesses. Other policy coordination cooperation areas include establishment of a regional information technology system that is compatible in design and standards, utilisation of communication methods that are prevalent in developing economies (such as radio), and establishment of a community information communications centre.

2.3 Related APEC Activities in Business Environment

2.3.1 Trade, Investment and Legal Systems

Trade

APEC already has initiatives in relation to all of the needs in trade liberalisation for the promotion of a KBE. Therefore, the specific areas of cooperation within APEC can be conducted, taking into account the existing work in the IAPs, CAP, EVSL and Eco-tech and various committees. APEC Finance Ministers are undertaking a range of initiatives to promote financial and corporate restructuring. These will enable economies to more fully realise the benefits of free trade.

Tariff and Non-tariff Measures

APEC member economies are working to eliminate tariff and non-tariff barriers to trade. Member economies are committed to creating a region of free and open trade and investment no later than 2010 for industrialised economies, and 2020 for developing economies. The Collective Action Plans for Tariffs and NTMs require APEC members to keep the data in the computerised tariff database (APEC Tariff Database) up to date; pursue incorporation of information on NTMs into a future version of the APEC Tariff Database (TDB); compile a list of measures recognised as non-tariff impediments to trade; compile a list of products affected by those impediments; and identify industries in which the progressive reduction of tariffs and NTMs may have a positive impact on trade and economic growth in the Asia-Pacific region, or for which there is regional industry support for early liberalisation. A new Market Access Group (MAG) was established in 1998 to handle the CTI's work on tariffs and NTMs. In 2000, the majority of APEC member economies reported significant tariff reductions, and many have taken steps to reduce non-tariff measures. Most have taken measures to liberalise their investment regimes, improve competition policy and deregulate their economies. There has been extensive work done to streamline customs procedures and harmonise standards.

Mutual Recognition of Standards

The CTI Sub-committee on Standards and Conformance (SCSC) was established by the Declaration on an APEC Standards and Conformance Framework in November 1994. One

of the principal objectives of the SCSC is to achieve mutual recognition, among APEC economies, of conformity assessment in regulated and voluntary sectors. The SCSC established the Ad Hoc Experts Group on Electrical and Electronic Products MRA in 1997 for consideration of an MRA for these products. The MRA on Conformity Assessment of Electrical and Electronic Equipment (the APEC Electrical MRA), and the Terms of Reference for the Joint Advisory Committee for the MRA on Conformity Assessment of Electrical and Electronic Equipment were endorsed by SCSC and the Committee on Trade and Investment in August 1999. The APEC Electrical MRA was also commended by APEC Ministers in September 1999.

Competition Policy

The globalisation of business has highlighted the importance of competition issues. APEC's objective in this work area is to enhance the competitive environment of the region. In November 1994, APEC Ministers agreed that the CTI should develop an understanding of competition issues, in particular competition laws and policies of economies in the region. They agreed that the CTI should learn how competition laws and policies affect flows of trade and investment in the APEC region, and should identify potential areas of technical cooperation among member economies. In 1996, the Osaka Action Agenda work programmes for competition policy and deregulation were combined in view of the linkages between the two issues. The competition policy/deregulation work area has been a key component of work on the strengthening markets' theme, promoted by the 1999 APEC Chair.

Intellectual Property Rights

The Intellectual Property Rights (IPR) Experts' Group (IPEG) has carried out a work programme since 1996 to achieve the planned Collective Actions as well as to enhance APEC-wide cooperation in the following areas: deepening the dialogue on intellectual property policy; surveying and exchanging information on the current status of IPR protection and administrative systems; studying measures for the effective enforcement of IPR; fully implementing the TRIPS Agreement no later than 2000; and facilitating technical cooperation to that end.

Investment

APEC leaders and ministers at Bogor, Osaka, Subic, and Vancouver have committed their economies to create free and open investment by 2010 (for industrialised economies) and 2020 (for developing economies). They endorse Individual Action Plans (IAPs) as a core instrument in this process. They have called for transparency in, and the annual improvement of IAPs. ABAC has also called on APEC economies to make progress in the investment area.

The Investment Experts' Group (IEG) of the CTI was established in 1994 to bring together officials in the region involved in the regulation of foreign investment. Its main role is to assist the CTI in achieving the investment-related components of APEC's liberalisation and facilitation agenda. In response to both government and business, the Investment Experts Group undertook to compile a "menu of options" for helping economies to identify policy measures that member economies may include unilaterally in their IAPs for implementation of this objective. There was a consensus that the project should focus on

concrete measures, rather than on continued philosophical debate. APEC ministers endorsed the "menu" initiative at Vancouver.

Based on the non-exhaustive “master menu” of investment-liberalising and business-facilitating measures, members have voluntarily selected a number of options to make progress towards creating a free and open investment regime. In addition, 13 economies have included commitments and targets for removing impediments to the development of domestic and regional capital markets in their 1998 IAPs.

With regard to infrastructure investment, APEC Finance Ministers agreed in 1997 on Voluntary Principles for Facilitating Private Sector Participation in Infrastructure, in which member economies undertook “to introduce necessary steps, where appropriate, to put in place a framework to provide a high level of investor protection”. In addition, the November 1997 Vancouver Framework for Enhanced Public-Private Partnerships in Infrastructure Development reaffirmed these principles and called for action to improve capacities in various areas.

2.3.2 Electronic Commerce

In various APEC fora, it has been recognised that e-commerce is potentially one of the most important technological developments of the decade. In many APEC member economies, however, there are not enough electronic sites where business can be done. Trust and confidence in e-commerce is hampered by regulations requiring paper forms, signatures, and the like. Some APEC member economies impose restrictions on electronic trade or on the use of high-level encryption technology.

A SOM Task Force on Electronic Commerce has been established within APEC to address these and other problems. In the first stage of its work, the Task Force will focus on studies and information exchange. In the second stage, it will consider principles for policy development and the options for technical cooperation within APEC. In “To Make the Asia-Pacific Information Society a Reality by the Year 2001”, three initiatives to promote e-commerce were identified: incorporating the OECD guidelines on privacy, security and cryptography as the APEC model framework; implementing UN/EDIFACT as the standard EDI/Electronic Commerce Data Protocol for customs documents; and encouraging ratification and implementation by APEC WIPO members of the WIPO Copyright Treaty and the WIPO Performances and Phonograms Treaty. By achieving progress on these issues, APEC member economies would go some distance in creating an environment that is conducive to the development of e-commerce APEC-wide.

In addition, a number of more specific e-commerce projects are currently underway within APEC. The Transportation Working Group has initiated a pilot EDI programme to facilitate e-commerce and to eliminate the requirement for paper documents. The TEL has launched a number of projects, including one to establish a Certifying Authority and procedure for the use of digital signatures. The INGECEP/CyberNet project experiments with electronic commerce applications over both the narrowband (Internet) and broadband (ATM) networks connecting APEC and G7 member economies. The TEL is also conducting seminars and undertaking surveys on e-commerce. The Human Resources Development Working Group (HRD WG), meanwhile, is developing training modules and courses to help prepare government officials for the public policy issues arising from e-commerce.

2.4 Impediments to Cooperation

2.4.1 Trade, Investment and Legal Systems

While openness to trade is clearly the backbone of a KBE, impediments to cooperation remain in this area. The voluntary nature of APEC facilitates cooperation as members are not obliged to commit to rules and standards. While APEC lacks WTO mechanisms underpinning cooperation, it nevertheless has made significant progress. At this year's APEC Trade Ministers' Meeting in Darwin (Australia), the majority of APEC member economies reported significant tariff reductions, and many have taken steps to reduce non-tariff measures. Most have taken measures to liberalise their investment regimes, improve competition policy and deregulate their economies. There has also been extensive work done to streamline customs procedures and harmonise standards.

Despite the potential for cooperation within APEC to stimulate investments for a KBE, complex investment regulations and laws of individual economies hamper the flow of international investments and create uncertainty for potential investors. These may act as formal investment barriers in the form of legislation and regulations, or as informal barriers in the form of administrative procedures and non-transparent policies. Another impediment to cooperation on investments is the lack of electronic data interchange of investment-related documents. Paperless transactions of investments expedite capital flows and thus act as an incentive for investments. However, reliance on conventional documents causes delays and costs to investors.

Potential impediments to cooperation in legal systems are the disparities in the stages and strategies of KBE. Problems due to the coexistence of different legal systems within the region pose a challenge to cooperation. The choice of legal frameworks tends to be influenced by economy-specificity in the industrial structure, education and level of development.

2.4.2 Electronic Commerce

There are significant differences in information and telecommunications policy among APEC member economies. While the trend towards increasing liberalisation of telecommunications services is well under way in the region, many important markets continue to be characterised by a monopolistic or duopolistic structure. The public sector still has a major stake in the provision of telecommunications services in many of the member economies.

While a cooperative approach must be sensitive to the different imperatives driving infrastructure development in various APEC member economies, these differences should not impede cooperation. Some economies in the region, however, have seen their specific circumstances as a justification for policies that are at odds with the general trend towards liberalisation in trade and investment. Developing economies, in particular, have been reluctant to remove trade and foreign investment restrictions in their information and telecommunications industries. Studies indicating that the social rate of return from R&D in high technology sectors is well above the private return have contributed to the view that information technology and telecommunications are strategic sectors that merit special treatment. In addition, studies of "learning by doing" have been used to justify the

protection of indigenous high technology firms that are seen to have an important role in nurturing local technological capabilities.[iv]

2.4.3 Coordination among Governments

A major setback to the potential of cooperation is the differences in KBE stages and strategies. Also, the lack of policy relating to the KBE in several developing APEC economies poses problems to the overall cooperation efforts. For example, in most developed APEC member economies such as the US, Japan, Australia, Canada, and New Zealand, there may be some room for improvement in innovation and technology diffusion policies. By contrast, a number of APEC member economies face a far-reaching science and technology policy agenda. They include Korea and Mexico where the institutional set-up for innovation and technology diffusion policies is not yet complete. Asian economies with less policy experience in this area (Philippines and Thailand) face a more ambitious agenda requiring higher costs in policy design and implementation of the emerging model of knowledge generation and use. The policy coordination in APEC for a KBE will have to take into account considerations such as the limitations of government, missing out on other priorities, and economy-specific conditions.

2.5 Directions of APEC's Actions

2.5.1 Trade, Investment and Legal Systems

As mentioned above, initiative for trade and investment liberalisation is already under way in APEC. However, in order to facilitate an environment for a KBE, these efforts need to be materialised and implemented. With regard to obstacles to trade, APEC should accelerate the removal of both tariffs and non-tariff barriers. It could achieve this through EVSL initiatives of high-tech industries, or moving forward the target dates of the collective action plans. In addition, APEC's actions should focus on promoting a consistent competition policy, mutual recognition arrangements of standards, and protection of intellectual property rights.

As foreign direct investment is a crucial element of a KBE, ideally, bilateral, regional and/or multilateral agreements on investment liberalisation would be desirable. In this sense, regional efforts within APEC to sign or establish such bilateral, regional and/or multilateral agreements or arrangements for the protection of investment with enhanced protection and openness for investors and investments should be pursued. In addition, establishment of an investment regulation database would help create a transparent environment.

Improvement of the level of automation of investment-related documents among member economies is also an area for future action by APEC. This would involve technical assistance to developing members in strengthening their capacities to implement Electronic Date Interchange (EDI) systems.[v]

With regard to legal systems, a way for APEC's actions would be to identify and introduce best practices, rather than present a comprehensive single model of a legal framework for all member economies. This is because a certain legal approach to the KBE may not be equally desirable across APEC member economies as economies differ in their preparedness or capacity to manage. Ultimately, APEC cooperation should strive for the

harmonisation of KBE-related legal systems within APEC so as to foster an equal environment for knowledge to flourish and flow within the region.

2.5.2 Electronic Commerce

The growth of e-commerce in the region will depend not only on these initiatives, but also on APEC's success in reducing the information infrastructure gap among member economies. Therefore, there is a strong link between cooperation on e-commerce and other APII-related ECOTECH programmes.
Cooperation in the area of e-commerce should be directed to the improvement of the level of related infrastructure, so as to lay the basic foundations for e-commerce. Specific measures to establish a high-level information network in the region are needed to address such. In addition, establishment of training programmes to train, dispatch and nurture experts is another area of cooperation that coincides with infrastructure development.

Cooperation on taxation and its applicable rates of e-commerce should be pursued. However, this should bear in mind commitments at the multilateral level. Therefore, any cooperation in this area should be towards accelerated elimination or reduction of tariffs.

2.5.3 Coordination among Governments

Policy coordination in APEC for fostering the KBE is needed against the impediments to cooperation.

First, policy coordination should be focused on improving the computerisation level within the APEC member economies.

Second, APEC's actions must address improving efficiency of contents management through continuous development of regional or international standards related to information and communications technology. A single common standard in the region would at least facilitate the transfer of knowledge within the region and provide a foundation for a common base to knowledge.

Third, APEC should orient its efforts to establish a broadband network in APEC and connect it to the World Wide Web. This could be achieved through the establishment of an "APEC Information Infrastructure".

Fourth, APEC can initiate an "e-APEC" to synchronise the information and communications technology development efforts of APEC member economies. This would focus on linking the region with high-speed communications networks, harmonisation of policies, restrictions and standards on information technology, and co-development of human resources relating to information technology.

Fifth, the establishment and implementation of measures that assist developing economies with technology provided by developed economies and funds provided by international financial institutions such as the World Bank could be pursued.

