Asia-Pacific
Economic Cooperation

2005

Patterns and Prospects on Technological Progress in the APEC Region

APEC
Economic
Committee

Asia-Pacific
Economic Cooperation

2005

Patterns and Prospects on Technological Progress in the APEC Region

APEC
Economic
Committee

Published by

APEC Secretariat, 35 Heng Mui Keng Terrace, Singapore 119616
Tel: (65) 6775 6012 Fax: (65) 6775 6013
Email: info@apec.org
Website: www.apec.org

ISBN 981-05-4464-2
APEC#205-EC-01.2

TABLE OF CONTENTS

Foreword

FOREWORD

The research project on Patterns and Prospects on Technological Progress in the APEC Region was presented at the second Economic Committee Plenary meeting (EC II) in 2005. This important study examines the state of technological progress among the APEC economies, and classifies them with respect to their patterns and salient features. It captures the current mechanisms in the process of technology diffusion and dissemination within the APEC region.

This study concludes that APEC economies have followed much-diverted patterns of technological progress and technological transfer. It is not productive to preset the default patterns for achieving technological transfer. However, the “flying geese” pattern is still useful to describe one of the salient features of technological transfer in the Asia-Pacific region. In particular, the theory correctly emphasizes the role of direct investment in the upgrade of technology in recipient economies. The recent progress in information and communication technology and “networking” processes appears to influence technology transfer. More focus should be placed on developing higher skilled labor and human resource networks.

My special thanks go to Dr. Kazutomo ABE, Professor of Tokyo Denki University, Japan.

Dr Kyung Tae Lee
Chair, APEC Economic Committee
Seoul, October 2005

Summary

EXECUTIVE SUMMARY

PROGRESS REPORT ON PATTERNS AND PROSPECTS ON TECHNOLOGICAL PROGRESS IN THE APEC REGION AND RESEARCH PROPOSAL ON TRENDS AND PERSPECTIVES ON HUMAN CAPITAL IN APEC

1. Patterns and Prospects on Technological Progress in the APEC Region

The research project on Patterns and Prospects on Technological Progress in the APEC Region was completed at the second Economic Committee Plenary meeting (EC II) in 2005. The study examined the state of technological progress in APEC economies, and endeavored to group them with respect to their patterns and salient features. Furthermore, the study surveyed the theoretical mechanisms of technology diffusion and dissemination within the APEC region. The "flying geese" model was reviewed for its enduring theoretical significance, as well as for its role in advancing APEC's goals.

The study reached several conclusions. First, APEC economies have followed many different paths to technological progress and technology transfer. Consequently, it is not productive to try to preset the default patterns for achieving technological transfer. Second, the flying geese model is still able to describe one salient feature of technological transfer in the Asia-Pacific region: foreign direct investment (FDI). The theory recognizes the role of FDI in the region in upgrading of technology of recipient economies. Third, recent advances in information and communications technology and "networking" appear to influence the technology transfer process. In this regard, more emphasis should be placed on developing higher-skilled labor and their human resource networks.

It is appropriate to confirm the importance of one of APEC's principal goals: to liberalize and facilitate FDI as an important engine of growth. At the same time, ECOTECH activities should be focused to expedite the development of human resources, especially high-skilled labor.

2. Proposal for a New Research Project

Title of Study: Trends and Perspectives on Human Capital in APEC

Objectives and Scope

The proposed study would examine human capital development in the context of economic growth in the Asia-Pacific Region. The study scope would encompass a theoretical survey of the new growth theory as well as recent analytical and empirical works on the growth functions of APEC economies. The new growth theory emphasizes the contribution of appropriate learning-by-doing processes to economic growth. At present, human capital factors—and development of highly skilled labor in particular—crucially influence the transfer and dissemination of information and communications technology.

Study Plan:

Japan has volunteered to undertake this study, the expected duration of which will be two years. During the first year, the study team will concentrate on a literature review and data collection and processing. In the second year the team will discuss the empirical results and policy implications with other member economies, and finalize a study report for the second Economic Committee meeting (EC II) in mid-2007.

Introduction

1. INTRODUCTION

Following the two reports titled *APEC Economies Beyond the Asian Crisis* in 2000, and *Renewed Importance of Entrepreneurship in the New Economy–Case Studies of Selected APEC Economies* in 2002, a Japanese research team launched a research project on "Patterns and Prospects on Technological Progress in the APEC Region" in 2003. This paper reports the findings of that research.

Technological progress is the engine of sustainable growth in the APEC region, and it has become increasingly important since the economic crisis of the late 1990s. The international dissemination of technology is one of the most important sources for upgrading the technological capabilities of developing economies, and APEC has played a role in promoting technological progress in the region with the ultimate goal of promoting sustained economic growth among its member economies. One goal APEC set was to achieve trade and investment liberalization and facilitation in the region. The achievement of that goal will lead to more active trade and direct investment in the region, a more efficient use of resources, and more competition, all of which should stimulate technological progress. The ECOTECH projects—a pillar of APEC activity—include those that directly address the issue of technological dissemination to sustain growth in the region. Human resource development is key in this sense.

APEC consists of unique and diverse economies. The shape, features, and engines of technological progress vary from the highly intensive structural reform measures in some developed economies to trade and investment liberalization and promotion of foreign direct investment in others. In addition, since the 1990s, the rapid progress of information and communication technology and other new frontiers have changed the patterns of technical progress and its dissemination in the region.

This study examines the state of technological progress in the APEC economies, and classifies them with respect to their patterns and salient features. In terms of private activities and public policies that support technological progress, the following features have been identified:

- Research and development (R&D) and importing technologies
- Knowledge networking
- Promotion of trade and investment by liberalization and facilitation
- Improving the environment to attract foreign direct investment
- Fostering entrepreneurship
- Formation of special economic zones and development of industrial clusters to exploit the merits of economic agglomerations

It would be useful for APEC to develop perspectives on technological progress and its international dissemination. The findings of the study may provide a reference for ECOTECH activities and suggest general policy implications for priority areas in APEC.

Furthermore, this study aims to capture the most recent mechanisms of the process of technology diffusion and dissemination within the APEC region. Industrial catch-up in the developing economies has been the main theoretical explanation of the diffusion processes. The "flying geese" pattern is the most famous hypothesis to illustrate the features of the process. However, the recent rapid progress in the manufacturing sectors in the Chinese and ASEAN economies may call for new theoretical frameworks, to at least supplement the flying geese hypothesis. The rapid progress in some specific high-tech sectors in developing

economies resembles a “leapfrogging” process, rather than a flying geese formation. In many cases in Asia, the production facilities of the high-tech sectors are concentrated in specific areas, thus gleaning the benefits of agglomeration. This pilot study may evolve into larger research projects that will focus on this aspect of technology development and dissemination.

