

# **Promoting Innovative Development in the Asia-Pacific Region Through the Internet Economy**

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## EXECUTIVE SUMMARY

ICT and Internet economy development has been one of the main interests of Asia-Pacific regional cooperation from the early stage of APEC and the Telecommunications and Information Working Group (TEL or TELWG) was established in 1990 to promote building the Asia-Pacific Information Society (APIS). The objective of this study is to highlight and analyze the economic benefits ICT development or the Internet economy will offer as a new source of economic growth, promoting innovative development in the Asia-Pacific region. This study begins by briefing the activities of APEC and the APEC Telecommunications and Information Working Group and then overviews the current state of ICT development in the APEC member economies based on the ICT Development Index (IDI) published by ITU, analyzes the potential benefits of further ICT development in terms of economic growth, or in some sense, productivity growth, and finally presents implications and suggestions for ICT development or the Internet economy to facilitate economic growth of the Asia-Pacific region. Some of the findings and implications of this study are as follows. Despite the huge gaps among the APEC member economies, ICT as a whole has been developed significantly in the APEC region and the gaps have also been reduced in general during 2002-2012. The progress seems to be converging rather than diverging among the APEC member economies. However, there are still huge and enlarged gaps between these economies when it comes to ICT utilization. APEC therefore needs to make efforts to bridge the ICT development gaps existing among its member economies, especially regarding ICT utilization, in addition to continued efforts to further close the gaps in ICT infrastructure, which is regarded as a great achievement of the previous decade. ICT development is expected to bring about

significant progress in the economic growth of each of the APEC member economies as well as APEC as a whole. APEC can share the experience of member economies with extraordinary progress in ICT development between 2002 and 2012, such as Viet Nam, Russia, Indonesia, China, Philippines, Peru, Malaysia, etc. APEC needs to identify and share their success factors and policy experiences.

**Keywords:** ICT development, Internet economy, APEC cooperation,  
Asia-Pacific region

**JEL Classification:** O47, O19, F53

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# Promoting Innovative Development in the Asia-Pacific Region Through the Internet Economy

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## I. Introduction

The Internet economy, based on information and communication technologies (ICT) as general purpose technology, is increasingly regarded as one of the most important and new sources of innovation and economic growth. In fact, most of countries in the world included plans to promote investment in ICT infrastructure and services in their stimulus package responding to the recent global economic crisis and following recession.<sup>1</sup> The Asia-Pacific region, or more specifically, APEC also recognized the importance of ICT for regional integration and established the Telecommunications and Information Working Group (TEL or TELWG) in 1990 to promote building the Asia-Pacific Information Infrastructure (APII) and ultimately the Asia-Pacific Information Society (APIS).<sup>2</sup>

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<sup>1</sup> Refer to OECD (2009).

<sup>2</sup> Refer to APEC (2005).

APEC economic leaders and ministers for telecommunications and information were also well aware of the significance of ICT for the socio-economic development and regional integration of the Asia-Pacific region. They set specific targets for universal access to ICT infrastructure and services through, for example, the Brunei Economic Leaders' Declaration (2000), the Bangkok Declaration (2008) and the Okinawa Declaration (2010) of TEL ministers.<sup>3</sup> In addition, China, as the host economy of APEC 2014, emphasized the importance of promoting innovative development, economic reform and growth as well as of strengthening comprehensive connectivity and infrastructure development in the theme and priorities of APEC 2014.<sup>4</sup> More specifically, China proposed developing the Internet economy through enhanced ICT cooperation in the Asia-Pacific region.<sup>5</sup>

The purpose of this study is to highlight and analyze the economic benefits ICT development or the Internet economy will offer as a new source of economic growth, promoting innovative development in the Asia-Pacific region and hence contributing to the APEC vision of building the Asia-Pacific Community. The outline of this study is as follows. First, it begins by briefing the activities of APEC and the APEC Telecommunications and Information Working Group. Second, it overviews the current state of ICT development in the APEC member economies based on the ICT Development Index (IDI) of the International Telecommunication Union (ITU). The index is considered comprehensive in that it covers infrastructure or physical access, utilization, and human capacity aspects of ICT development. It includes APEC member economies as reporting countries (except Chinese Taipei and Papua New Guinea for 2012 and other years).

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<sup>3</sup> Refer to APEC (2000), APEC (2008), and APEC (2010b).

<sup>4</sup> Refer to APEC (2013).

<sup>5</sup> Refer to APEC (2014a).