Sixth, policy coordination to promote the establishment of new venture enterprises and SMEs related to KBIs would be crucial since these are the very foundations for new technologies and ideas in a KBE.

Finally, an important priority in coordinating efforts among governments is establishing development/assistance programmes for developing economies. Initially, the programmes should start with holding seminars and conferences to provide information and enhance an awareness of the KBE among developing members. These efforts should move onto education and training programmes so as to provide substantive results.

3. COOPERATIVE POTENTIAL IN INNOVATION SYSTEM FOR PROMOTING KBEs IN APEC

3.1 Changing Role of Innovation in a Knowledge-Based Economy

With the emergence of a knowledge-based economy, innovation has become an increasingly important factor in the competitiveness of firms, the prosperity of economies, and dynamic world growth. In all sectors of the economy, firms need innovation to grow and to stay ahead in the market. It helps producers to satisfy diverse and fast changing consumer demands, and generally enables improvements in health, communications, and the quality of life. In other words, innovation is the driving force of progress.

Innovation uses scientific progress to meet the changing needs of society, and is thus one of the keys to sustainable development. Every economy ranks the capacity to innovate - the transformation of knowledge and ideas into new products, processes and services - as a top priority. Innovative capacity plays a dominant, and probably decisive, role in determining who will prosper in the global arena. Without it, firms cannot introduce new products, services and processes. They find it difficult, if not impossible, to gain market share, reduce costs, or increase profits. In effect, if the pulse of innovation is missing, firms quite simply die. For countries, the ability to leverage innovation not only to achieve national goals (improved security, health, and environment) but to increase productivity and attract investment from an array of global sources, is the key to continuous improvements in the standard of living and quality of life. Promoting innovation is now a high priority in most economies.

According to recent research by the OECD (1999; 2000), the process of innovation and technology diffusion is undergoing substantial change. The main driving forces are increasing market pressures stemming from globalisation, deregulation, changing patterns of demand and new social needs as well as scientific and technological developments such as increasing multi-disciplinarity in the production of new knowledge, and the diminishing cost of access to and processing of information. Several trends combine to change the conditions for successful innovation (OECD 1999):

First, innovation increasingly relies on a well-functioning interaction between the knowledge base and the business sector.

Second, more competitive markets and the accelerating pace of scientific and technological changes force firms to innovate more rapidly.

Third, networking and collaboration between firms are now more important than in the past and increasingly involve knowledge-intensive services.

Fourth, SMEs, especially new technology-based firms, have a more important role in the development and diffusion of new technologies.

Fifth, the globalisation of economies is making the innovation systems of economies more interdependent.
In sum, in an era of a knowledge-based economy, innovation performance depends not only on how specific actors (for example, enterprises, research institutes, and universities) perform, but also on how they interact with one another as elements of an innovation system at local, national and international levels.[vi]

3.2 Potential Areas of Cooperation in Innovation Systems

Traditionally, governments have intervened in the technology arena to address market failures when for example, firms fail to invest enough in R&D due to the existence of spillover, which limits their ability to fully appropriate returns, or due to the uncertainty associated with innovation by measures aimed at increasing the volume of R&D without enough consideration on how to improve the effectiveness and efficiency of existing R&D.

The new role of governments requires that they also address systemic failures which block the functioning of the innovation system, hinder the flow of knowledge and technology and, consequently, reduce the overall efficiency of national R&D efforts (OECD 1998d). Such systemic failures can emerge from mismatches between the different components of an innovation system, such as conflicting incentives for market and non-market institutions, for example, enterprises and the public research sector. Other market and systemic failures may result from institutional rigidities based on narrow specialisation, asymmetric information and communication gaps, and lack of networking or mobility of personnel.

Governments need to play an integrating role in managing knowledge on an economy-wide basis by making technology and innovation policy an integral part of overall economic policy, particularly promoting closer coordination with education and labour policy and programmes. Governments also need to take on a more active role as a catalyst in bringing together the various actors of innovation systems.

Such efforts of governments might call for new approaches or institutional arrangements, including public/private partnerships, to formulate and implement technology and innovation policies. Better techniques and institutional mechanisms for evaluation are in many economies prerequisites for improving decision-making across the traditional delineation of administrative competencies, and can spur innovation in government (OECD 1998).

3.3 Related APEC Activities in Innovation Systems

3.3.1 Industrial Science and Technology Working Group (ISTWG)

The Industrial Science and Technology Working Group (ISTWG), which was formed at the APEC Ministerial Meeting in Singapore in 1990 as the Working Group on Expansion of Investment and Technology Transfer, is guided by the statements of APEC Ministers responsible for Science and Technology. The ISTWG has six key priorities: improved

availability of information; improved human resources development; improved business climate; contribution to sustainable development; enhanced policy dialogue and review; and facilitation of networks and partnership.

3.3.2 Publication of IST Handbook and Creating APEC's Science and Technology Web Site

The ISTWG issued the ISTWG Handbook for Members to ensure that its members are well briefed and that the group is effectively organised. The Handbook describes the current aims, policies, procedures, and practices of the group.

The ISTWG has also created the APEC Science and Technology Web (AST Web) to help expedite information flow among member economies. The AST Web's address is at http://www.apecst.org.

3.3.3 Ongoing IST Projects

In addition to conducting a series of seminars, symposia and workshops, the ISTWG has completed several projects, but has some that are ongoing.[vii] The ISTWG's current programme is based on the working group's vision for the 21st century of a dynamic and prosperous Asia-Pacific region, built on the development and application of industrial science and technology, that improves the quality of life while safeguarding the natural environment and achieving sustainable development.

The continuing projects include those related to Networking of APEC R&D Leaders and Researchers; Cleaner Production Strategy/Clear Technology Strategy; APEC-wide Studies of Megacities and Technology and Learning in 2010; Gender and Science and Technology; emergency preparedness, and health issues. The ISTWG, in cooperation with other APEC fora or sub-fora, will continue to follow up its recommendations on the APEC Agenda for Science and Technology Industry Cooperation into the 21st Century, which was endorsed by the Ministers in September 1999 in New Zealand. The recommendations include:

- Strengthening APEC's ECOTECH focus on the opportunities and challenges for small and medium enterprises in knowledge-based economies.
- Developing an action agenda to strengthen the involvement of women in science and technology in the APEC region.
- Strengthening science and technology dialogue in the region.
- Working together with the APEC Secretariat to strengthen ECOTECH project coordination across all APEC fora.
- Providing the second progress report on this agenda built on the encouraging results of the first report.

3.3.4 Support from ECOTECH Subcommittee (ESC)

The ECOTECH Sub-Committee (ESC) was established in 1998 to assist the SOM in coordinating and managing APEC's economic and technical cooperation (ECOTECH) agenda, and in identifying value added initiatives for cooperative action. It seeks to advance more effective implementation of the 1996 Manila Framework for Strengthening Economic Cooperation and Development through consultation with APEC fora, and the development of policy management tools and guidelines for projects.

The ESC, with assistance from the APEC Secretariat, examined and reported on the 250 ECOTECH projects that were underway or reaching completion in 1999, monitored and reported on the implementation of projects/activities that flowed from the Kuala Lumpur Action Programme on Skills Development and the APEC Agenda for Science and Technology Industry Cooperation into the 21st Century endorsed by APEC Leaders in Kuala Lumpur, Malaysia in 1999, and established a system of focal points (coordinators) to review progress in the implementation of the six priority ECOTECH themes under the 1996 Manila Declaration.

In 1999 the ESC reported on the themes of "developing human capital", "harnessing technologies for the future", "sustainable development", and "strengthening the dynamism of SMEs". It also reported on the policy elements of the self-reviews submitted by the working groups, including the Agricultural Technical Cooperation Experts Group (ATCEG) and the Ad hoc Policy Level Group on Small and Medium Enterprises (PLGSME), and monitored the implementation by APEC fora of its "Guidance on Strengthening Management of APEC ECOTECH Activities". The ESC also noted that more importance was now being placed on ensuring that projects were outcome-oriented, and developed a "weightings matrix" that was endorsed by Ministers at their meeting in Auckland in September 1999. The aim of the ECOTECH Weightings Matrix is to provide APEC fora with a better appreciation of the overall ECOTECH priorities, including desired project outcomes. The ESC will monitor its implementation during the year 2000.

The ESC will continue to work with Lead Shepherds/Chairs to ensure that ECOTECH activities add value and contribute to the achievement of APEC goals. It will establish an ECOTECH Clearing House mechanism to enhance information flows between the identification of ECOTECH needs and the capacity to provide appropriate expertise to meet those needs. The ESC will also devote more effort to demonstrating the benefits of APEC's ECOTECH activities in its communications and outreach work programmes.

3.4 Impediments to Cooperation in Innovation System

3.4.1 Differences in Innovative Capacity among Member Economies

Globalisation is making the innovation systems of different economies increasingly interdependent, and is enhancing the diffusion of knowledge, technology, and people across borders. It affects scientific research as well as technology strategies in the business sector. While the globalisation process touches all economies, it presents different challenges for individual economies depending mostly on their industrial structure, the size and openness of their economy, and the strength of their science and technology base.

In fact, the globalisation process has not markedly diminished differences in innovation systems, and may actually be accentuating the technological and industrial specialisation of different economies. In contrast to developed economies such as the US, Japan, Australia, Canada, and New Zealand, there seems to be much room for improvement in the innovation and technology diffusion policies in the case of the developing economies in APEC.

The implementation of the KBE model will have to take into account considerations such as the limitations of government, missing out on other priorities, and economy-specific conditions. As Andersson (1998) emphasises in his paper, the choice of policy instruments that are most relevant and efficient is influenced by economy-specificity in the mechanisms underlying innovation, technology diffusion, and closely linked processes such as organisational change and up-skilling of the workforce; and that economy specifications influence the lessons that an economy can draw from the experience of others.

3.4.2 Institutional and Organisational Rigidities

Institutional and organisational rigidities can stifle innovation, and deliberate government policy is needed to break down such structures. In many economies, university researchers do not have the right incentives to engage in research that has potential commercial applications or to cooperate with the business sector. The United States was among the first countries to recognise the need to unblock this. Since the passage of the Bayh-Dole Act in 1980, US universities have been allowed to patent the results of federally funded research. Previously, patents would be assigned to the federal government. In Japan, recent legal changes also assign publicly funded researchers half of the patent rights for their inventions. These are regulatory improvements that stimulate innovation and strengthen the link between scientific research and the innovation process.

Other bottlenecks require action too, such as rules that prevent university researchers from working with the business sector, or regulations that unduly inhibit cooperation between firms themselves. Access to venture capital appears to be another problem in need of government attention.

3.4.3 Government Overprotection for the Results of Domestic R&D

Governments in every economy are reacting to the pressures of globalisation primarily through policies designed to improve their domestic innovation capacity. They are reinforcing the basic framework conditions for innovation, concentrating on the promotion of a highly skilled labour force and a dynamic research base. More and more economies are taking steps to actively strengthen their innovation systems. Globalisation, however, is posing challenges for international technology cooperation.

Many governments remain concerned about the globalisation of R&D, whether they are net recipients or net sources of FDI. Source economies are wary of a hollowing out of the research base as domestic corporations do a larger share of their R&D abroad. They are worried that their industrial strength and independence will be eroded if innovation becomes as mobile as production.

Meanwhile, recipient economies are sometimes skeptical that foreign-affiliate laboratories are anything more than listening posts whose contribution to the domestic research base could be improved. The research intensity of foreign affiliates is, indeed, generally lower than that of national firms with the exception of a few economies like Ireland, Australia, and the United Kingdom, so it is understandable that host economy governments should want to maximise the spillover for the domestic economy of foreign R&D investments.

Another problem which seems to make all economies worried is the effect of international mergers and acquisitions on R&D. One of the hallmarks of cross-border mergers and acquisitions, as witnessed in pharmaceuticals and telecommunications, has been a rationalisation of redundant activities worldwide. The question of which laboratories will be kept and which will be downsized is inevitably a cause of some anxiety.

3.5 Direction for APEC's Actions in Innovation System

3.5.1 Cooperation in Basic Research

Scientific research is at the core of much of our knowledge. Curiosity about mankind, the environment in which we live, and the universe drives scientists to explore new frontiers and expand the stock of basic knowledge. The scientific enterprise depends mostly on universities, but also includes public and private laboratories.

Over the past few years, governments have undertaken efforts to enhance the contribution that science can make to economic growth and innovation, and to link scientific research more closely to business and society.

An important element of this reform effort concerns science funding. To enable scientific research to take a long-term perspective, overall funding needs to be stable. However, an adequate amount of funding should be linked to research contracts, as this strengthens the responsiveness of science to business needs. Funding of basic research, including most university funding, should primarily be linked to criteria of excellence, whereas funding of applied research should primarily be based on relevance. Closely linked to this demand is the issue of autonomy. Universities are often able to engage in new forms of research, and in new collaborative structures, provided they are given the freedom to do so.

A second important element of science reform involves the interface between science and industry. The removal of obstacles that hinder cooperation, such as regulations that prevent scientists from financially benefiting from innovation, or pension schemes that limit the mobility of researchers, is essential in linking science more effectively to business needs. Increased cooperation may have benefits beyond science and innovation, since university researchers often create new firms based on the spin-offs of their research, and thus contribute to growth and job creation.

Finally, new developments in medicine and genetic engineering, such as cloning and genetically modified organisms, are generating public concern, and have raised ethical issues that require discussion involving the broader public. If science is to be effective, the interaction between science and society must improve.