Present Status of Technological Progress in APEC Secretariat

2. PRESENT STATUS OF TECHNOLOGICAL PROGRESS IN APEC

Total Factor Productivity Growth of APEC Economies

Measuring technological progress throughout the APEC region from scratch would require massive econometric research. Total Factor Productivity (TFP) is the most frequently used indicator of technological progress. Table 1 below demonstrates various existing empirical work on the annual growth rates of TFP before the Asian financial crisis.

Table 1: Total Factor Productivity Growth in Selected Developing APEC Economies Before the Asian Crisis

(Percent, annually)

Economy	World Bank[1] (1993) 1960–1985	Young (1994) 1966–1990	Collines and Bosworth (1996) 1960–1994	Sarel (1997) 1978–1996
China	--	--	4.6	--
Hong Kong, China	3.6	2.3	--	--
Indonesia	1.3	1.2	0.8	1.2
Korea	3.1	1.7	1.5	--
Malaysia	1.1	1.1	0.9	2.0
Philippines	--	--	-0.4	-0.8
Singapore	1.2	0.2	1.5	2.2
Chinese Taipei	3.8	2.6	2.0	--
Thailand	2.5	1.5	1.8	2.0

Source: Yusuf and Evenett (2002), Can East Asia Compete? The World Bank.
Notes: 1. The World Bank (1993), The East Asian Miracle.

Throughout the 1970s and 1980s, the growth of Asian developing economies mainly rested on the accumulation of factor inputs, especially capital. TFP growth provided a small but steadily expanding contribution to the growth rate. Most estimates showed that the proportional share of TFP in Asian developing economies was still below that of industrialized economies. That tendency appears to be maintained even after the economic crisis, in spite of structural adjustments. This implies that technological progress will be the major potential source of future growth.

United States and Japan: Some Contrasts

Among the APEC economies, the United States has been leading in economic growth for at least the past decade. The growth reflected active innovation in the information and communication sectors, and the mobility of resources to shift toward growing sectors. It appears that the United States economy has established an “innovation system”.

While other industrialized economies in APEC generally exhibited steady growth in the 1990s and early 2000s, Japan’s economic performance was weaker. A research report by the Japanese government, “Annual Report on the Japanese Economy and Public Finance 2001-2002”, demonstrated that in the 1990s, Japanese TFP growth dropped sharply. In some sectors, including construction, trade, and banking, TFP growth rates slowed substantially, and even turned negative. Recently, structural reform measures in Japan have improved productivity, and economic growth has regained momentum.

Perspectives on the Creation and Dissemination of Technology in APEC

3. PERSPECTIVES ON THE CREATION AND DISSEMINATION OF TECHNOLOGY IN APEC

Innovation in each industry is a source of economy-wide technological progress, while the most efficient use of productive resources also improves productivity and leads to technological progress. New technology, which is typically generated by innovation, is not usually confined to one economy, but is disseminated through international economic activities. For developing economies, where new inventions have been scarce, technology dissemination from the advanced economies has served as a critical source to upgrade productivity.

This project analyzes relevant indicators to identify the salient features of technological progress in APEC economies. In this section, we examine the creation and dissemination of technology, including R&D activities, technology imports, knowledge networking, inflow of FDI, imports of information goods, entrepreneurship to create venture businesses, and formation of industrial clusters.

(1) R&D Activities and Technology Imports

Increasing Trends of R&D in the 1990s

R&D activities directly enhance the domestic capacity for innovation, and facilitate the assimilation of process and product technologies from abroad. In terms of the number of patents granted, which is strongly correlated to R&D, developing economies in APEC lagged far behind the industrial economies (Table 2). Most developing economies in APEC invest less than one percent of GDP in R&D, which creates various challenges for them.

Table 2: Numbers of Patents Granted: Selected APEC Economies

(Annual average)

	1989–1991	1992–1994	1995–1997	1998–2000	2001–2002
Australia	12,283	12,430	9,374	14,076	14,240
Canada	15,320	14,851	7,856	11,825	12,485
Chile	574	--	--	510	--
China	--	4,802	3,288	8,576	18,885
Hong Kong, China	1,068	1,336	1,884	2,564	1,661
Japan	52,934	87,633	157,295	139,129	120,880
Korea	6,808	11,210	17,869	50,160	39,987
Malaysia	--	1,348	--	--	--
Mexico	1,793	4,570	3,556	4,215	6,046
New Zealand	3,307	2,848	3,078	3,703	3,044
Philippines	1,046	--	753	593	--
Russia	--	13,897	25,001	20,138	17,203
Singapore	1,131	1,481	2,356	--	7,583
Thailand	153	441	779	--	--
USA	94,141	99,154	107,683	152,834	166,686

Source: World Intellectual Property Organization.

However, the number of patents of APEC economies was generally on an increasing trend in the 1990s and early 2000s. R&D contributes to productivity growth in various ways: by increasing the stock of knowledge, creating new scientific instruments and methodologies, and training skilled staff. For the developing economies in APEC, R&D contributed to their acquiring

process technology and a modest degree of incremental innovation. The rates of return from R&D should be comparable to those for the industrialized economies, as long as appropriate rule of law is assured.

Technology Imports

In contrast with developing economies, basic research—something that the United States and other industrial economies have heavily invested in—in the industrialized economies has played a major role in the development of high technology. The industrialized economies have supplemented applied R&D with basic research that has contributed to product innovation. In APEC, China, Korea, Singapore, and Chinese Taipei are now approaching this stage (Yusuf (2003)). These economies may import basic technical knowledge from abroad in the form of licenses, supplement their own R&D, and develop new products. Japan has adopted this process since the 1950s, until recently. This type of innovative system can be followed by developing economies.

Table 3 summarizes the ratio of royalties and license fee payments to total imports in selected APEC economies. Japan, Korea, and New Zealand recorded the highest ratios, around two to three percent. This illustrates two salient features of Japan and Korea: that they tend to import basic technological knowledge, and that they concentrate on developing product and process innovation by supplementing applied R&D. New Zealand's high ratio provides an interesting finding.