Third, it analyzes the potential benefits of further ICT development in terms of economic growth, or in some sense, productivity growth. Some econometric analyses will be introduced such as a production function and endogenous growth model approach. Fourth, it presents implications and suggestions for ICT development and the Internet economy to facilitate the economic growth of the Asia-Pacific region and ultimately contribute to building the Asia-Pacific Community.

## II. ICT Development and Cooperation in APEC

### 1. APEC Activities and ICT Cooperation

The Asia-Pacific Economic Cooperation (APEC) is a summit-level regional economic forum where 21 Asia-Pacific economic leaders meet together every year to discuss current regional and global economic cooperation agenda.<sup>6</sup> The primary goal of APEC is to support sustainable economic growth and prosperity in the Asia-Pacific region. More specifically, APEC is to build a dynamic and harmonious Asia-Pacific Community by facilitating and promoting free and open trade and investment, accelerating regional economic integration, and encouraging economic and technical cooperation.

[Note] APEC Development<sup>7</sup>

APEC was established in 1989 with 12 founding Asia-Pacific members; Australia, Brunei Darussalam, Canada, Indonesia, Japan, Republic of Korea, Malaysia, New Zealand, the Philippines, Singapore, Thailand, and the United States. The three Chinas—the People's Republic of China, Chinese Taipei, and Hong Kong joined at the same time in 1991. Mexico and Papua New Guinea (PNG) followed in 1993. Chile

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<sup>6</sup> APEC Webpage [<http://www.apec.org>]. (accessed April 4, 2014)

<sup>7</sup> APEC Webpage [<http://www.apec.org/About-Us/About-APEC/History.aspx>].(accessed June 3, 2014)

acceded in 1994. And in 1998, Peru, Russia and Viet Nam joined, taking the current full membership to 21.

Between 1989 and 1992, APEC met as an informal senior official and ministerial level dialogue. The practice of an annual APEC Economic Leaders' Meeting (AELM) was established in 1993. Since then, the economic leaders of the Asia-Pacific region meet every year to discuss current global and regional agenda and to strengthen regional cooperation and integration. APEC cooperation is focused on two main aspects, trade and investment liberalization and facilitation (TILF) and economic and technical cooperation (ECOTECH). TILF and ECOTECH are two mutually complementary means of Asia-Pacific regional cooperation with the diversity of APEC member economies in terms of their geographical distribution and economic development stage.

The scope of APEC cooperation is evolving and broadening to address current and emerging issues of the Asia-Pacific region including counter terrorism, human security, disaster preparedness, climate change, energy security, global financial crisis, and bridging the digital divide. One of the recent emphases APEC has made is to play a role as an engine of global economic growth with its dynamic nature. More specifically, APEC is focusing on innovation and economic growth, the Internet economy as a new source of growth and job creation as well as connectivity to promote and accelerate regional economic integration. The focus of APEC is also well represented in the theme and priorities of APEC China 2014 (refer to Table 1). In addition, China, as the host economy of APEC 2014, proposed “Developing the Internet Economy Through Enhanced ICT Cooperation” during the First Senior Officials' Meeting (SOM 1) held in Ningbo,

China in February 2014.<sup>8</sup> In the concept note, China emphasizes that “the ICT cooperation and the Internet economy is a cross-cutting subject and will promote regional economic integration, unleash innovative development, economic reforms and growth and strengthen comprehensive infrastructure and connectivity development”. China also identified challenges to address and envisioned the possible outcomes of APEC cooperation in the areas of ICT innovation and application, and the development of the Internet economy as well as ICT infrastructure connectivity as an entry point of economic innovations, reforms and growth.

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**Table 1. APEC 2014 - Theme and Priorities**

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Theme

**Shaping the Future Through Asia-Pacific Partnership**

- Acknowledging a weak economic recovery, unsustainable growth patterns and a risk of fragmentation that pose serious challenges to regional economic integration

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Priorities

**1. Advancing regional economic integration**

- While there have been signs of improvement in the world economy, a full recovery has not yet been achieved.
- A need to consider the difficulties facing developing economies as well as major shocks to emerging economies

**2. Promoting innovative development, economic reform and growth**

- Despite internal and external risks and challenges, the Asia-Pacific region is still an engine for global economic growth.