3.5.2 Sharing the Best Practices in Strengthening Operation of the Innovation System

In transition towards a knowledge-based economy, the main task of each government of the APEC member economies will be to improve the innovation system itself through maintaining a regulatory framework that promotes innovative behavior, reducing obstacles that prevent the formation of networks, and ensuring that the public research infrastructure works in close collaboration with businesses. Policies in this area will also involve the removal of barriers to cooperation, such as conflicting incentives for research in firms and

universities, institutional rigidities, information and communication gaps, and regulations that limit the mobility of personnel. The government can also provide information about new technologies to businesses, for instance through the Internet, and promote innovation by being a demanding customer in serving public procurement needs in areas such as construction, defence, and health.

3.5.3 Enhancing Networking between Firms and Public Institutions

The business sector is now a more important driver of the innovation process than in the past. Currently, an increasing share of about 60% of the total spending on R&D is funded by business. Increasingly competitive markets and the accelerating pace of scientific and technological change are forcing firms to innovate more rapidly. This trend, together with the expanding range of technologies which firms must manage, is stimulating firms to make business R&D more effective, and is squeezing out private investment in long-term applied research. To access basic research and new technologies, enterprises increasingly need to finance research in universities. In this context, it is important that governments recognise the growing importance of the private sector and increasingly work with businesses in promoting innovation. New mechanisms, such as public-private partnerships, are used to shape such cooperation.

3.5.4 Identifying and Disseminating Non-technology Based Knowledge

The flow of knowledge will be incomplete without that of non-technology-based knowledge such as movies, fashion design, animation, and basic agricultural skill. In particular, APEC needs to focus on governing cross-border transactions, facilitating joint knowledge creation, and disseminating best practices in this area.

4. COOPERATIVE POTENTIAL IN HUMAN RESOURCE DEVELOPMENT FOR PROMOTING KBEs IN APEC

4.1 KBE and Human Resource Development

A knowledge-based economy is a new paradigm emerging in the 21st century which will replace the existing industrial society. In this new paradigm, economic entities will nurture their innovative capacities by acquiring, applying, and expanding new knowledge, and contribute to further growth and development. In a knowledge-based economy, the ultimate transformation of the means of production from capital and labour to intangible intellectual capital and innovative mindset will take place. This, in turn, will determine an economy's international competitiveness, businesses' productivity, and the individual's position within a labour market.

There will be a rising demand for intellectual workers equipped with professional knowledge and creativity when the share of knowledge-based industry increases, and concentration of knowledge in existing industries continues. Looking at the composition of employment categories by industry based on knowledge concentration, there is a general employment increase in the service industry, and even greater growth in the knowledge-based industry.

Knowledge, as the new core factor of production in a knowledge-based economy, is fundamentally different from the traditional factors of production in that it does not dry up,

but instead produces a snowball effect of increasing returns to scale and externality, and encouraging further creation of knowledge. In this light, it is highly recommended that there should be policies which encourage sufficient levels of education and R&D. Diffusion and application of knowledge are equally important in order to facilitate the efficient distribution of intangible intellectual capital by maximising its external economic effects and characteristics as a public good.

Therefore, in order to respond to the current trend towards a knowledge-based economy and to survive in a highly competitive environment, we need to improve job competency. This is the first reason for cooperation in human resource development among APEC economies.[viii]

Human resource development is a consolidated social welfare programme that will stabilise the labour market by reducing the knowledge gap among the constituents or economies. That is to say, cooperation in human resource development among APEC members is much more important in the knowledge-based economy. This is the second reason for cooperation in human resource development among APEC economies.[ix]

4.2 Potential Areas of Cooperation in HRD

4.2.1 Sharing of Information on Education and Labour Market Best Practices

Enhancement of the capacity and opportunities for the movement among member economies of people who have skills relevant for economic growth is a necessary element in achieving trade and investment liberalisation and facilitation in the region. Thus, consistent with the goals of APEC, its HRD activities must facilitate the movement and interaction of qualified persons. To further promote HRD in the region as a means to achieve economic goals, projects to be undertaken in the short term shall include the sharing of information on the best practices of education and training, and the planning of an experts' meeting to discuss new exchanges in higher education for the 21st century. For example, we should be able to easily share information on systems of accreditation, curriculum development and certification on which are recently focused.[x]

In the medium term, the publication of member economy profiles, including labour market information, in booklet and video forms for distribution among schools and training institutions, and the establishment of a communication network among education and human resource policy makers to promote information sharing shall be pursued.

Other areas for sharing would be as follows: Enhancing Labour and Management Participation in Human Resource Development, Youth Initiative, Facilitating Mobility of Persons and Information Exchange for HRD and Economic Growth, and Developing Ways to Monitor Performance of Education and Training Systems

4.2.2 Research on Best Practices of HRD

The different experiences of the APEC economies – how they have developed, how they have encouraged changes in the workplace, and what the results of such changes were - all provide fertile ground for information sharing among all APEC economies. Building on existing experience would be a medium-term direction and would necessarily be focused

on the results of changing workplace practices. Innovative ways need to be found that should allow these experiences to be shared in a way that benefits both workplace parties and can lead to practical outcomes.

For example, the collaborative study of which 'best practices' tend to work particularly well in what workplace situations (that is, 'lessons learned') is one approach that the APEC economies might want to pursue. Or, as has been suggested, there may be a desire to focus more closely on those workplace practices that can improve skill mobility and foster productivity in the informal sector. If necessary, it may be desirable to establish a research institute like CEDEFOP (European Centre for the Development of Vocational Training) of the EU.

As the APEC economies move towards the 21st century, the introduction of new workplace practices that have been illustrated here are likely to become more prevalent. Increasingly, organisations, including different governments, view these new workplace practices as a means to create more flexible and adaptable organisations, to provide greater economic security for all its citizens, and to have a positive impact on society as a whole.

4.2.3 Improving Skills Development through Cooperation and Participation

Skills development is one of the most important instruments for adjusting to the changes in the labour market and economic environment. Additionally, skills development could contribute significantly to overall economic well-being and human welfare through its impact on economic growth and development. In addition, a better-educated and trained workforce is vital to improving productivity and rapidly adapting to a changing economic environment. Therefore many member economies should reassess their systems as they prepare for the 21st century, and make every collaborative effort to research the following proposal for the establishment of education hubs.

First of all, we should find effective training methods for new workforce entrants and improve the skills of those already in the workforce, while collecting and sharing information and experiences in skills development. Secondly, we should continue to enhance the participation of the private sector in skills development, develop methods to retrain instructors, teachers, and administrators, and develop effective means of catering to the needed skills development for groups like the disadvantaged and people with disabilities. Lastly, the curriculum development of member economies and collaborative research on lifelong learning systems are necessary.

4.2.4 Mutual Exchanges of Persons

The increased levels of exchanges of students, staff, education officials and researchers through University Mobility in the Asia Pacific (UMAP), and increased exchanges of education officials are envisioned for the *medium to long term.* Significantly, facilitating the mobility of qualified persons and information exchange for HRD should be pursued in line with the more general goal of promoting economic growth within the region. This goal emanates from the recognition that the intra-regional movement of qualified and experienced human resources will contribute to the economic development of professions in the short-term.

Bilateral student exchange especially should be expanded at various levels. For example, universities from member economies will provide student volunteers who will be placed in the economies of their interest where they will serve as experts in their major fields. Informal exchanges like working holidays can contribute to mutual understanding, cooperation, and exchanges of information among the member economies.

4.2.5 Recognition of Vocational Qualifications between Professional Bodies or Government

A series of bilateral agreements for the mutual recognition of professional qualifications between professional bodies or governments will also be made in the long term. Mutual recognition of qualifications should be realised in the *long term* through a series of bilateral agreements between professional bodies and governments in the region.

In practice, APEC members can collaborate on work towards mutual recognition of qualifications in the following. Information on professional recognition requirements and surveying for member economies can be collected, analysed, and shared in the HRD Working Group. A second stage of this work focuses on mapping existing arrangements for accreditation, recognition, and development of professional qualifications, with a view to identifying best practices. Work can also be undertaken by the network on comparability and disparity of skill testing standards in the region. Data-gathering and analysis on standards in several select trades have already begun.

4.3 Related APEC Activities in HRD

APEC developed a programme with a wide range of activities aimed at promoting economic and technical cooperation (ECOTECH). However, the current status of ECOTECH projects shows that despite the great effort put in, the impact of the projects has been somewhat weak. Furthermore, it is questionable whether holding events like seminars or conferences actually promotes substantial cooperation. Many such projects are one-time events lacking any follow-up actions. In many cases, reports are simple references that are not influential to policy making. It is true that we should not expect a huge impact from ECOTECH projects, considering that many of them are in their early stages. However, unless general improvements are made, the current status of these projects foreshadows a not-so-bright future for ECOTECH.

Current issues of HRD cooperation among APEC economies lie in the centre of more active and practical policy execution. The problem arises from two main areas. One is financial limitations, and the other is that some governments, mainly those of developed economies, tend to put some ECOTECH responsibility on the private sector, mostly universities and institutes which are naturally inclined towards writing reports or holding seminars and conferences. This limits the horizon of economic and technical cooperation in APEC. Another reason for this gloomy future is the limitation of project designs. Basically, project designs have been limited due to the insufficient supply of capital and technology for ECOTECH. In relation, participation by developing economies has been limited due to their reserved attitude towards present ECOTECH projects. Since current

projects are too oriented towards seminars, workshops, and organising fora, results from ECOTECH projects have not been satisfying for developing economies. Therefore, APEC economies should make efforts not only to solve these problems, but also to confer about the development and execution of HRD programmes which have been discussed in various APEC meetings.

In a related vein, the Economic Committee is promoting the FEEEP (Food, Energy, Environment, Economic Growth, and Population) project. The project is designed to analyse the relationship between the five stated factors. Human Resource Development (HRD) issues are of importance in this analysis, and issues such as rural-urban migration or the role of women in the labour market are dealt with in the FEEEP context. International labour mobility issues, such as the mobility of professional expertise, are also related to the development of human capital. The related projects have to do with the recognition of professional qualifications and trade in education and training services. Relevant analytical work on temporary labour migration is also being conducted by both the Economic Committee and the HRD Working Group.

Furthermore, the HRD Working Group is promoting projects on measuring and monitoring the effectiveness of education, the improvement of teacher preparation, curriculum development, and the use of technology in educational and training. These projects are important in order to strengthen education cooperation.

4.4 Impediments to Cooperation in HRD

There are a number of impediments to successful cooperation in HRD among APEC economies, namely the sustainability of joint cooperation, differences in labour market structures and systems such as labour laws and culture, imperfect market conditions defining the government's role in facilitating private sector participation in HRD, and the presence of mutual distrust between labour and management.

4.4.1 Sustainability of Joint Cooperation among APEC Economies

As we will see, many programmes for cooperation in HRD have been discussed within APEC. Due to the absence of leadership, however, most programmes discussed in HRD could not be put into practice. That is to say, the lack of lateral cooperation among APEC member economies as well as APEC sub-fora is the first impediment to cooperation in HRD.

4.4.2 Differences in Labour Market Structures and Systems among Member Economies

There are great differences in labour market structures and systems among APEC economies: the size and structure of labour supply and demand, the quality of manpower, investment in HRD, and laws and regulations on HRD. These, in turn, hamper cooperation.

4.4.3 Imperfections in Labour Markets in Some APEC Member Economies

Imperfections exist in the labour market, like a structural mismatch between labour demand and supply, mal-working of the wage setting system, and imperfection of the LMI

system, and should be taken into consideration. For example, among labour surplus economies, employers bear the brunt of the shortcomings in HRD where they have to increase the training cost of firms wishing to develop satisfactory levels of skills among their employees. This qualitative mismatch of the labour force is attributed to the imperfect market conditions such as the low levels of basic education, and the economic domination of small firms that lean toward informal, minimal training compared to larger firms. Limited training opportunities for the majority of workers likewise encourage the practice of poaching workers, especially by companies which are unwilling to spend money for training. A huge informal sector can prevent wages from functioning as a market signaling. This brings about abnormally low wages and wage exploitation, which may hinder investment in HRD. Other market imperfections also exist: inaccessibility to training financing, underdeveloped human resource management capabilities, and the imperfection of labour market information systems.

4.4.4 Lack of Specific Roles of Governments in HRD Cooperation

The value of governments providing the proper environment to stimulate long-term labour and management participation in HRD is demonstrated by the experiences of the majority of the APEC economies. While greater participation by the private sector in HRD is desired, a certain amount of government intervention is still necessary. Currently, governments assume the role of a direct training provider rather than that of a facilitator. However, more specific supporting roles for the government are still needed, especially in economies with less investment in HRD, and these should then be articulated. Likewise, the government role in cooperation in HRD among APEC economies is also unclear. Defining the government's role in cooperation can obviously help private sectors take an active part in HRD.

4.4.5 Presence of Mutual Distrust between Labour and Management

Many labour organisations are still in the process of determining their strategies, responses, and roles vis-à-vis the changing needs of HRD amidst a new economic order. Their concerns stem from direct ways by which work tenure and work processes are changing in offices and shop floors, in turn affecting the way human resources are developed, utilised and disengaged. In some measure, these challenge the principle on which the traditional labour-management relationship is premised - that of a long-term contract. Also many unions think that the cooperation in HRD among APEC economies may cause a deterioriation in their working conditions. Nevertheless, HRD requires active cooperative action by trade unions, as mutual distrust between labour and management in HRD makes cooperation among APEC economies difficult.