Table 3: Ratio of Royalties and License Fees Payments to Total Imports

(Percent)

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003
Australia	2.9	1.6	1.7	1.8	1.7	1.7	1.5	1.4	1.4	1.5
Canada	--	1.1	1.1	1.2	1.4	1.6	1.6	1.7	1.9	2.0
Chile	0.5	0.3	0.7	0.8	1.3	2.3	1.8	1.5	1.5	1.5
China	--	--	--	0.4	0.3	0.6	0.8	0.9	1.1	0.9
Hong Kong, China	--	--	--	--	0.3	0.2	0.2	0.2	--	--
Japan	2.6	2.8	2.8	2.8	3.2	3.2	2.9	3.2	3.3	2.9
Korea	1.9	1.7	1.7	1.7	2.5	2.2	2.0	2.2	2.0	2.0
Malaysia	--	--	--	--	--	0.7	0.7	1.0	0.8	1.0
Mexico	1.2	0.7	0.4	0.5	0.4	0.4	0.2	0.3	0.4	0.4
New Zealand	--	1.4	2.0	2.4	2.3	2.2	2.3	2.4	2.3	2.4
Philippines	0.3	--	0.2	0.4	0.2	0.3	0.5	0.5	0.6	0.7
Russia	--	--	--	0.0	0.0	0.0	0.2	0.8	0.7	1.2
Singapore			1.5	1.5	1.8	3.5	2.7	2.9	2.7	2.6
Thailand	0.5	0.9	1.0	1.3	1.2	1.2	1.2	1.3	1.7	1.7
USA	0.6	0.9	1.0	1.1	1.2	1.2	1.3	1.5	1.6	1.5

Source: IMF Balance of Payment Statistics.

Table 3 shows that industrialized economies generally recorded higher ratios, demonstrating a "horizontal trade" in technical knowledge with one another. Some of the developing economies in APEC, including China and Thailand, witnessed an increase in their ratios in the late 1990s and early 2000s. This illustrates their catching-up process, as indicated above.

(2) Knowledge Networking[1]

For APEC economies, the localization of knowledge should go hand in hand with the international mobility of knowledge workers and technology imports. Their leading universities and research institutes need to maintain global connections if they are to attract the best talent and knowledge. Domestic R&D investment alone does not result in research that generates marketable innovation. Research universities in the developing economies need to establish links with institutions in the main research clusters in Japan, the United States, and Europe so that they can tap into the large pools of knowledge that sustain the world's main industrial clusters. This is an integral part of knowledge networking.

As is underscored by the experience of the high-tech sectors of the United States in the 1990s and early 2000s, the international movement of human capital is enormously fruitful in generating new knowledge, and remains a major conduit for transferring knowledge. The APEC Eminent Persons Group once recommended establishing a system to exchange university-affiliated people among the APEC region.

(3) Foreign Direct Investment to Transfer Technology

Foreign Direct Investment Transfers Technology

Since the 1960s, FDI has served as a source of capital formation for APEC economies. FDI facilitated the transfer of technology and played a role in bridging the savings-investment gap. For Asian member economies, FDI inflows played a crucial role in transferring higher levels of technical knowledge and skills.

In recent years, the role of FDI in building "innovation systems" has grown as a result of technology spillover and production networking. Multinational companies often invested in R&D facilities in the developing economies. Malaysia and Singapore in particular have relied on technology transfer from multinational enterprises. China has attracted a large amount of FDI since the middle of the 1990s, and more remarkably since the year 2002, when WTO accession was achieved. Table 4 summarizes the trends of FDI inflows.

1 See Yusuf and Evenett (1992).

Table 4: FDI Inflows in Selected APEC Economies

(annual average, million US$)

	1985–1989	1990–1994	1995–1999	2000–2001	2002–2003
Australia	5,448	5,496	7,507	8,023	10,939
Canada	4,895	5,625	15,532	47,041	13,805
Chile	556	1,207	5,333	4,591	2,435
China	2,487	16,062	40,867	43,809	53,124
Hong Kong, China	2,978	4,588	13,481	42,386	11,621
Indonesia	442	1,692	2,423	-3,914	-226
Japan	99	1,365	3,886	7,262	7,782
Korea	688	819	4,338	6,241	3,347
Malaysia	799	4,423	5,209	2,171	2,839
Mexico	2,000	7,786	11,600	19,718	12,764
New Zealand	1,422	2,003	2,223	2,454	1,420
Philippines	389	942	1,312	1,517	1,056
Russia	--	--	3,116	2,627	2,303
Singapore	2,427	5,181	9,267	7,008	8,569
Chinese Taipei	790	1,154	1,764	4,579	949
Thailand	732	1,975	3,334	3,286	1,435
USA	48,759	37,240	140,887	212,674	46,321

Source: UNCTAD

One study suggested that FDI accounted for as much as 10 percent of the total capital investment in the APEC developing economies in Asia. “Greenfield investment,” rather than mergers and acquisitions (M&A), was the dominant type of FDI in Asia. On technology transfer, some research has suggested that technology spillovers from foreign firms to local ones were modest, and vertical transmission of technology is much more likely than horizontal transmission (see Saggi (2002) in the case of Indonesia). According to other findings, however, domestic firms derived technological gains from FDI through training of local workers and managers, upgrading skills of local supporting firms, and spillover of know-how.

Many studies conclude that diffusion of technology through FDI is not automatic. An important mediating factor is the local supply of skills and R&D capacity. Without investment in basic skills and the constant upgrading of the skills of the local labor force, it is impossible for the host economies to assimilate the technologies by FDI. China’s recent success rests on its conducive environment in terms of human capital and physical infrastructure.

Import of Technology-Embodied Goods

Technology transfer is brought about by various factors. In the case of assembly manufacturing, an important factor is to replace and upgrade production capital, which embodies new technology. In this sense, imports of technology-embodied goods provide a good indicator for technological progress. One of the most important areas of new technology is information technology (IT). Table 5 summarizes the ratio of imports of IT-related goods to total imports.