**3. Strengthening comprehensive connectivity and infrastructure development**

- Exploring the possibilities of practical cooperation in such areas as promoting reform of the economic structure, advancing innovative growth, deepening convergence of the industrial chain and the value chain, and developing a green economy in the Asia-Pacific region
- 

Source: APEC (2013), “APEC announces 2014 theme: ‘Shaping the Future through Asia-Pacific Partnership’”. APEC Informal Senior Officials’ Meeting held in Beijing. December 10. [<http://www.apec-china.org.cn>]. (accessed May 8, 2014)

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<sup>8</sup> Refer to APEC (2014a).

## 2. APEC TEL Focus and Targets

Among the 13 sectoral working groups in APEC, the Telecommunications and Information Working Group (TEL or TELWG), established in 1990, focuses on regional cooperation in ICT and the Internet economy. APEC TEL aims to improve telecommunications and information infrastructure in the Asia-Pacific region by developing and implementing appropriate policies, including human resource and development cooperation strategies. APEC TEL has also been working on its vision of promoting the transition from the Asia-Pacific Information Infrastructure (APII) into the Asia-Pacific Information Society (APIS).

*“The APIS is the society - ubiquitous network society - where digital divide issues have been resolved by information and communication infrastructure developed throughout the APEC region and, regardless of time and location, that everyone can create, disseminate, access, and utilize variety of information.”<sup>9</sup>*

APEC TEL has three focused steering groups to conduct its work programs: Liberalization Steering Group (LSG), ICT Development Steering Group (DSG), and Security and Prosperity Steering Group (SPSG). A Mutual Recognition Arrangement Task Force (MRATF) was created under the LSG to implement a mutual recognition arrangement on conformity assessment of telecommunications equipment (MRA-CA) and to draft a mutual recognition arrangement for equivalence of technical requirements in telecommunications equipment (MRA-ETR) (refer to Table 2).

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<sup>9</sup> Refer to APEC (2005).

**Table 2. APEC TEL Structure and Work Programs**

Sub-group	Main focus and work programs
Liberalization Steering Group (LSG)	Promotes and implements: <ul style="list-style-type: none"> <li>- Trade and investment liberalization in ICT;</li> <li>- Effective policy &amp; regulatory frameworks (e.g. VPNs, leased lines, compliance and enforcement issues);</li> <li>- Trade or investment facilitation in ICT, including MRA-related issues;</li> <li>- Capacity buildings to promote competition and transparency (e.g. interconnection and international mobile roaming markets); and</li> <li>- Regulatory roundtables</li> </ul>
Mutual Recognition Arrangement Task Force (MRATF) <u>under the LSG</u>	<ul style="list-style-type: none"> <li>- Streamlines the conformity assessment procedures for a wide range of telecommunications and telecommunications-related equipment, facilitating trade among member economies;</li> <li>- Implements a mutual recognition arrangement on conformity assessment of telecommunications equipment (MRA-CA); and</li> <li>- Drafts a mutual recognition arrangement for equivalence of technical requirements in telecommunications equipment (MRA-ETR)</li> </ul>
ICT Development Steering Group (DSG)	Promotes and implements projects aimed at: <ul style="list-style-type: none"> <li>- Expansion of networks to achieve universal access to broadband in all APEC economies by 2015;</li> <li>- Development and dissemination of strategies to assist developing economies to deploy broadband networks;</li> <li>- Making ICT more accessible to people with special needs;</li> <li>- Development/implementation of advanced technologies (e.g., IPv6, grid computing, and cloud computing); and</li> <li>- Promotion of ICT applications for socio-economic development (e.g., green ICT, smart grids, disaster management, e-Government, e-Health and e-Education)</li> </ul>
Security and Prosperity Steering Group (SPSG)	Scope of work includes: <ul style="list-style-type: none"> <li>- Promoting security, trust and confidence in networks/ infrastructure/services/technologies /applications/e-commerce;</li> <li>- Computer Emergency Response Teams (CERTs) and Computer Security Incident Response Teams (CSIRTs);</li> <li>- Spam / Spyware;</li> <li>- Cybercrime prevention;</li> <li>- Human resource development and capacity building on combating cybercrime and implementing effective cyber security awareness initiatives; and</li> <li>- Business facilitation through discussions with the private sector on promoting security, trust and confidence in the use of ICT for business and trade</li> </ul>

Source: APEC webpage [<http://www.apec.org>]. (accessed June 20, 2014)



To achieve its vision and goals, APEC set up a number of common targets and made cooperative efforts. In the Brunei APEC Economic Leaders' Declaration in 2000, for example, the Brunei Goal was adopted to triple Internet access by 2005 and achieve universal Internet access by 2010 in the APEC region.