4.5 Direction of APEC's Actions in HRD

4.5.1 Enhance HRD Assistance in Developing Economies through Internship

The new era has been characterised by the increasing participation by civic groups, NGOs, and universities in assisting developing economies. In the past several years, a number of universities have very successfully engaged in assisting sister institutions in developing economies in the area of computer and Internet skills. With this in mind, we should encourage universities to adopt other educational institutions in the recipient economies for the purpose of transferring Internet and computer skills.

As a kind of internship programme, universities from member economies will provide student volunteers who will be placed in the countries of their interest where they will serve as "IT experts". The volunteers will teach the people in the recipient economies how to utilise the Internet to access global knowledge stock. At the same time, each of the volunteers will have attained a certain level of competency in computer and Internet skills, English, and so on. It is advisable for the organiser of the programme to give flexibility and freedom to the volunteers and the participating institutions in the selection of service areas, countries, and duration of their services. It will be necessary to create a mechanism for efficiently coordinating these efforts.

A related component of this project includes the provision of computer equipment. In principle, the cost of implementing the Internet volunteer programme will be borne by the countries from which the volunteers originate. The range of the programme involves a multi-year commitment by the participating institutions to ensure the continuous enhancement of the competence of recipient economies in the use of computers and the Internet.

4.5.2 Increase Assistance in Training by 'Fortune 100 in APEC'

Historically, there are mainly three types of international cooperation in HRD: intake of trainees, dispatch of specialists to host countries, and donation of training equipment to host countries. It has mostly been led by public institutes such as ODA and executed in the form that advanced economies donated to developing economies.

To build the knowledge-based economy, a new paradigm for the 21st century, private-based cooperation in HRD among APEC economies rather than public-based cooperation is needed. Japan's overseas cooperation in HRD involves various types of international cooperation by NGOs in APEC. Large enterprises in APEC such as 'Fortune 100 in APEC' can play a leading role. First of all, head companies in benefactor economies which own companies in host economies can invest and donate directly to host economies by building training centres and dispatching short-term specialists for teaching skills. Secondly, head companies in benefactor economies which own companies in host economies can train local staff at the head offices in benefactor economies. Lastly, social contribution by private enterprises can take the form of providing scholarships for trainees, building training centres, dispatching specialists for social contribution, and taking in trainees from benefactor economies.

4.5.3 Establish Labour Market Infrastructure and Foster Linkage between Learning and Work

LMI System

One aim of the LMI system is improving labour market information and analysis to support flexible and efficient labour markets which contribute to economic growth, trade, and investment in the region. Before building the LMI system, it is important that APEC economies undertake a key project on collaborative labour market policy studies for the APEC region, which includes a feasibility study on establishing a regional Labour Market Information (LMI) database. The first HRD Ministerial meeting, recognising the importance of LMI, called for the acceleration and strengthening of labour market projects

being implemented by the HRD Working Group, with a particular emphasis on the development of an LMI framework for member economies. In response to this call, the LMI Group was formed, with representation from all member economies.

The work will encourage and facilitate cooperation among APEC members through the exchange of information, statistical analysis and capacity building, and the sharing of expertise. This will assist in more effective policy making and encourage trade and investment in the APEC region. It will also assist the mobility of business people through the collection of comparable information on regulations affecting mobility.

Fostering the Linkages between Learning and Work

Lifelong learning and school-to-work transition are essential to creating an adaptable workforce as well as providing individuals with relevant skills. These strategies can enable all the member economies to improve the quality of life for individuals, enhance continuing employability, improve economic growth and development, improve labour market efficiency, and build a quality workforce for the 21st century. A solid academic foundation incorporating high levels of literacy, numeracy, other basic skills and proper values, and attitudes towards life and work is the basis of all future learning.

Through networks, APEC economies can strengthen their efforts to improve access to quality education and training opportunities by the use of new technologies, and ensure access to labour market information to help people make informed choices about careers, employment, education, and training. Secondly, the collaboration of all relevant parties, such as students, employers, workers, teachers, parents/guardians, and all levels of governments should be an underlying principle of these strategies. Thirdly, the cooperation of stakeholders promotes agreement on the skills and competencies to be acquired whether in school or the workplace, and on what each partner is responsible for providing. This results in effective connections between learning, training, and work experience to ensure the quality and relevance of the skills and knowledge acquired. Fourthly, a well-integrated approach to learning, training and work experience will enhance labour market efficiency by providing a pool of qualified workers with strong basic skills. Lastly, the exploration of a variety of pathways for acquiring skills and knowledge, such as youth internships and mentoring in the transition from school to work, and lifelong learning, is necessary.

4.5.4 Improve Skill Development through Cooperation and Participation

One way of implementing the issues we have discussed above is to create a network of skill development institutions among APEC member economies. Also, the skill development institution participating in the network could form its own network within its economy. The network aims to encourage and facilitate cooperation among economies by sharing information and experiences in skill development. It also aims to define and set the standards for all skill development institutions and their programmes, as well as help member economies to decide on and implement skill development policies effectively and efficiently. Finally, the network could try to modernise and improve training activities to keep abreast of technical and socio-economic changes in member economies. Specifically, the network could focus its activities on the following areas: developing curriculum and materials for skill development, exchanging qualified persons and materials among institutions involved in skill development and related activities, upgrading skill

development facilities, training instructors and administrators, and obtaining and disseminating up-to-date information on skill development.

4.5.5 Expand E-education Programmes

Due to the rapid development of information and communication technology, there have been many changes in the education sector. Cyber learning is a new mode of education that will help to enhance the learning process with formidable speed and convenience. Much of this can be seen in the increasing use of the Internet in the classrooms of advanced economies. Naturally, developing countries will also aspire to participate in such advances. E-education is one of the most urgent areas demanding attention. The ultimate goal of the project is to alleviate social and economic disparities by developing human resources among member economies through educational cooperation. By educating and empowering their people with e-education, the member economies will be able to disseminate a higher level of skills to all sectors of society. The result will yield synergies between people and knowledge that will spur economic development and the strengthening of national competitiveness. For launching e-education among APEC economies, human resources should be mobilised, and financial and technical support from member economies should be guaranteed.

4.5.6 Other Recommendations

Maintaining a medium- to long-term perspective is critical for the investments necessary for the development of skills. Strengthening these investments will be vital for the future productivity and flexibility of the workplace. In fact, adjusting workplace practices is one of the key means of getting the most benefit out of new technologies for both workers and management. Achieving these goals will require a commitment from all participants to upgrade skills and provide training in a variety of contexts, including special retraining efforts focused on women, minority ethnic groups, and youth. Efforts to improve the mobility of skills between workplaces will help to build a more adaptable economy that can respond to changing economic conditions. The viability of training institutions also needs to be strengthened. Given APEC's past focus on this aspect, it may want to build on its past work.

In a global world with rapid technological change, organisations have to be adaptive and flexible in order to be able to meet changing economic conditions. Governments also need to be able to adapt programmes to meet changing economic circumstances and support changing workplaces. Efforts could be concentrated in the medium to long term on ways to enhance flexibility in organisations with government assistance where appropriate. Organisations also need to be flexible in the ways they can meet the needs of their workers by recognising their different situations (for example, work and family), and providing them with different options. Such flexibility can ensure that employees remain productive and have high morale. Ways to facilitate these twin objectives of flexibility, including sensitivity to cross-cultural management issues, would be one direction for governments to pursue in the medium to long term.

In many of the APEC economies, strengthening the employer-employee contract will improve the ability to implement new workplace practices more effectively. Participatory approaches require a commitment from both the employer and employee, or their representative groups where they exist. There appears to be a role for governments to

encourage and even sponsor activities that can be undertaken in a joint fashion, as part of an essential building block towards the workplace of the 21st century. Building trust and commitment takes time, and consequently such efforts by the government can be viewed as an investment with a medium- to long-term payoff. The importance of participatory approaches has been articulated. The direction to be pursued now must be to build the capacity to ensure such approaches bear fruit.

5. COOPERATIVE POTENTIAL IN INFORMATION AND COMMUNICATION TECHNOLOGY FOR PROMOTING KBEs IN APEC

5.1 KBE and Information and Communication Technology (ICT)

Research developers use ICT-based communications such as the Internet and email, and this increases the efficiency of collaboration between them.[1] The rise in computing power allows speedy data analysis, and easy management of diverse, complex processes to economise research development time and costs. The growth in ICT transcends national borders to form networks between more universities and research centres. In research development, ICT also supports economy of scale and economy of scope. More research developers can now conduct research and share views on a joint subject, and a multidisciplinary effort to expand the scope of research matter has been made possible. ICT advance allows easy access to vast quantities of digitalised data and reduces the costs involved in storing, processing, and retrieving information. An expanded research development network and the externality effect attributed to the interactivity make continuous creation of knowledge possible.

The recent, rapid growth in digital technology is digitalising all information and knowledge including text, voice and graphics, and moving pictures. The rise in the computing power of personal computers, the development of XML (Extensible Markup Language) and Search S/W, and the growth of network technology such as xDSL, cable modem, LMDS, satellites, and FTH (Fiber to Home) enable faster processing, storing and exchanging of information without limitations in time and cost. In particular, the spread of the Internet produces an explosion of connectivity between economic subjects.[xi] This spread essentially enables exchanges of information and expands the scope of economic activity from local to state and to the world.

Another change brought about by a growth in ICT is the quantity of accessible information. In the past, the storing of information had physical limitations, but this recent growth has eliminated these constraints. Existing libraries have been developed into digital libraries to retain an infinite amount of information. ICT also reduced the burden of using knowledge as the marginal cost of additional knowledge acquirements essentially fell to zero. The construction of a faster network such as the Internet□, and the development of efficient search technology and diverse Internet connection equipment accelerate the use of ICT.

5.2 Potential Areas of Cooperation

Discussions in the ICT area are mainly conducted in the Telecommunication Working Group (Telecommunication: TEL WG). TEL WG selected its objective from the 1994

Bogor Declaration and formed four steering groups to achieve that end. The four groups - Liberalisation Steering Group (LSG), Human Resource Development Steering Group (HRDSG), Development Cooperation Steering Group (DCGS), and Business Facilitation Steering Group (BSFG) - conduct discussions on relevant fields in Telecommunications.[xii] Korea's APII Cooperation Centre (APIICC) supports the work of the TELWG, maintaining the web site for the TEL WG, and organising programmes for electronic commerce, education, and training. However, in spite of the active efforts in the creation of knowledge, the programmes are provided by only a few participating economies, while the spread and use of developed knowledge is relatively low.

Another cooperative effort currently exerted by APEC TEL WG is the APII Testbed Project. The APII Testbed Project Working Team was established at the 14th APEC TEL WG meeting in 1996, and as of September 1999, is composed of representatives from Japan, Korea, and Singapore. This project has the following aims: (i) testing interconnectivity and interoperability of a number of domestic broadband Testbeds currently developed or planned in the near future in the region; (ii) modernising telecommunications networks, expanding the markets and contributing to building the regional information infrastructure that will be the basis for the sustainable growth of the region; (iii) conducting joint R&D efforts in the application services to be available on the AP II such as teleconferencing and telemedicine. A Japan-Korea and Japan-Singapore submarine cable supports the APII Testbed Project. Satellite links between Japan, Hong Kong, Thailand, and Indonesia conduct experiments such as next generation Internet technology. The APII Testbed Project Working Team is conducting cooperative experiments and is urging more participation from APEC members.[xiii]

5.3 Impediments to Cooperation

5.3.1 Differences in Cross-border Economic Development and Technological Capability

As shown in Table III-1, GDP, GDP per capita, and human resources in R&D greatly vary between APEC members. Based on the preceding discussions, it is viewed that while economies with strong economic development and technological capability participate actively in cooperative projects, those in weak positions participate only passively.

5.3.2 Differences in ICT Infrastructure

As Table III-2 shows, there are significant differences among APEC economies in investment scale in telecommunication, penetration rate of telephones, mobile phones and personal computers as well as Internet usage. Such differences are, first of all, proportional to economic power and technological capability. It is because development and effective utilisation of ICT generally requires labour and capital with accumulation of advanced technology.

In particular, large-scale capital must be invested in the construction of information and communication networks, and thus economic power and technology is one of the most important preconditions. Also, utilisation of ICT such as the Internet is proportional to economic power, illustrating the digital divide among economies, which was pointed out in Davos Forum early this year.[xiv]

The second explanation for differences in ICT infrastructure is different legal systems. Restrictions on the telecommunications service industry determine entrepreneurs' equity and the number of entrepreneurs, as well as competition. The lower the competition, the smaller the incentive toward investment in new services or advanced networks, and the higher the service charge, which translates into a low penetration rate and extent of utilisation of ICT.

Table III-1
Competitiveness and Technological Development in APEC Economies

	Population (million persons, 1998)	GDP (billion US$, 1997)	GDP per capita (US$, 1997)	Scientists and engineers in R&D per million people (1981-1995)	Net secondary enrolment ratio (% of relevant age group, 1995)
Northeast Asia					
Korea	46.4	442.5	9,622	2,636	96
Japan	126.5	4,192.7	33,231	5,677	96
China	1,225.7	917.7	734	537	-
Hong Kong, China	6.7	173.6	26,700	-	71
Chinese Taipei	21.9	255.2*	11,652*	27,430*	96*
ASEAN					
Singapore	3.2	95.1	30,645	2,512	-
Thailand	60.3	149.1	2,478	173	-
Malaysia	22.2	97.9	4,517	87	91
Indonesia	206.3	215.0	1,068	151	42
Philippines	72.9	82.2	1,136	90	60
Brunei	0.3	5.0	17,556	-	-
Viet Nam	77.6	23.4	312	334	-
Oceania					
Australia	18.7	393.7	21,245	2,477	89
New Zealand	3.9	65.0	17,146	1,778	93
Papua New Guinea	4.3	4.9	1,205	-	-
NAFTA					
US	270.4	8,083.4	30,173	3,732	89
Canada	30.3	618.3	20,608	2,322	93
Mexico	95.8	402.4	4,216	95	-
South America					
Chile	14.8	75.8	5,182	364	53
Peru	22.8	65.2	2,676	273	53
Russia	147.7	445.8	3,030	-	-
World	5,924.6	29,327.7	5,148	-	-

Source: World Bank (1999), ITU (1999).