Table 5: Imports of Information Technology-related Goods

(Percent, ratio to total imports)

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003
Australia	12.0	15.7	15.3	15.0	14.2	15.6	17.0	15.2	13.2	13.7
Canada	12.7	15.0	15.1	14.6	14.5	15.1	16.0	13.4	12.1	11.5
Chile	10.2	10.3	10.1	11.2	12.6	13.4	12.1	10.4	10.0	9.7
China	8.4	15.8	13.6	15.2	18.5	26.1	31.8	25.9	25.9	26.8
Hong Kong, China	17.3	22.7	23.2	24.6	25.0	26.1	29.3	29.5	32.1	33.3
Indonesia	6.9	7.7	9.0	9.9	6.7	4.0	4.3	4.8	6.3	5.6
Japan	5.6	12.0	13.3	13.3	14.0	15.3	17.1	16.3	16.0	15.8
Korea	13.1	9.1	14.9	17.1	20.8	23.6	23.3	21.5	22.1	22.2
Malaysia	24.2	33.7	34.6	33.7	41.6	43.3	45.1	42.2	43.1	44.5
Mexico	11.8	24.1	23.4	23.2	23.9	25.2	27.2	26.4	24.4	23.2
New Zealand	12.4	12.4	11.9	11.9	12.0	11.9	13.0	11.1	10.3	10.4
Philippines	8.3	--	27.2	31.6	36.6	37.1	31.1	28.9	39.0	39.1
Russia	--	--	--	7.0	6.7	6.6	6.2	8.0	8.8	8.1
Singapore	23.5	36.2	34.5	34.1	36.5	37.5	40.1	36.7	36.2	36.9
Chinese Taipei	16.9	21.5	22.1	23.1	26.5	29.8	--	--	--	--
Thailand	11.4	17.8	17.9	20.4	23.7	22.6	25.2	23.9	--	22.7
United States	14.1	19.3	18.7	18.8	17.9	18.4	19.2	17.1	16.3	15.7

Source: National trade data.

Note: The definition of IT-related goods is based on "Information Technology Outlook 1997 (OECD)".
Office Equipment & computers SITC751,752, Consumers' AV apparatus SITC761,762,763
Communications equipment: SITC764
Components: SITC771,772,776
Other: SITC773,774,778.

After 1995, the ratio increased sharply in many of the developing economies in APEC, as well as Korea and Japan. IT contributes to the productivity improvement of these economies. In addition, some of the goods are imported as parts and components for further assembly. This may be the case for the APEC developing economies that have become production centers for IT related goods.

(4) Entrepreneurship[2]

State of Entrepreneurship

The state of entrepreneurship in APEC economies seems quite mixed. According to the ranking based on the entrepreneurship index of the International Institute for Management Development (IMD)[3], published in 2004, the highest-ranked APEC member in terms of entrepreneurship was Hong Kong, China, with a score of 7.61 (Chart 5), and Japan, with a score of 4.15, both lagged behind.

According to the ranking of entrepreneurship, the top five economies in APEC were Canada; Hong Kong, China; Malaysia; Chinese Taipei; and the United States. The bottom five were

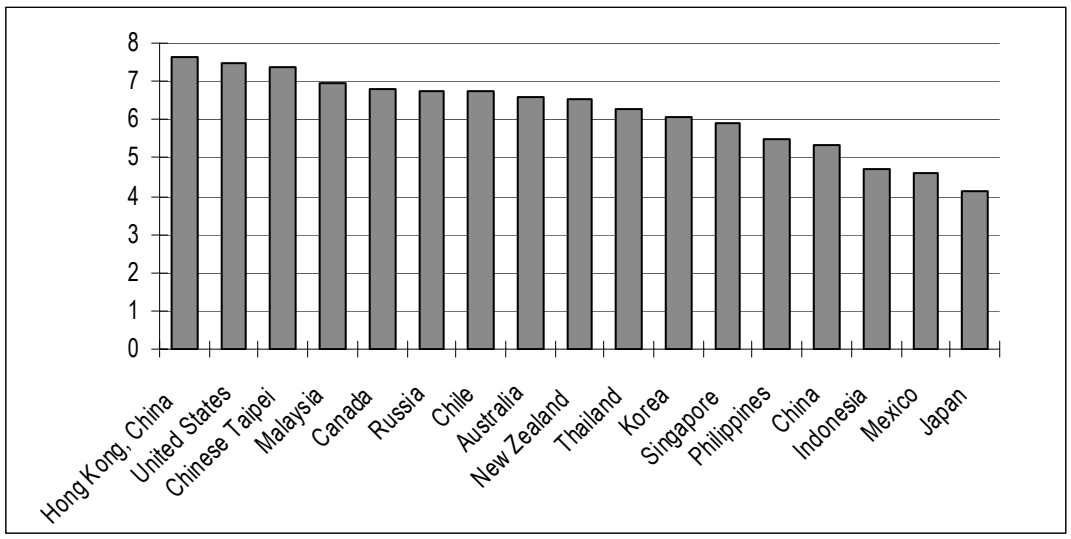
---

[2] This section benefits from APEC (2001).

[3] The entrepreneurship index is a component of the IMD's competitiveness index. Based on the assumption that the competitiveness of nations and the competitiveness of companies are interdependent, the competitiveness index tries to measure and compare the extent to which a country provides an environment that fosters domestic and global competitiveness of the companies operating within its borders. Quantitative hard data and qualitative survey data are gathered. The two sets of data are then combined, aggregating the 293 criteria into various rankings. One criterion is entrepreneurship.

Japan, Mexico, Indonesia, China, and the Philippines. There is a generally positive correlation between the performance of the members in terms of the environment for entrepreneurship and the ranking. Many of the top economies recorded robust growth during the Asian financial crisis period, while some of the developing economies suffered serious economic turbulence.

Chart 1: State of Entrepreneurship



Source: International Institute for Management Development (IMD), The World Competitiveness Yearbook 2004.

What Determined Entrepreneurship?

Among APEC members, it appears convincing that the members with higher entrepreneurship indexes tend to have a better mix of macroeconomic, microeconomic, institutional, and social conditions. Hong Kong, China; the United States; and Chinese Taipei have achieved higher growth with low inflation. They also maintain free and open markets and good institutional and social environments for entrepreneurs.

The diversity among APEC seems to reflect the fundamentals of each economy. The determining factors, in turn, should have been affected by the combination of policies and programs, while public policies alone are by no means responsible for the results. In the Asian APEC economies of China, Korea, and Singapore, the governments have supplied much of the venture funds.

APEC (2001) listed a menu of policy options to foster entrepreneurship, described below:

1) Expanding Access to Finance and Taxation to Ease Cash Flow
    a. Equity Investment by Angels and Venture Capitals and Effects of Taxation
    b. Tapping Stock Markets
    c. Financing by Public Financing Institutions
2) Mobilizing Human Resources for New Businesses
    a. Flexible Labor Markets
    b. Education and Training
3) Expanding Access to Technologies and Information
4) Developing Legal Infrastructure

(5) Academic-Corporate Cooperation and Formation of Clusters

Innovative ideas can turn into successful ventures only when they are combined with managerial skills and business know-how. Information regarding technological innovation, business opportunities, and business skills is key to the formation of successful new businesses.