* *Chinese Taipei Statistical Data Book,* 2000

Table III-2
ICT Infrastructure in APEC Economies

	Telecom-munications investment per inhabitants (US$, 1998)	Main telephone lines per 100 inhabitants (1998)	Cellular mobile subscribers per 100 inhabitants (1998)	Internet users per 10,000 inhabitants (1998)	Estimated PCs per 100 inhabitants (1998)
Northeast Asia					
Korea	176.0	43.27	30.19	668.32	15.68
Japan	280.6	50.26	37.38	1,323.42	23.72
China	14.4	6.96	1.90	16.72	0.89
Hong Kong, China	269.4	55.77	47.47	1,495.39	25.42
Chinese Taipei	109.0	52.44	21.56	1,373.07	15.86
ASEAN					
Singapore	247.2	56.20	34.60	1,738.58	45.84
Thailand	9.3	8.35	3.25	33.17	2.16
Malaysia	101.0	19.76	9.92	360.66	5.86
Indonesia	7.5	2.70	0.52	14.54	0.82
Philippines	12.7	3.70	2.19	20.56	1.51
Brunei	-	24.68	15.60	317.46	-
Viet Nam	-	2.58	0.24	1.29	0.64
Oceania					
Australia	152.0	51.21	28.82	1,603.51	41.16
New Zealand	77.4	47.9	20.26	1,583.86	28.21
Papua New Guinea	-	1.14	0.07	0.12	-
NAFTA					
US	89.6	66.13	25.60	2,219.16	45.86
Canada	133.1	63.39	17.56	2,475.21	33.00
Mexico	16.7	10.36	3.50	140.87	4.70
South America					
Chile	63.4	20.55	6.50	202.37	4.82
Peru	29.8	6.67	3.00	80.65	1.81
Russia	-	19.66	0.51	67.71	4.06
World	31.9	14.26	5.38	250.32	6.43

Source: World Bank(1999), ITU(1999).

5.4 Directions for APEC's Action

ICT infrastructure and a knowledge-based economy is in a virtuous cycle relationship equivalent to that of content and networks. It was previously analysed that ICT infrastructure increases worldwide interactivity and thus promotes the creation of knowledge. People construct advanced ICT infrastructures in order to access and utilise new and useful knowledge at reasonable cost. Advanced ICT infrastructures, in turn, become a driving force for vigorous interactivity and the creation of knowledge. In this line of reasoning, the role of government is to find the bottleneck in the virtuous cycle and implement a policy to fix it.

The role of international organisations in maximising spillover effects, a characteristic of a knowledge-based economy, should also be discussed. According to the new growth theory, the externality effect produced in the process of creation, propagation, and utilisation of knowledge is proportional to the extent of participation. As more economic bodies from a growing number of economies participate, the externality effect increases. The connection of ICT infrastructure among economies is the basic precondition for all of this to take the place.

The directions of APEC's action in supporting the ICT infrastructure construction among APEC economies, like the direction of the policy for an individual economy, can be broadly divided into two categories: direct support and indirect support. Direct support is to directly provide resources needed for the ICT infrastructure construction, for example, the provision of human or financial resources used in telecommunications network construction. But because the investment scale needed in the construction of telecommunications network is so large, the utilisation or effect of direct support is limited. On the other hand, indirect support is to offer an investment incentive toward the ICT infrastructure by improving the legal system, business environment, and the like. It is a universal principle that the construction of a knowledge-based economy should be led by the private sector. In fact, most of the large-scale investment needed in the telecommunications network is made by private entrepreneurs' decisions in profit maximisation. For example, many countries are easing various restrictions on the telecommunications service industry and in turn, inducing investment in an advanced telecommunications network. One example of indirect support that international organisations may propose is to ease restrictions on trade in goods and services and capital flow among economies, and thus induce efficient distribution of resources.

We can find indirect support used in other international institutions to build the ICT infrastructure. "Electronic Commerce for Developing Countries (EC-DC)", which is a special programme of the International Telecommunication Union (ITU), is a good example. The goal of this programme is to assist developing countries in building the soft and hard infrastructure and services for electronic commerce, and to share the benefits worldwide. Instead of developing the ICT infrastructure for electronic commerce directly, EC-DC uses the policies that will induce the private sectors to invest in the ICT infrastructure. It adopts strategies to enhance benefits from the private sectors' use of ICT. It expects the private sectors to increase the investment in the ICT infrastructure as profits and the level of awareness rise.

5.5 Recommended Action Plans

5.5.1 Production of APEC ICT-related Statistics

Each year, progress in the ICT infrastructure in APEC economies should be recorded and published. Statistics such as penetration rate, tariff, traffic and market size of telecommunication service and qualitative data such as competition and legal systems should be prepared each year. This annual report can be used as a basis for regular examination of balanced development in the ICT infrastructure among APEC economies, and for the determination of investment.

5.5.2 The Provision of a Database for Country-specific Knowledge

The provision of a database should be expedited for sharing the knowledge used as a local base in each economy as international public goods. Expenses incurred can be supported by APEC funds. The APII Cooperation Centre or Knowledge Clearing House, explained in the latter part, may take charge of operation and maintenance of the developed database.

5.5.3 Medical and Educational Institutions' Support of Networking

APEC TEL's Development Cooperation Steering Group includes the following commitments in deciding on priority and projects: (i) to achieve full 100% interconnection of universities in member economies with the APII, beginning with the Internet as the preliminary realisation of the Distance Learning Network for APEC; (ii) to encourage the connection to the APII (beginning with the Internet) of public institutions such as hospitals, museums, galleries and libraries, and specifically to maximise the number of hospitals connected. As more schools and hospitals are connected to the network, more economies will be induced to participate in the projects related to telemedicine and distance education. Also, as the network of schools and hospitals is expanded, better utilisation of research results is expected, and the effects of investment in projects should be increased.

However, concrete actions to implement such commitments are not currently in progress. For successful implementation of commitments, as the IED (Internet for Economic Development) initiative[1] of the US government shows, efforts from not only each of the APEC economies' governments but all other leading bodies that coordinate participation of multilateral organisations, NGOs, and the private sector are needed.

5.5.4 Systematic Framework Supporting Transaction and Exchange of Knowledge

A systematic framework would be necessary to support the APEC economies' propitious transition to a knowledge-based economy, and also to support effective and efficient propagation and utilisation of results of projects undertaken by APEC TEL. In case of a particular economy's request, effective utilisation of project results, tailored to each country's circumstances, should be made possible. It is also necessary to identify the proposal for collectively needed projects and investments in projects that are expected to yield a larger propagation effect.

6. RECOMMENDATIONS FOR COOPERATIVE DEVELOPMENT OF KBEs IN APEC

The preceding discussion mainly dealt with the potential for cooperation among APEC economies in the four major areas of KBE development, that is, business environment, innovation system, human resource development, and information communication technology. A brief summary of the results of the preceding chapters is presented in Table III-3.

Drawing on the above examination of potential areas of cooperation within APEC, the Economic Committee makes three specific recommendations for action. As regards the implementation of these recommendations, the lead economies of the Task Force will continue to take a leading role and propose detailed projects to be undertaken by relevant APEC fora.

- Establishment of 'Knowledge Clearing House'
- Generation of 'Igniting Policies' for triggering the transition to KBEs
- Inclusion of 'KBE Status Indicators' in APEC's 'Economic Outlook'

6.1 Establishment of Knowledge Clearing House

6.1.1 Purpose

Based on a set of suggestions presented in the previous chapters, it is viewed that a Knowledge Clearing House (KCH) is definitely needed for cooperative development of KBEs in APEC. For instance, cooperation among APEC members requires us to possess a minimal level of knowledge or perhaps a database that can guide us towards specifically understanding the knowledge gap and the areas in which cooperative merits are strong. In short, a roadmap for APEC-wide cooperation must be built first before any cooperative efforts are undertaken. Discussions in the previous chapters collectively indicate that constructing such a knowledge base is imperative for APEC-wide cooperation for KBE development.

The proposed Knowledge Clearing House (KCH) aims to play the role of a network hub. Through the hub, various types of knowledge can flow among APEC economies. In this way, unnecessary efforts by each economy to tap all other economies in search for particular knowledge can be reduced significantly. The forms of knowledge that KCH channels can provide include statistical data, expert database, know-how, manuals, and guidelines. By creating an APEC-wide knowledge network first on the Internet, KCH will play the role of a focal point or information centre in the knowledge flows within APEC.

For the APEC KCH to work effectively, it is viewed that the KCH should possess the following characteristics.

KCH as a Loosely Connected Network

With respect to the operational philosophy of KCH, it is strongly recommended that a minimal level of administrative work is involved. Specifically, as opposed to creating a full-blown institutional entity in APEC, KCH should aim to be a loosely connected network, consisting of: (1) KBE specialists from each economy, (2) KBE-related databases

of each economy, and (3) other types of resources that can be shared among member economies.

In a sense, the gist of KCH is very analogous to ISDN lines. As public demands for fast and reliable connections to telephones and Internet hosts are increasing, the ISDN lines, that is, an infrastructure that permits such connections, are much needed. Similarly, as APEC economies move increasingly towards KBEs, the need for interconnections and communications among the member economies will obviously increase. Anticipating such increased flows of knowledge, KCH is to lay a common channel through which the member economies can communicate and get connected to each other in an efficient manner, that is, without necessarily developing multiple channels of their own on an economy-to-economy basis.

KCH as an Infrastructure to Promote Market-based Knowledge Flows

KCH should not operate as a way of controlling or governing the knowledge flows among member economies. Rather, it should operate by supporting the market-based transactions or transfers of knowledge. Once a minimal infrastructure of the communication network is laid out, KCH should permit market principles to dictate in most areas, for instance, in deciding how knowledge transfers and flows will take place along its network, and what types of databases are to be constructed.

KCH as Playing the Role of Chief Knowledge Officers (CKOs)

Another important aspect of KCH is that KCH is not just about transferring knowledge *per se*, but often will play the role of locating the best experts on a particular issue. Similar to the role of Chief Knowledge Officers (CKOs) in private corporations who accumulate the database for 'who knows what' in their corporations, KCH proposes to eventually accumulate a stock of databases that list experts on KBE issues. This way, even if the needed knowledge is not directly available from KCH, or is difficult to transfer due to its implicitness, KCH can still direct the request to experts on the relevant issue.

6.1.2 Potential Benefits

KCH is expected to reduce the knowledge gap between the developed and the developing economies in APEC. While the benefits to knowledge-receiving economies are rather obvious, knowledge-giving economies will also benefit from KCH by increasing the dissemination and utilisation scope of their existing knowledge. Also, they can avoid incurring their own cost of search and trial-and-error by learning how the knowledge-receiving economies tailor their knowledge to local conditions in order to utilise the knowledge.

6.1.3 Objectives

It is viewed that APEC may consider the following work before the effective launch and continuous operation of KCH:

- Endorsement of KBE specialist(s) by each economy so that the person(s) can act as the contact for the KCH network
- Establishment of a ‘KCH website’ as the operational platform of KCH processes

- Construction of KBE-related databases
- Offering of KBE-related documents and databases upon request by member economies
- Provision of KBE-related consulting services to member economies upon request
- Provision of other services, such as offering KBE-related materials for use in college courses

6.2 Generation of 'Igniting Policies' for Triggering the Transition to KBE

6.2.1 Purpose

In the preceding PART I and II, this report has provided ample information regarding the preconditions of and policies for KBE development. However, for an economy to actually trigger its transition to a KBE, what should the economy do on the first day? To be responsive to such realistic challenges that many economies will face, APEC needs to provide a more concrete set of action plans. Building on the diverse experiences of member economies, APEC may take the initiative to generate a "menu set" consisting of such igniting policies. On a voluntary basis, interested economies will be invited to evaluate them and choose which to adopt.

6.2.2 Potential Benefits

Clearly, some igniting policies which proved to be effective in other economies will provide a good reference point for policy choice, thus reducing search and investigation costs. A good example is Korea's five-year economic development planning that was successfully adopted by several Southeast Asian and Middle East economies. APEC should also make the igniting policies sensitive to the local idiosyncratic differences of the member economies so that potential benefits are fully realised.

6.2.3 Objectives

The following non-exhaustive goals could be points of consideration:
- Collection of past experiences in economic triggering strategies for KBE
- Recommendation of the igniting policies to APEC member economies for their adoption on a voluntary basis
- Tailoring the igniting policies to better meet the specific needs of a particular economy will be also considered

6.3 Inclusion of 'KBE Status Indicators' in APEC Economic Committee's 'Economic Outlook'

6.3.1 Purpose

Using KBE Status Indicators, APEC provides information on how APEC is progressing towards a KBE, both collectively and individually.

6.3.2 Potential Benefits

KBE Status Indicators have various potential benefits. First of all, KBE Status Indicators will provide valuable information as to how effective APEC's cooperative efforts are in making progress towards a KBE in a given year. For individual economies, by comparison

with the previous year(s), a progress check can be done as well. Also, by observing how some economies are progressing faster than others, APEC as a whole can start learning the success formula for later adoption by other economies.

6.3.3 Objectives

The following non-exhaustive goals could be considered:
- Identification of a set of key KBE Status Indicators by a KBE expert panel
- Endorsement of KBE specialists by member economies for KBE-related data compilation and sharing
- Submission of the Report of the KBE Progress Profile for each voluntary economy by an *ad hoc* KBE specialist team, to be included in the Economic Outlook

6.4 Conclusion

With the APEC-wide cooperation for KBE developments in mind, this report made three specific recommendations for actions. They are: (1) establishment of the 'Knowledge Clearing House', (2) generation of 'Igniting Policies' for triggering the transition to KBEs, and (3) inclusion of 'KBE Status Indicators' in the APEC 'Economic Outlook'.

Continuing discussions and wisdom-gathering for the above three recommendations will, of course, help the collective and harmonious progress of APEC economies towards KBEs. It is also noted that even the initial efforts of scholars and government officials from every member economy to discuss how to implement those recommendations will clearly have merits of their own. Such discussions will have an impact of having the policy makers and advisors truly appreciate the critical nature of the KBE as a new economic model as well as a framework for devising economic growth policies in each of their economies. With the continuous interaction among the experts across borders, awareness of the KBE will increase, and constructive mindsets for KBEs can grow.

Table III-3. Summary of Cooperative Potentials for KBE

	Potential Areas of Cooperation	Related APEC Activities	Impediments to Cooperation	Directing APEC's Actions
Business Environment: Trade, investment, and legal systems	▪ Reduction of tariff and non-tariff barriers ▪ Mutual recognition of standards ▪ Strengthened competition policies ▪ Protection of intellectual property rights ▪ Voluntary investment liberalisation and improvement of investment procedure ▪ Guarantee of transparency for investments ▪ Introduction of APEC-wide laws and regulations for KBE	▪ Plan of Free Trade in APEC Economies by 2010 and 2020 ▪ Updating APEC Tariff Database (TDB) ▪ Market Access Group (MAG) created in 1998 ▪ CTI subcommittee on standards and conformance (SCSC) established in 1994, ongoing APEC discussion ▪ Competition and policy/deregula-tion areas ▪ IPR Experts' Group formed in 1996	▪ Recent scale down of TILF agenda in APEC ▪ Non-binding nature of APEC initiatives ▪ Complex investment laws and regulations in economies ▪ Various non-transparent investment barriers ▪ Difficulty in harmonising legal systems due to economy-specificity in the industrial structure, education and level of development	▪ Pursue multilateral agreements for FDI facilitation in the region ▪ Improve the level of automation of investment-related documentation ▪ Create an investment promotion body ▪ Generate and distribute best practices in legal systems ▪ Establish a working group for harmonising laws and regulations in APEC

	Potential Areas of Cooperation	Related APEC Activities	Impediments to Cooperation	Directing APEC's Actions
Business Environment: Electronic commerce	▪ Reduction of bureaucratic regulations on e-commerce ▪ Cooperative establishment of e-commerce related infrastructure ▪ Cooperation on taxation in e-commerce	▪ Electronic Commerce Task Force established and on-going efforts are made to facilitate e-commerce in APEC ▪ TEL WG working on various projects	▪ Significant differences in e-commerce infrastructure among APEC economies ▪ Lack of legal/institutional development to project and facilitate e-commerce ▪ Protection measures taken by some major industrialised economies as well as developing economies	▪ Improve the level of related infrastructure in each economy ▪ Establish and coordinate legal systems pertaining to e-commerce ▪ Establish e-payment systems

	Potential Areas of Cooperation	Related APEC Activities	Impediments to Cooperation	Directing APEC's Actions
Business Environment: Coordination among governments	▪ Coordination on foreign exchange policies related to KBE ▪ Coordinate macroeconomic policies such as interest rates among APEC member economies	▪ Continuous efforts in many related working groups	▪ Differences in KBE stages and strategies ▪ Lack of policies related to KBE in several developing APEC economies ▪ Significant gap in e-commerce infrastructure among APEC economies ▪ Lack of legal/institutional development to project and facilitate e-commerce ▪ Protection measures taken by some major industrialised economies	▪ Improve computerisation level within APEC economies and build a computer network among governments ▪ Improve efficiency in content management through standardisation of ICT area ▪ Establish broadband network in APEC by connecting to World Wide Web ▪ Coordinate policies for promoting SMEs in APEC economies ▪ Establish assistance programmes for developing economies

	Potential Areas of Cooperation	Related APEC Activities	Impediments to Cooperation	Directing APEC's Actions
Innovation System	▪ Research collaboration ▪ Networking by firms ▪ Institutional ties ▪ Increase in personal mobility ▪ Competition policy to facilitate cooperative research	▪ Industrial Science and Technology (IST) Work Group established in 1990 ▪ Publication of IST handbook ▪ Several IST projects have been completed, others are ongoing. ▪ IST WG created APEC Science and Technology Web (AST Web) ▪ Support from ECOTECH subcommittee (ESC)	▪ Differences in innovative capacity among member economies ▪ Institutional and organisational rigidities ▪ Governments' concern about the globalisation of R&D	▪ Cooperate in basic research ▪ Cooperate in identifying and disseminating existing non-technology-based knowledge ▪ Share best practices in strengthening innovation systems

	Potential Areas of Cooperation	Related APEC Activities	Impediments to Cooperation	Directing APEC's Actions
Hunan Resource Development	▪ Sharing of information on best practices ▪ Research on best practices of HRD, including training methods and participation of the private sector ▪ Natural recognition of qualifications	▪ ECOTECH (Economic and technical cooperation) activities ▪ Pursuing human resource development common policy concepts and undertaking the human resource development programme 21	▪ Lack of sustainability of joint cooperation among APEC members ▪ Differences in labour market structures and systems ▪ Market imperfection ▪ Lack of specific supporting roles for government ▪ Mutual distrust between labour and management	▪ HRD assistance in developing economies through internship ▪ Assistance in training by 'Fortune 100 in APEC' ▪ Structuring infrastructure ▪ Fostering linkages between learning and work ▪ Improving skill development through cooperation and participation ▪ E-education
Information and Communications Technology	▪ Production of APEC ICT-related statistics ▪ Provision of database for economy-specific knowledge ▪ Medical and Educational Institutions' support of networking	▪ Operation of APII centre and organisation of e-commerce, education and training programmes by the four steering groups of the Telecommunications Working Group (TEL WG) ▪ APII Tested Project	▪ Differences in economic development and technological capability ▪ Differences in ICT infrastructure	▪ Direct support-provision of human resources used in telecommunica-tions network construction ▪ Indirect support-improvement of legal systems and business environment, and offering of investment incentives

End Notes

[i] FDI can be an indicator of a KBE since it brings with it new technology and knowledge. Therefore, attention needs to be devoted to encouraging investments and strengthening institutional factors, such as the efficiency of capital markets and the state of the economy's physical infrastructure that may affect the investment process. In a KBE, inadequacies in infrastructure or the structure of capital markets constrain or distort investment and could, in turn, significantly impair technological change.

[ii] Infrastructure investment will create new opportunities for producers of telecommunications equipment and providers of related services within the APEC region.

[iii] Establishment of e-payment systems is to be examined thoroughly in the Finance Minister's Process.

[iv] Advocates of protectionist measures often ignore the evaluation the gains from trade and foreign direct investment. Protectionist policies are based on a short-term analysis of an economy's national interest, and fail to take account of the consequences of reciprocal actions by other economies. APEC member economies should understand their common interest in cooperative arrangements that can facilitate realisation of the information society.

[v] Stimulation of inward investments through the exchange of information and the establishment of an investment promotion body among member economies, as well as the establishment of investment cooperation guidelines, is another channel through which investments can be facilitated. APEC is in a good position to move on these issues as the work is already under way at IEG.

[vi] The case of the United States implies that measures to ease access to venture capital and to enhance the commercialisation of public-funded research are major elements in policy initiatives to strengthen innovation systems.

[vii] IST projects which have been completed are as follows: Technomart I and II, Meetings of the APEC Science and Technology Industrial Parks Network, The 1st Asia-Pacific Youth Science Festival, APEC Study on Promoting Researcher Exchange, Establishment of the APEC Virtual Centre for Environmental Technology Exchange, Establishment of the APEC Centre for Technology Foresight, Establishment of the APEC Coordinating Centre for Good Clinical Practice, Study on Available Industrial Science and Technology Indicators, Survey of relevant laws and regulations of APEC members governing trade and investment-related technology, APEC Symposium concerning Public Understanding of Science and Technology (S&T), Training for Practical Use of Laser Technology of Laser, Asia-Pacific Workshop on Seismic Design and Retrofit of Structure, and APEC Joint Research on Biodiversity and its Bioconversion.

[viii] Given that transformation towards the knowledge-based economy is often entailed by such side effects as an increase in unemployment and bipolarisation within the labour market, more aggressive strategic plans for human resources development are needed to narrow the knowledge gap.

[ix] The experiences of OECD economies imply that the wage gap between the rich and the poor has widened during the past two decades.

[x] It would be interesting to look into recent Korean experience on educational reform such as 'BK 21', which literally means Brain Korea 21.

[xi] The figure of the world population online rose from 140 million in 1998 to more than 200 million in 1999, and is expected to rise to 350 million by 2005 (NUA Internet Surveys 1999).

[xii] The work of each steering group and a number of active task groups are accessible through the TEL WG site at http://www.apii.or.kr/telwg.

[xiii] As of September 1999, 12 possible application experiments were identified between Japan and Korea, while 9 possible application experiments were identified between Japan and Singapore.

[xiv] For eight economies whose GDP per capita exceeds the average of APEC economies, the number of Internet users was 1,588 per 10,000 people, while it was 229 for 13 economies whose GDP per capita is less than the APEC average.

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Appendix 1: Statistical Data

This appendix collects tables of indicators of economic, social and KBE development for selected APEC economies. This data is drawn from the chapters describing the country case studies. Although the data has been collected from reputable sources, as indicated in the notes on each table and in the technical notes, it is intended for purposes of broad comparison and should be taken as indicative only. Most of the data refers to 1997 or thereabouts, but Table SA-4 gives data from 1992 for comparison.

For technical detail (including dates) and sources of the KBE indicators, see the technical notes in Appendix 2. For the reasons these particular indicators were chosen, see Chapter 3 of Part 1.

Table SA-1. Economic Indicators

	GNP per capita (US$, PPP) 1997	GDP annual growth % 1990-1998	Inflation % (average annual rate) 1998	Exports of G&S (% of PPP, GDP) 1997	Imports of G&S (% of PPP, GDP) 1997	Service Sector (% of GDP) 1998
(see note:)	**(A)**	**(B)**	**(C)**	**(D)**	**(E)**	**(F)**
Most Developed Economies						
Australia*	20170	3.6	1.9	22.0	21.0	71
Canada*	21860	2.2	1.0	36.0	34.0	na
Japan*	23400	1.3	0.6	15.0	14.0	60
New Zealand	16600	3.2	1.3	28.0	28.0	na
United States	28740	2.9	0.8	12.0	13.0	71
Latin American Economies						
Chile*	12080	7.9	4.7	11.0	12.0	57
Colombia	6720	4.2	16.7	5.8	6.8	49
Mexico	8120	2.5	16.0	15.0	15.0	68
Peru	4390	5.9	7.3	13.0	17.0	55
High Performing Asian Economies						
Hong Kong, China	24540	4.4	4.5	144.0	146.0	85
Korea*	13500	6.2	8.3	26.0	27.0	51
Singapore*	29000	8.0	3.2	177.0	164.0	65
Chinese Taipei	19200	7.5	1.7	34.0	32.0	na
Asian Fast-Growing Economies						
Indonesia	3450	5.8	20.0	9.0	9.0	41
Malaysia	10920	7.7	5.2	53.0	52.0	40
Philippines*	3670	3.3	10.0	15.0	19.0	52
Thailand*	6590	7.4	15.0	17.0	17.0	49
China	3570	11.1	4.0	5.4	4.3	33
Vietnam	1670	8.6	7.7	46.0	54.0	43
Other						
Brunei (**G**)	15200	2.1	-0.4	50.0	40.0	na
PNG	2390	5.7	13.5	52.0	48.0	36
Russia	4190	-7.0	84.4	16.0	14.0	49

*Indicates case study economy

Notes:

(A) World Bank Development Report, 1999/00, Table 1, PP 230-31. Taipei from World Competitiveness Yearbook and Brunei from Statistical Yearbook

(B) World Bank Development Report, 1999/00, Table 11, PP 250-55. Brunei from Statistical Yearbook and Taipei from DFAT (confirm DFAT Details)

(C) WCY, Table 1.24, P362 Peru, PNG and Vietnam from IMF World Outlook, October 1999, Table 12, P 185. Brunei from 1998 Statistical Yearbook.

(D) WCY, Table 1.03, P 351 PPP GDP. GDP figures for Peru, PNG and Vietnam from World Bank, 1998/99 Report, Table 15. Brunei figures calculated from 1998 Statistical Yearbook.

(E) WCY, Table 1.03, P 351 PPP GDP. GDP figures for Peru, PNG and Vietnam from World Bank, 1998/99 Report, Table 15. Brunei figures calculated from 1998 Statistical Yearbook.

(F) World Bank Development Report, 1999/00, Table 12, PP 252-3. Figure for Japan is for 1997, from 1998/99 WB Yearbook.

(G) All figures for Brunei are calculated at an exchange rate of US$0.598 to B$1. All Brunei figures are at current prices, not PP.