Cooperation between academia and the corporate world enhances access to technologies and information. The significance of university-company cooperation in fostering new businesses in high-tech areas is well underscored by Silicon Valley, where Stanford University continues to play a prominent role. Other similar “hot spots” of entrepreneurial activities include Gladstone in Australia, the Valencia region in Spain, and the Hsinchu Science-based Industrial Park in Chinese Taipei. These places point to the significance of the spatial concentration or “clustering” of business activities. Clusters of high-tech business activities have been formed in other APEC members. Universities and research institutions can serve as the core of a clustering of venture businesses.

Table 6: Cluster Analysis to Group the Economies

	Group Number	Distance from Central Point
Australia	2	0.810
Canada	2	1.151
Chile	2	1.439
China	2	1.674
Hong Kong, China	1	1.122
Indonesia	2	2.662
Japan	2	1.998
Korea	1	1.122
Malaysia	2	2.251
Mexico	2	1.664
New Zealand	2	2.304
Philippines	2	1.572
Russia	3	0.000
Thailand	2	0.958
USA	2	1.585

Technological Transfer and Growth in APEC

4. TECHNOLOGICAL TRANSFER AND GROWTH IN APEC

(1) The Flying Geese Model and APEC

Flying Geese Model of Economic Development

The “flying geese” pattern of economic development is renowned as a way of describing the rapid economic growth in East Asia. Kojima (2003), who developed the model, surveyed the theory in detail. The flying geese model explains the catch-up process of industrialization in late-comer economies, which consists of: (i) a basic pattern, i.e. a single industry grows by tracing the three successive curves of imports, production, and exports; and (ii) a variant pattern in which industries are diversified and upgraded; these industries make everything from consumer goods to capital goods, and tend to make simple products first, and then move on to more sophisticated products. Akamatsu, who discovered these two patterns, was stimulated by the appearance of the “product cycle” hypothesis by Verson (1965). Later, Akamatsu added another pattern of flying geese: international transmission. For example, once an economy is able to produce consumer goods of the same standard as that of the advanced economies, the export of the consumer goods of the economy tends to decline. This is attributable to the fact that consumer goods are put into production in other less-advanced economies.

Context of APEC: Okita’s Address

In the context of the Asia-Pacific region, Dr. Saburo Okita, former Foreign Minister of Japan, mentioned the theory in his address at the fourth Pacific Economic Cooperation Council (PECC) meeting in Seoul in 1995 (Okita (1985)):

> “The division of labor in the Pacific region has aptly been called the *flying geese pattern* of development. Traditionally, there have been two patterns of types of international division of labor: the vertical division of labor that prevailed in the 19th century to define relations between the industrialized country and the resource-supplying country or between the suzerain and the colony; and the horizontal division of labor typified by the EEC with its trade in manufactures among industrialized countries, often among countries at the same stage of development and sharing a common culture. By contrast with both of these types, the *flying geese pattern* represents a special kind of dynamism. In the Pacific region, for example, the United States developed first as the lead country. Beginning in the late 19th century, Japan began to play catching-up development in the nondurable consumer goods, durable consumer goods, and capital goods sectors, in that order. Now, Asian NICs and the ASEAN countries are following in Japan’s footsteps.
>
> Because there is such great variety in the Asian nations’ stages of development, natural resources endowment, and cultural, religious, and historical heritages, economic integration on the EEC model is clearly out of the question. Yet it is precisely this diversity that works to facilitate the *flying geese pattern* of shared development with a supportive division of labor.”

According to Kojima (2003), the idea behind Okita’s address is “nothing but the third pattern of flying geese development;” that is, the international transmission of industries. The idea of flying geese now appears to be embraced both politically and economically in APEC. The influence of the theory is found, more or less, in many of the addresses, statements, and reports in APEC.

(2) Growth Theory and Flying Geese

Growth Theory with Changing Leading Industries

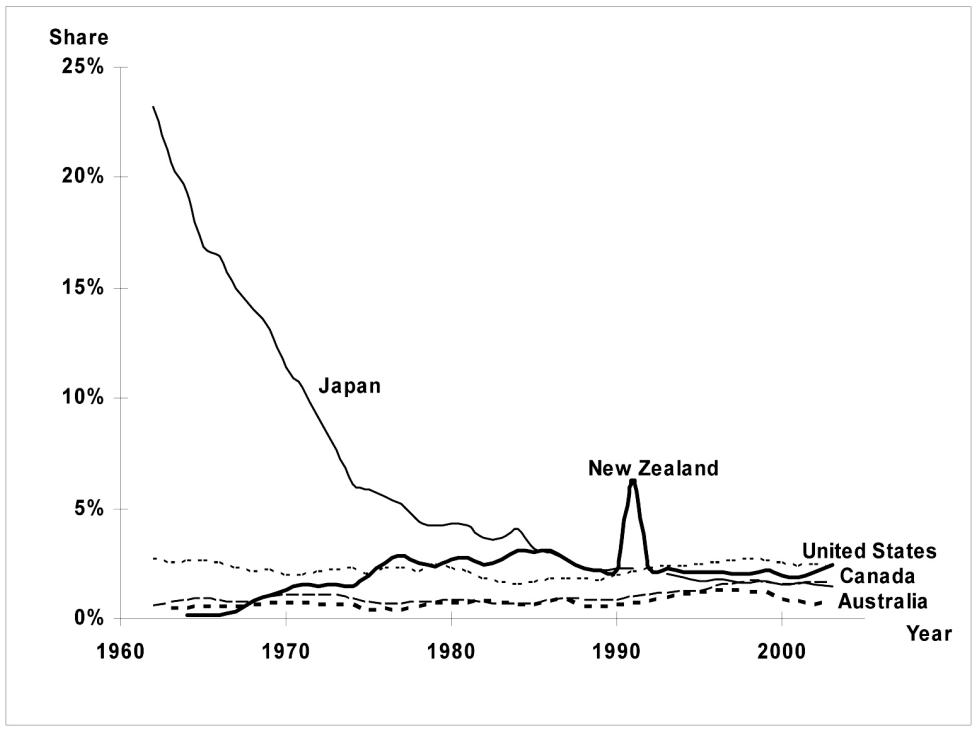
The flying geese hypothesis provides a strong explanation of the diffusion process of technology. A recent study (Ito, *et al.* (2000)) suggested that the growth theory and the flying geese theory are compatible. The main issue here is how the flying-geese type industrial shifts contributed to the rapid growth in APEC economies.