Brunei Statistics from Brunei Darussalam Statistical Yearbook, 1998.

Table SA-2. Social Indicators

	Population (1998) in millions	Population Growth Rate, %, 1990-1998	Human development index (1995)	Literacy %	Life expectancy at birth (1996)	Female/Male Ratio in High School Education
(see note:)						
Most Developed Economies						
Australia*	19.0	1.3	0.932	99	78	0.99
Canada*	31.0	1.4	0.960	99	79	0.95
Japan	126.0	0.3	0.940	99	80	0.99
New Zealand	4.0	1.7	0.939	99	77	0.99
United States	270.0	1.1	0.943	99	76	0.95
Latin American Economies						
Chile*	15.0	1.2	0.893	95	75	1.18
Colombia	41.0	2.2	0.850	91	71	0.96
Mexico	96.0	2	0.855	90	72	0.94
Peru	25.0	2	0.729	89	68	0.91
High Performing Asian Economies						
Hong Kong, China	7.0	2.3	0.909	92	79	0.98
Korea*	46.0	1.1	0.894	98	72	0.9
Singapore*	3.0	2.2	0.896	91	77	1.1
Chinese Taipei	22.0	0.85	na	na	80	na
Asian Fast-Growing Economies						
Indonesia	204.0	1.9	0.679	84	65	0.85
Malaysia	22.0	2.8	0.834	84	72	1.38
Philippines*	75.0	2.6	0.677	95	68	1
Thailand*	61.0	1.4	0.838	94	69	0.97
China	1239.0	1.2	0.650	82	70	0.83
Vietnam	78.0	2.3	0.560	94	70	0.9
Other						
Brunei **(G)**	0.3	3	0.889	88	73	1.12
PNG	5.0	2.6	0.570	72	57	0.64
Russia	147.0	-0.1	0.769	99	64	1.06

*Indicates case study economy

Notes:

(A) World Bank Development Report, 1999/00, Table 1, PP 230-31. Taipei from World Competitiveness Yearbook and Brunei from Statistical Yearbook

(B) World Bank Development Report, 1999/00, Table 11, PP 250-55. Brunei from Statistical Yearbook and Taipei from DFAT (confirm DFAT Details)

(C) WCY, Table 1.24, P 362 Peru, PNG and Vietnam from IMF World Outlook, October 1999, Table 12, P 185. Brunei from 1998 Statistical Yearbook.

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(E) WCY, Table 1.03, P351 PPP GDP. GDP figures for Peru, PNG and Vietnam from World Bank, 1998/99 Report, Table 15. Brunei figures calculated from 1998 Statistical Yearbook.

(F) World Bank Development Report, 1999/00, Table 12, PP 252-3. Figure for Japan is for 1997, from 1998/99 WB Yearbook.

(G) All figures for Brunei are calculated at the exchange rate of US$0.598 to B$1. All Brunei figures are at current prices, not PP.

Brunei Statistics from Brunei Darussalam Statistical Yearbook, 1998.

Table SA-3. KBE indicators for selected APEC economies (c.1997)

	US	AUS	CDA	ROK	SIN	CHL	RP	THA
Business Environment								
KBI (% of GDP)	55.3	48	51	40.3	57	na	na	na
Services Exports (% of GDP)	2.83	4.48	4.68	5.75	31.94	4.66	18.4	10.3
High-tech Exports (% mfg exports)	44	39	25	39	71	19	56	43
High-tech Exports (% of GDP)	2.99	3.60	7.31	11.83	91.52	2.88	23.77	14.21
FDI/GDP	1.2	2.3	1.2	0.6	9.0	7.5	1.5	2.0
Govt Transparency (rating)	5.93	6.76	6.6	3.45	8.45	6.4	5.25	5.44
Financial Transparency (rating)	6.95	7.25	7.62	3.39	7.16	8.04	5.82	3.93
Competition Policy (rating)	6.15	6.75	6.91	5.44	6.45	6.42	4.42	4.28
Openness (rating)	7.48	7.22	6.94	3.83	7.61	8.29	6.21	5.84
Information and Communication Technology								
Mobile Phones (per 1,000).	241.2	323.8	175	304.2	280.7	8.2	19	39.6
Phone Lines (per 1,000).	676.6	530.7	615.1	467	464.6	207.8	31.9	82.2
Computers (per 1,000)	499	431	400	150	344	56	16	33
Internet users (% of pop.) (1998)	29	18	29.6	3.9	14.7	1	0.03	0.21
Internet users (% of pop.) (1999)	39	30.5	42.3	8.53	na	na	na	na
Internet hosts (per 10,000)	1131.52	420.57	364.25	40	210.02	20.18	1.21	3.35
E-commerce (M$)	13,000	380	5500	720	800	7	<200	<200
Innovation System								
Scientists & Engineers (per million)	3732	3166	2656	2636	2728	448*	157	119
Researchers (per million)	3676	3357	2719	2193	2318	445	na	103
GERD/GDP	2.546	1.67	1.56	2.79	1.49	0.65	0.22	0.18
BERD/GDP	1.9	0.82	1	2.24	0.92	0.11	0	0.02
US Patents	80295	720	2974	2359	120	16	8	13
Company co-op (rating)	5.5091	5.07	5.77	3.11	5.82	3.82	4	3.05
Company-uni co-op (rating)	5.523	5.09	5.14	3.2	6.06	3.63	3.67	2.84
Human Resource Development								
Secondary enrolment (% of age group)	97	148	104	102	74	75	77	56
Natural Science Graduates per annum	1730	1683	3558	3169	3976	940	1188	382
Knowledge Workers (% of labor force)	32.3	35.5	33.3	17.6	39.1	12.5	7.8	11.5
Newspapers (per 1,000)	212	297	159	394	324	99	82	65
Human Development Index	0.943	0.932	0.96	0.894	0.896	0.893	0.677	0.838

(Table continues…For further technical details, see Table 3.2 in Part 1 and Appendix 2)

Table SA-3. KBE indicators for selected APEC economies (c.1997) *(continued)*

	JPN	CT	PRC	MAS	MEX	OECD average
Business Environment						
KBI (% of GDP)	53	na	na	na	41.3	51
Services Exports (%of GDP)	1.62	6.01	2.72	20.13	2.78	9.39
High-tech Exports (% of mfg exp)	38	na	21	67	33	33.15
High-tech Export (% of GDP)	3.62	na	3.72	47.79	8.04	10.2
FDI/GDP	0.1	0.6	4.9	5.2	3.1	1.9
Govt Transparency (rating)	3.3	5.71	6.43	6.27	4.55	5.47
Financial Transparency (rating)	3.32	5.67	4.99	5.88	5.79	6.56
Competition Policy (rating)	5.7	6.32	4.17	4.52	5.35	6.04
Openness (rating)	5.38	6.51	4.32	5.58	6.72	7.34
Information and Communication Technology						
Mobile Phones (per 1,000).	315.7	194.7	20.1	101.5	34.2	223.3
Phone Lines (per 1,000)	493.9	543	73.6	204.7	98.1	507
Computers (per 1,000)	272	78	7	78	49	273
Internet users (% of pop.) (1998)	14.4	10.01	0.08	3	0.5	12.15
Internet users (% of pop.) (1999)	9.6	18.99	0.26	na	0.6	18.5
Internet hosts (per 10,000)	133.53	na	0.14	21.36	11.64	317.65
E-commerce (M$)	1,500	na	na	na	na	Na
Innovation system						
Scientists & Engineers (per million).	6309	na	350	87	213	2207
Researchers (per million)	4909	na	454	93	214	2460
GERD/GDP	2.829	1.922	0.644	0.199	0.309	2.15
BERD/GDP	2.2	1.16	0.29	0.14	0.04	1.04
US Patents per Annum	30841	3100	72	23	57	2220
Company co-op (rating)	6.0661	5.58	4.47	4.76	3.31	5
Company-uni co-op (rating)	4.017	5.02	4.17	4.16	2.58	4.4
Human Resource Development						
Secondary enrolment (% of age group)	103	na	69	61	64	108.75
Natural Science Graduates (per annum)	2076	na	297	na	524	1564
Knowledge Workers (% of labor force)	16	na	na	14.3	15.5	28
Newspapers (per 1,000)	580	na	42	163	97	245
Human Development Index	0.94	na	0.65	0.834	0.855	0.92

(see Appendix 2 for technical details and sources)

Table SA-4. KBE indicators for selected APEC economies 1992

Indicator:	USA (92)	Aust (92)	Canada	Korea	S'pore	Chile	Phil	Thailand
Business Environment								
KBI (%GDP)								
Services exports	2.74	3.57	3.21	4.33	35.54	6.02	13.06	8.14
HT Export % GDP								
FDI /GDP	0.04	1.69	1.57	0.19	12.26	1.80	0.44	1.93
Govt transparency	4.3	4.9	3.7	3.8	7.5	6.4	na	3.9
Financial Transparency								
Competition Policy	7.8	5.4	5.7	3.5	6.5	5	na	4.8
Openness	6.5	7.4	6.2	5.3	8.3	8	na	5.4
Information and Communications Technology								
Mobile Telephones p.c.	62.1	66.6	18.3	10.8	57.7	6.2	na	8
Phone lines p.c.	565	471	592	357	415	94	10	31
Computers p.c.	265	175	162	33	116	na	na	na
Internet Users pc (98)								
Internet Users pc (99)								
Internet hosts p.c.	218.2	172.5	166.2	6.7	77.4	6.7	0.3	0.7
Innovation System								
Researchers	3676	3009	2320	2032	1426	433	157	114
GERD /GDP	2.62	1.34	1.49	1.83	0.88	0.7	na	0.21
BERD / GDP	1.82	0.58	0.92	0.89	0.23	0.06	na	0.01
US Patents	52254	410	1964	779	32	5	7	1
Company co-op	4.2	4.3	4.3	3.3	5.8	4.3	na	3.7
Company-uni co-op	5.1	4.6	3.7	3.8	5.7	4.4	na	3.6
Human Resource Development								
Secondary enrolments	97	84	104	91	67	69	76	37
Natural science graduates								
% Knowledge workers	30.7	24.7	32.5	10	15.8	11.8	7	5.9
Newspapers PC	240	261	215	407	336	455	49	74
HDI	0.976	0.972	0.982	0.872	0.849	0.864	0.603	0.715

(Table continues…)

Table SA-4. KBE indicators for selected APEC economies 1992

Indicator:	Japan	Taipei	China	Malaysia	Mexico	*92 OECD av*	*97 OECD av*	*out of..*
Business Environment								
KBI (%GDP)							51	
Services exports	1.35	5.65	1.80	9.52	4.06	7.22	9.39	28.00
HT Export % GDP							10.2	
FDI /GDP	0.07	0.47		7.10	1.63	1.09	1.90	27.00
Govt transparency	4	5.5	na	6.4	na	4	5.47	25
Financial Transparency							6.56	
Competition Policy	6.3	5.9	na	5.7	6.5	5.95	6.04	26
Openness	4.9	7.7	na	6.5	7.4	7.4	7.34	26
Information and Communications Technology								
Mobile Telephones p.c.	17.1	26.9	0.5	17.9	4.6	31	223.3	27
Phone lines p.c.	464	371.3	10	112	80	413	507	27
Computers p.c.	84	68	na	na	13	105	273	25
Internet Users pc (98)							12.15	
Internet Users pc (99)							18.5	
Internet hosts p.c.	22	12.4	na	2.2	1.5	93	317.65	29
Innovation System								
Researchers	5671	na	349	88	161	2140	2460	27
GERD /GDP	2.97	1.74	0.7	0.09	0.21	1.65	2.15	28
BERD / GDP	2.06	0.87	na	na	0.1	1.08	1.04	25
US Patents	21925	1000	41	5	39	1556	2220	28
Company co-op	7	4.7	na	4.7	3.8	4.4	5	26
Company-uni co-op	6.6	4	na	4.5	2.4	4.1	4.4	26
Human Resource Development								
Secondary enrolments	96	na	55	58	54	99	108.75	28
Natural science graduates							1564	
% Knowledge workers	15.8	na	na	11	10.9	25	28	17
Newspapers PC	576	na	36	140	116	292	245	29
HDI	0.983		0.566	0.79	0.805	0.9268	0.92	28

For further technical details, see Table 3.2 and Appendix 2. For 1992, figures have only been provided where available.

Appendix 2: TECHNICAL NOTES ON INDICATORS

A2.1 Sources and details of indicators used

The following table gives details of the indicators listed in Table SA-3 of Appendix 1 and which have been put in a graph in the country charts of Part 1. With appropriate adjustments, they also apply to the older data in Table SA-4.