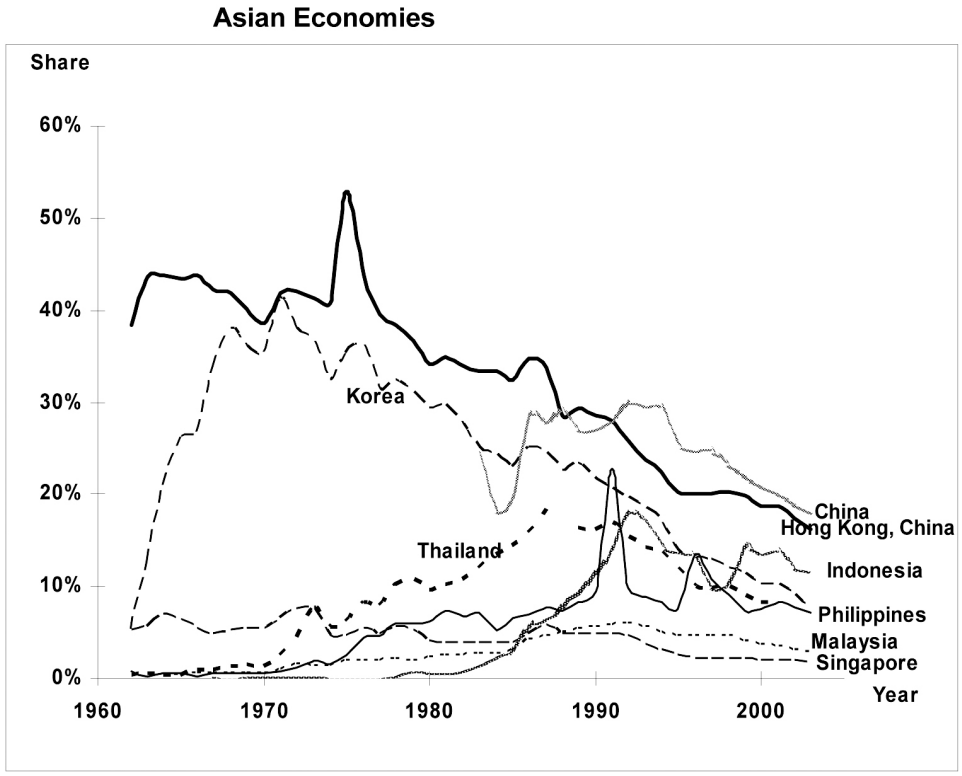
Ito, *et al.* (2000), in addition to some related references, made the theoretical proposition that the changes of the leading industries in Asian developing economies enabled them to sustain higher rates of economic growth. Under the convergence theory with the one-sector model, economies would grow rapidly with capital accumulation, but only for the convergence periods. After the convergence process is completed, economic growth should slow down along the long-run growth path. In APEC developing economies, however, their leading industries alternately changed. The flying geese mechanism caused the changes in the industrial structure. Reflecting the change of leading industries, the convergence process started again and capital accumulation took place in the new leading sectors.

The rapid growth in APEC developing economies can be explained by the repetition of the medium-term convergence process, caused by flying-geese upgrading industrial structures. Under this theory, higher rates of economic growth are possible in the long run only if the industrial structure continuously upgrades and the leading industries continually shift. APEC developing economies have successfully followed this pattern (Chart 2).

Chart 2: Patterns of Flying Geese in APEC Economies

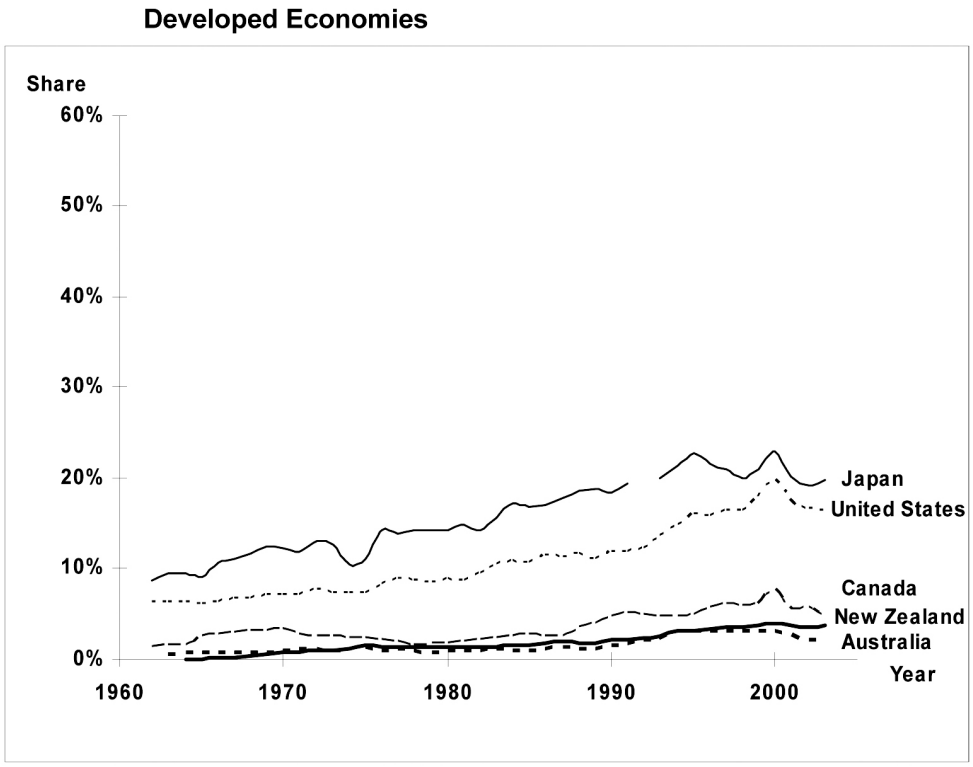
(i) Share of textile yarn, fabrics, made-up articles, and clothing as a percentage of total export

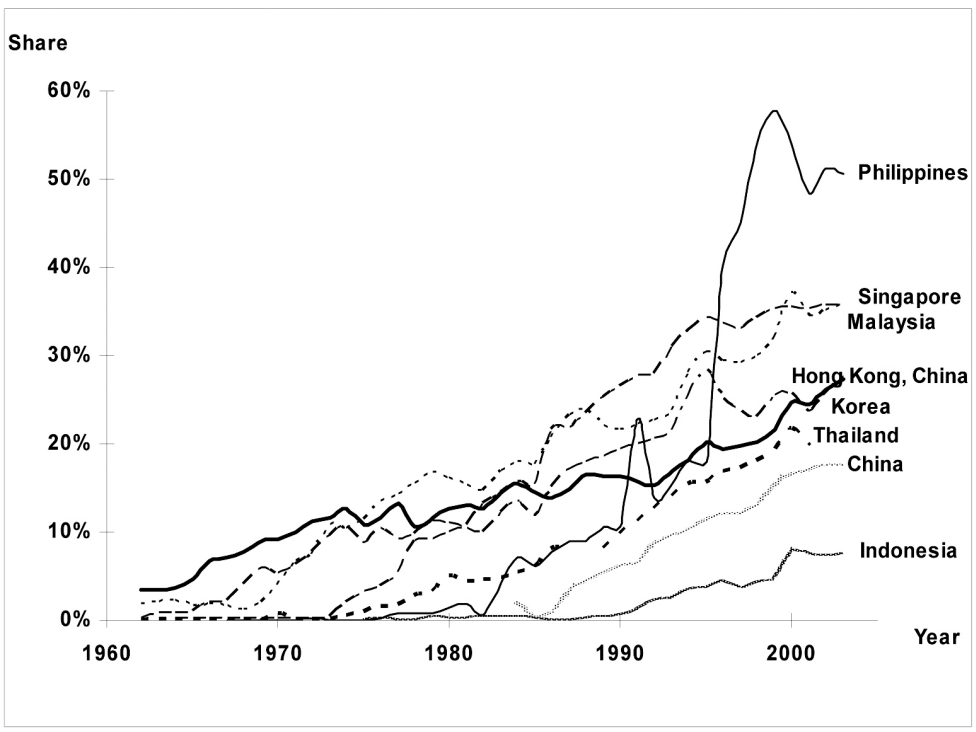




Source: United Nations, International Trade Statistics Yearbook.

(ii) Share of electrical machinery, apparatus, and appliances as a percentage of total exports





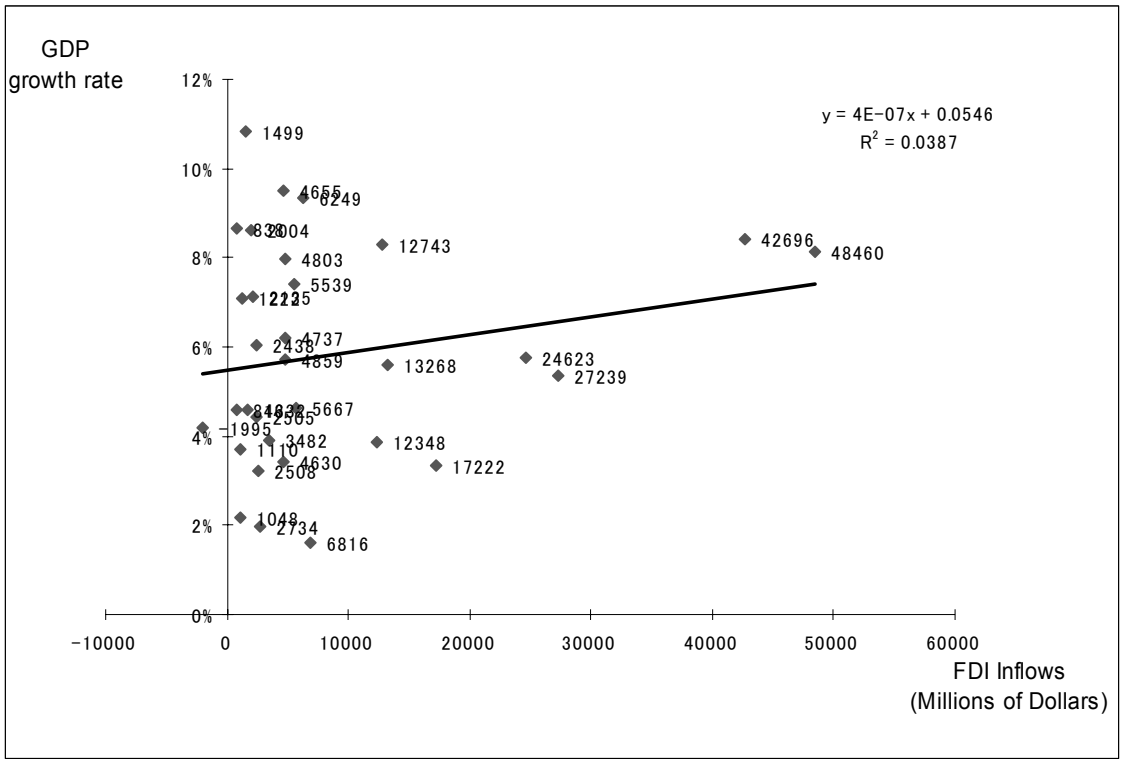
Source: United Nations, International Trade Statistics Yearbook.

Flying Geese and the Importance of Direct Investment

As a pioneer of the flying-geese theory, Kojima (2003) introduced a theoretical model in which the accumulation of physical and human capital causes the economy to diversify first to more capital-intensive key industries, and then to rationalize them so as to adopt more efficient production methods.[4] Later, Kojima developed a model of pro-trade-oriented FDI. FDI is undertaken from an investing country's comparatively disadvantaged industry, having its foreign production in the other (often developing) country to achieve stronger comparative advantage through providing appropriate capital goods and technology.[5]

This underscores the critical importance of FDI inflows as a driving force of industrial upgrading to ensure sustainable economic growth. Indeed, economies that receive FDI more densely tend to grow faster (Chart 3).

Chart 3: Foreign Direct Investment Stimulated Growth in APEC



Source: IMF, International Financial Statistics Yearbook.
UNCTAD, Foreign Direct Investment database.

Note: The data come from 32 samples, consisting of 11 economies (Chile; China; Hong Kong, China; Indonesia; Korea; Malaysia; Mexico; New Zealand; Philippines; Singapore; Thailand). The time periods are 1990-95, 1996-2000, 2001-2003. China's 1990-95 data are missing. GDP and FDI growth rates are annual averages.

Greenfield investment under FDI contributes to the learning-by-doing process that is assigned an important internal growth role in the new growth theory. Moreover, the recent rapid progress in the high-tech manufacturing sectors in the Chinese and ASEAN economies appears to

[4] As indicated above, Kojima (2003) called it the "Kojima Model I" of the flying geese model.
[5] This is Kojima's "Kojima Model II".

demonstrate industrial “leapfrogging” upgrades.[6] High-technology industries can be diffused to the lower-income economies. FDI enabled the economies to implant such high-tech industries. It would be natural to see very high growth, once the lower-income economies successfully upgrade their industrial structures.