Indicator	Detail	Data year	Primary Reference Source
Business Environment			
KBIs	Value added by "knowledge-based industries" as % of GDP. (KBIs as defined by OECD 1999 Scoreboard - see text.) Not available for all countries.	1996	OECD ST&I Scorecard, p.115; S'pore from MH Toh (private communication 1999).
Export of services	As % of GDP. Commercial services include transportation, travel, other private services and income. Data are not always fully comparable across countries.	1997	World Trade Organisation, Annual Report, 1998. UN Comtrade database. National Statistics.
High-tech Exports	As % of GDP. World Bank data for 1998 give % of mfg exports. Converted to % of GDP using UN trade data. "High-tech" covers any product from certain sectors (similar to but not identical to those called "high tech" by OECD).	1997	Calculated from 1997 Statistics in World Bank Development Report, 1999/00 and UN International Trade Statistics Yearbook 1997.
Foreign Direct Investment (FDI)	Inward flow as % of GDP.	1997	IMF Balance of Payments Statistics Yearbook, 1998, Vol 49, part 1 from FDI in $. World Bank for PPP GDP. 1997 Figures.
Government transparency (rating)	WCY 1999, scale 1-10. (10= "The government communicates its policy intentions clearly")	1997	WCY, 1999 Survey.
Financial transparency (rating)	WCY 1999, scale 1-10. (10= "Financial institutions provide adequate information about their activities")	1997	WCY, 1999 Survey, Table 4.23.
Competition policy (rating)	WCY 1999, scale 1-10. (10= "Competition laws prevent unfair competition in your country")	1999	WCY, 1999 Survey, Table 3.43.
Openness (rating)	WCY 1999, scale 1-10. (10= "National protectionism does not prevent foreign products and services from being imported")	1997	WCY, 1999 Survey, Table 2.33.
Information and Communications Technology			
Mobile Telephones (per 1,000)	Number of mobile telephones in use per 1,000 inhabitants	1998	Siemens International Telecom Statistics, 1999.
Telephone mainlines (per 1,000)	Number of telephone mainlines in use per 1,000 inhabitants	Dec – 1998	Siemens International Telecom Statistics, 1999.
Computers per capita	Number of computers (PCs, mainframes, et cetera) per 1,000 inhabitants	1988	Computer Industry Almanac Inc. www.c-i-a.com
Internet users (1998)	Number of internet users, as % of population	1998	http:/www.nua.ie/survey/how_many_online/
Internet users (1999)	Number of internet users, as % of population	1999	http:/www.nua.ie/survey/how_many_online/ (Singapore end 97)
Internet hosts per	Internet hosts per 10,000	Jan –	World Bank World Development

10,000		1999	Report, 1999/00, Table 19 p 266
E-commerce (M$)	Expected e-commerce Revenues, 1999, M$US	Mostly 1999	http://www.bcg.com/asia_online/press_release.as USA 1998 fig from http://futurefocusinc.com/inetnewsbits.html#growth
Innovation system			
Scientists & Engineers (per million)	Scientists and engineers in R&D per million of the population	1985-1995	World Bank 1999/2000, Table 19 p266, * UNESCO 1998 Yearbook, 1995 figure, PP5.3 (population)
Researchers (per million)	Full-time researchers per million of population	1997	UNESCO Yearbook, 1999, Table III.1. Figures from 1997 or nearest year
GERD/GDP	Gross expenditure on R&D (% of GDP)	1997	Main Science and Technology Indicators, 1998/2. UNESCO Statistical Yearbook 1998. National Statistics.
BERD/GDP	Business expenditure on R&D (% of GDP)	1997	Main Science and Technology Indicators, 1998/2. UNESCO Statistical Yearbook 1998. National Statistics. National quarterly accounts.
US Patents per annum	Number of US Patents awarded in specified year to residents of specified country. USA not included in determining the "OECD average"	1998	US Patents Office, 1998. Ftp://ftp.uspto.gov/pub/taf/st_co_98.tx
Company co-op (rating)	WCY Survey (10= "Technological cooperation is common between companies")	1997?	WCY, 1999, p479
Company-uni co-op (rating)	WCY Survey (10= "Technology transfer between companies and universities is insufficient")	1997?	WCY, 1999, p480
Human Resource Development			
Secondary enrolment (% of age group)	Total enrolment, regardless of age, divided by the population of the official age group which corresponds to a specific level of education.	1996	UNESCO Statistical Yearbook, 1999, Table II.8. Gross enrolment rates
Natural Science Graduates per annum	Number of new graduates in natural sciences and engineering in year specified	1997	UNESCO Yearbook, 1999, Table II.16. Figures from 1997 or nearest year
Knowledge Workers (% of labor force)	As percentage of the labour force. Based on ILO occupational statistics - see text for details.	1997	Calculated from ILO Yearbook of Labour Statistics 1998.
Newspapers (per 1,000 pop)	Daily circulation per 1,000 inhabitants	1996 but 1990 for China	UNESCO Statistical Yearbook, 1998, Table 7.8.
Human Development Index (HDI)	UNDP index based on three indicators of human development: longevity (measured by life expectancy at birth), educational attainment (measured by a combination of adult literacy [2/3 weight] and the combined 1st, 2nd, 3rd-level gross enrolment ratio [1/3 weight]), and standard of living (measured by purchasing power, based on real GDP per capita adjusted for the local cost of living [purchasing power parity]). (Maximum value= 1.000)	1998	UNDP World Development Report, 1998.

A2.2 "Knowledge workers" and the ILO classification of occupations

Some form of occupational statistics are collected by almost all countries as part of their census process. The International Labour Organisation (ILO) annually compiles these statistics into an internationally comparable form. However, to accommodate the range of occupational classifications used by countries, the ILO asks the responsible national agencies to report in one of two standard classifications (ISCO-68 or ISCO-88) set out below.

In its annual Yearbook of Labour Statistics, the International Labour Organisation (ILO) uses two similar but not fully compatible classifications of occupations, referred to as ISCO-68 and ISCO-88. Though the latter is the more recent and probably better suited to describing a modern labour force, many countries still report their data under the older (ISCO-68) categories. The table below summarises the categories at 1-digit level (all that is tabulated in the ILO yearbook). For further details, see the ILO yearbook.

ISCO-68 Class	ISCO-68		ISCO-88 Class	ISCO-88
0/1*	Professional and technical		1*	Managers and senior government officials
2*	Administrative and managerial		2*	Professionals
3	Clerical		3*	Associate professionals
4	Sales		4	Clerks
5	Service		5	Service and sales
6	Agricultural		6	Skilled agricultural workers
7/8/9	Production and transport workers and labourers		7	Tradespersons
			8	Production operators
			9	Elementary occupations

In compiling the data tables of this report, those in occupations marked * have been counted as " knowledge workers".

This results in the ISCO-88 figures in Tables SA-3 and SA-4 of Appendix 1 (which are expressed as a proportion of the labour force). Note that this definition excludes category 4 ("clerical workers") and category 7 ("craft and related trade workers"), both of which shade into "associate professionals", and may well include many workers whose key selling point is their knowledge (whether codified or tacit). Similarly for those countries reporting under the ISCO-68 classification, for Table 3.1 we have taken "knowledge workers" to be those in the ISCO-68 category 0/1 ("professional and technical") or category 2 ("administrative and managerial"). A few countries report "new employees seeking work" as part of their total. For the purposes of this study, this makes an insignificant difference to the results.

It transpires that our definition of "knowledge workers" in terms of ISCO-88 categories is identical to that used by OECD (1998) to define "white-collar high skilled" workers. (Figure 1.6 of *Technology, productivity and job creation* gives data but no definitions; inquiry to the OECD elicited the latter, which are set out in an internal OECD working paper "OECD data on skills: employment by industry and occupation", OECD document number DSTI/DOC (98)4 .)

APEC economies currently reporting under ISCO-88 are:
Australia, Hong Kong (China), Korea, Mexico, New Zealand, Peru, and Singapore.

APEC economies currently reporting under ISCO-68 are:
Canada, Chile, Japan, Malaysia, Philippines, Thailand, and the US

The remaining APEC economies do not yet report occupational data in either of these formats to ILO.

Table SA-3 and Figure 8-2 (derived from it) show that the figures for "percentage of knowledge workers" for all the most developed economies, regardless of whether they are based on ISCO-68 or ISCO-88, are very similar to each other and substantially higher than those for the Asian Fast-Growing Economies and the Latin American Economies (which also cluster together); see also Figure 3.1. This suggests that the figures for "percentage of knowledge workers" derived as described above give a reasonably robust indicator, which does not depend on whether they are derived from ISCO-68 or ISCO-88.

However, it should be noted that there are some anomalies in the data, which the drafting team is still investigating in more detail. Most notably, using the above definitions of knowledge worker for Korea (ISCO-88, 1997 data, 17%), Japan (ISCO-68, 1997 data, 16%) and Australia (ISCO-68, 1988-1993, 24%) yield what appear to be anomalously low results in comparison to those for other Most Developed Economies and High Performing Asian Economies, which are around 30%. The reasons appear to lie in the way in which each economy's occupational data (which is collected on the basis of differing national classifications of occupations) have been mapped by the respective national statistical authorities into the ILO classes.

For example, it is likely that Japan has classified as "production" or "clerical" workers under ISCO-68 many highly skilled workers who would in other countries have been classified as "technical" or "administrative". In deriving the figures in Tables SA-3 and SA-4, the latter are counted as "knowledge workers" but the former are not. A similar explanation may also apply for Korea. The high figure for Singapore seems realistic, in view of its economic structure, which is reflected also in its high proportion of KBIs.

Since 1996, Australia has reported under ISCO-88, and the Australian data since then are consistent with other OECD countries. Indeed the ISR (2000) publication *Knowledge-based activities: selected indicators*, has mapped Australian national data (at 3-digit level) from 1986 to 1997 onto ISCO-88 at 1-digit level. Figure 10 of that report shows only a 0.5% change from 1993 to 1997 in the percentage of "skilled workers" (which they define exactly like our ISCO-88 definition of "knowledge worker").

A2.3 Other desirable indicators

Matrix of indicators that would be illuminating if obtainable

(This matrix complements that in Table 3.1 (Chapter 3 of Part 1) which shows indicators actually used in this report.)

	Business environment	ICT infrastructure	Human res. development	Innovation system
Knowledge. Acquisition			Life-long learning	
Knowledge creation.	*Investment in knowledge*	*R&D on ICT*	No. of scientists and engineers in R&D (*per LF)*	Innovation in services
Knowledge dissemination	*Expenditure on tech diffusion; Libraries*		.	*Extent of networks/ linkages*
Knowledge use (industrial production)	*KBIs as % of GDP "High-tech exports" as value added*			*E-commerce revenue*
Other				

A brief elaboration of possible detail of each of these indicators follows.

Investment in knowledge. The OECD *STI Scoreboard* gives a version of this - comprising the sum of expenditure on R&D, public spending on education, investment in computer software - expressed as a percentage of GDP. (Some adjustments to each component are made by OECD to exclude double counting.) An obvious component not counted by OECD (1998) is private expenditure on education, which for some countries is significant. Comparisons of this measure to other forms of investment (for example, in plant and equipment) are revealing.

Expenditure on technology diffusion. A possible, although certainly only partial, measure might be public expenditure on programs dedicated to technology diffusion (for example, ITRI in Chinese Taipei, and the technology diffusion program in Australia).

Libraries. Although UNESCO collects statistics on libraries, the data is so incomplete that none of the tables they give cover enough countries to give useful comparisons. In many countries, public libraries represent an important decentralised and cheap (or free) access point to information of all kinds; that is, they act as a dissemination mechanism for information, including that obtained through the internet. Useful data could include: total lendings, access to the internet (number of public libraries having it), number of public libraries, and so on. Data on each country's main national library, while often more readily available, are less relevant to dissemination of information across the populace. Data on national holdings of scientific and technical journals is another measure which has sometimes been collected, and is also a measure of research infrastructure, though nowadays a somewhat old-fashioned one.

KBIs as proportion of GDP. This can be worked out fairly straightforwardly from sufficiently detailed national accounts and input/output matrices, provided these are available using the OECD definition of KBIs. It is a key indicator of status as a KBE.

The calculation that yields value added by KBIs will also yield value added by the various classes of KBI, in particular *value added by manufacture of high technology products*. As noted in chapters 6 and 8 of Part 1, the current measure (high technology exports) is

misleading for many APEC economies, as the value added to these exports (of mainly ICT goods) is low - many countries import them with most of the ”high technology” content ready-made. The value added measure gets round this, or if the focus is to be on trade, the figure for HT exports (readily available in World Bank tables) needs to be complemented by the corresponding figure for *HT imports* (and/or *value of net HT exports*). Both of these could be calculated from detailed (classified) figures for imports (for example, from UNCTAD compilations).

R&D on ICT. This expenditure (including software development) gives a measure of knowledge creation in relation to ICT - most other ICT indicators relate to uptake of ICT. Available for several OECD economies.

Number of scientists and engineers in R&D (as proportion of labour force). This is an alternative measure of the stock of researchers, and is fairly easily obtained from the figure tabulated by the World Bank. Measuring as a proportion of the labour force rather than as a percentage of the population makes some adjustment for age distribution of the population. (But this would barely affect the gross differences in stock of researchers between countries seen in Appendix 1 and Figure 8-3.)

Innovation in services. Conventional measures of innovation, whether of input or output (R&D, patents, numbers of new products et cetera), focus on manufactures. As with productivity in services, it is not at all clear how innovation in services should or could be measured, but it is clearly important to do so, since service industries dominate many modern economies (more than 60% of GDP in many OECD economies). This area needs further thought.

Extent of networks/ linkages. Linkages between companies, research institutes, et cetera (that is, personal links, as distinct from the related ICT infrastructure) are critical to knowledge dissemination. In this report, our only measures of this are surveys (“yes, there are extensive links/no, there are not”), but in Europe more quantitative measures are emerging (for example, how many other companies is yours linked to, in this way or that; how many international research collaborations are you engaged in, et cetera). Some recent OECD papers (to be published in the OECD *STI Outlook*) report on this.

E-commerce revenue. This is an important economic measure of modern ICT usage, as distinct from access. Estimates of this are available for some countries from various commercial research firms, but they are often not on a consistent basis - for example, some count only business over the internet, while others count older EDI systems. Again, some only count retail (business to consumer), while others count business to business (which is far bigger). Though some data is given in Appendix 1 of this report, none is shown in the country charts, for this reason.