Information and Communication Technology: Some Implications

The nature of the recent progress in information and communication technology might be influential, as such technology requires highly skilled labor but does not require long supply chains or massive capital investment. Some agglomerated areas in one economy, like special economic zones or industrial parks, may provide a seedbed sufficient for bringing about a new industry. More fundamentally, the new information and communication technology has made the borders of economies meaningless for economic analysis. Many of the industrial clusters in the APEC region are newly connected through backward and forward linkages of production. The flying geese model does not deny the leapfrogging process. Simply redrawing the border in the analysis would be sufficient to ensure the model is still applicable.

The APEC initiative to liberalize and facilitate investment has contributed to sustainable growth. FDI becomes increasingly important in the light of recent new information and communication technologies. Highly skilled labor is one key to its success.

Other Theoretical Frameworks

The flying geese hypothesis provides a strong explanation of the diffusion process of technology. This hypothesis was studied in the context of new growth theory (Ito, *et al.* (2000)), and was found to be compatible with the framework of internal growth theory. However, the recent rapid progress in the manufacturing sectors in China and ASEAN economies may call for some supplements and modification. Krugman *et al.* (1993) introduced the “leapfrogging” hypothesis to explain international technological leadership.[7] This hypothesis is not fully applicable to the present situation in Asia, but demonstrates the possible applicability of other theories.

The nature of the recent progress in information and communication technology might affect this, as such technology requires highly skilled labor but does not require long supply chains or massive capital investment. Some agglomerated areas in one economy, like special economic zones or industrial parks, may provide a seedbed sufficient for bringing about a new industry. More fundamentally, the new information and communication technology has made the borders of economies meaningless for economic analysis. Many of the industrial clusters in the APEC region are newly connected through backward and forward linkage of production. The flying geese model does not deny the leap-frogging process. Simply redrawing the domestic and international borders in the analysis would be sufficient to make sure the model is still applicable. However, it is still important to examine the process to capture the situation more fully and accurately

---

[6] Elise S. Brezis; Paul R. Krugman; Daniel Tsiddon, “Leapfrogging in International Competition: A Theory of Cycles in National Technological Leadership,” *The American Economic Review*, Vol. 83, No. 5. (Dec., 1993), pp. 1211-1219.

[7] Elise S. Brezis; Paul R. Krugman; Daniel Tsiddon, “Leapfrogging in International Competition: A Theory of Cycles in National Technological Leadership,” *The American Economic Review*, Vol. 83, No. 5. (Dec., 1993), pp. 1211-1219.

Policy Implications and Directions

5. POLICY IMPLICATIONS AND DIRECTIONS

Based on the study, one may draw the following conclusions and implications. First, APEC economies have followed diverse patterns of technological progress and technological transfer. It is not productive to preset the default patterns for achieving technological transfer. Second, the flying geese pattern model is still useful to describe a salient feature of technological transfer in the Asia-Pacific region. Particularly, the theory emphasizes the importance of direct investment in the region to promote the upgrade of technology in the recipient economies. Third, the recent progress in information and communication technologies and the “networking” process appear to influence the focus of the technology transfer process. More focus should be placed on higher-skilled labor and human resource networks.

It is important to emphasize APEC’s goal to liberalize and facilitate direct investment as an important driving force of growth. At the same time, ECOTECH activities should become a focus to expedite the development of human resources, especially high-skilled labor.

Another implication that the research team in Japan identified is the importance of the human capital factors in technological dissemination. The new growth theory emphasizes the contribution of appropriate learning-by-doing processes to economic growth. In light of the importance of accumulating human capital, especially highly skilled labor, the research team recommends undertaking further research in the APEC Economic Committee on human capital development in the context of economic growth. The new research would be a two-year project, starting from 2006, and would be led by Japan.

REFERENCES

APEC Economic Committee (2000), *APEC Economies beyond the Asia Crisis.*

APEC Economic Committee (2002), *"*Renewed Importance of Entrepreneurship in the New Economy – Case Studies of Selected APEC Economies,*" The New Economy in APEC: Innovations, Digital Divide and Policy,* pp. 79-108.

Brezis, E., Krugman, P. and Tsiddon, D. (1993), "Leapfrogging in International Competition: A Theory of Cycles in National Technological Leadership," *The American Economic Review*, Vol. 83, No. 5, pp. 1211-1219.

International Institute for Management Development (2002), *The World Competitiveness Yearbook 2002.*

Government of Japan (2003), *Annual Report on the Japanese Economy and Public Finance 2001-2002.*

Kojima, A. (2003), "The "Flying Geese" Model of Asian Economic Development: Origin, Theoretical Extensions, and Regional Policy Implications," *The Flying-Geese Theory of Economic Development*, Chapter 8.

Okita, S. (1985), "Special Presentation: Prospect of the Pacific Economies," Korean Development Institute, Pacific Economic Cooperation Council, Seoul.

Saggi, K. (2002) "Trade, Foreign Direct Investment, and International Technology Transfer: A Survey," *The World Bank Observer* 17(2):191-235.

Vernon, R. (1966), "International Investment and International Trade in the Product Cycle," *Quarterly Journal of Economics*.

World Bank (1993), *The East Asian Miracle,* Oxford University Press.

Yusuf, S. and Evenett, S. (2002) *Can East Asia Compete?* The World Bank and Oxford University Press.

Yusuf, S. (2003) *Innovative East Asia*, The World Bank and Oxford University Press.

Proposal for a New Research Project

PROPOSAL FOR A NEW RESEARCH PROJECT

Title of Study: Trends and Perspectives on Human Capital in APEC

Objectives and Scope

The proposed study would examine human capital development in the context of economic growth in the Asia-Pacific Region. The study scope would encompass a theoretical survey of the new growth theory as well as recent analytical and empirical works on the growth functions of the APEC economies. The new growth theory emphasizes the contribution of appropriate learning-by-doing processes to economic growth. At present, human capital factors—and development of highly skilled labor in particular—crucially influence the transfer and dissemination of information and communications technology.

Study Plan:

Japan has volunteered to undertake this study, the expected duration of which will be two years. During the first year, the study team will concentrate on a literature review and data collection and processing. In the second year the team will discuss the empirical results and policy implications with other member economies, and finalize a study report for the second Economic Committee meeting (EC II) in mid-2007.

Abbreviations

ABBREVIATIONS

APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of South-East Asian Nations
EC	Economic Committee
ECOTECH	Economic and Technical Cooperation
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
IMD	Institute for Management Development
IT	Information Technology
M&A	Mergers and Acquisitions
PECC	Pacific Economic Cooperation Council
R&D	Research and Development
TFP	Total Factor Productivity
WTO	World Trade Organisation