*"We commit to develop and implement a policy framework which will enable the people of urban, provincial and rural communities in every economy to have individual or community-based access to information and services offered via the internet by 2010. As a first step toward this goal we aim to triple the number of people within the region with individual and community-based access by 2005."*<sup>10</sup>

In the TEL Ministerial Statement called "Bangkok Declaration", which was adopted at the APEC TELMIN-7 conference in Bangkok in 2008, the ministers acknowledged that the first Brunei Goal of tripling Internet access had been achieved and established a new goal of achieving universal access to broadband within the APEC region by 2015.

*"We also noted with satisfaction that the Leaders' Brunei Goal of Tripling Internet Access within the Asia-Pacific region set in 2000 had been achieved.*

*We applauded the remarkable progress made in the APEC region by individual member economies towards achieving the Brunei Goal of universal Internet access by 2010. We further asked the TEL to encourage economies to continue their efforts to expand the reach of networks with the ambitious goal of achieving universal access to broadband by 2015."*<sup>11</sup>

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<sup>10</sup> Refer to APEC (2000).

<sup>11</sup> Refer to APEC (2008).

In the Okinawa Declaration, the Ministerial Statement of TELMIN 8 in 2010, the ministers further encouraged TEL to work together to achieve the goal of access to next generation high speed broadband by 2020.

*“We recommend that the TEL works toward achieving the ambitious goal of access to next generation high speed broadband by 2020 to expand and improve ICT infrastructure for knowledge-based economies in the APEC region.”<sup>12</sup>*

From its establishment, APEC has considered ICT as an important means of achieving APEC goals and objectives of fostering economic growth, liberalizing trade and investment, facilitating business activities, and promoting economic and technical cooperation. In the APEC process, the TEL Steering Groups and the MRA Task Force propose and implement projects that address priorities set by both the APEC Economic Leaders and the Telecommunications and Information Ministers. In 2010, the 8th Ministerial Meeting on Telecommunications and Information (TELMIN 8) endorsed the APEC TEL Strategic Plan for 2010-2015, with the following priority areas.

- (i) To develop information and communications technologies (ICT) to promote new growth
- (ii) To enhance socio-economic activities through the use of ICT
- (iii) To promote a safe and trusted ICT environment
- (iv) To promote regional economic integration
- (v) To strengthen cooperation in the ICT sector

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<sup>12</sup> Refer to APEC (2010b).

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**Table 3. APEC TEL Strategic Plan for 2010-2015 and Key Areas for Action**


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1. Develop ICT to Promote New Growth
    - Universal access by 2015
    - Strategies to assist developing economies
    - ICT availability to people with special needs
    - Regional deployment of IPv6
    - Infrastructure sharing
  
  2. Enhance Socio-Economic Activities through the Use of ICT
    - Development of innovative technologies and services
    - Smart grids and sensor networks
    - ICT applications to drive socio-economic activities
  
  3. Promote a Safe and Trusted ICT Environment
    - Safe and trusted ICT environment
    - Cyber security capacity building
    - Raising cyber security awareness
    - Cyber security initiatives with industry
    - Safe and secure online environments for vulnerable groups
    - Internet economy
  
  4. Promote Regional Economic Integration
    - Free and open trade and investment
    - Technical conformity assessments and equivalence of technical requirements
    - International mobile costs
    - Consumer awareness
    - Peer learning
    - Submarine cable protection
  
  5. Strengthen Cooperation in the ICT Sector
    - Collaboration within APEC: enhance coordination of ICT related activities within APEC
    - Collaboration outside APEC: enhance outcomes by collaborating with relevant multilateral organisations and Internet-related technical and administrative bodies
- 

Source: APEC (2010a).

Currently, APEC TEL is discussing the update of the Strategic Action Plan 2010-2015 and the draft of the Strategic Action Plan for 2016-2020 reflecting recent socio-economic changes and demands in the APEC region. In addition to the current five priority areas, APEC member economies proposed new areas of

interest for the Strategic Action Plan 2016-2020 in the recent meeting (TEL 49, Yangzhou, China, April 21-26, 2014). Examples of the proposed areas include “practical effects of ICT such as productivity” (Australia), “regional integration by innovative growth and strengthening connectivity”(China), “social aspect of ICT such as bridging the digital divide and capacity building” (Indonesia), and “regulatory reform and business facilitation” (Korea). APEC member economies agreed to consider some other areas such as “expansion of infrastructure and services”, “facilitation of innovation and innovative development utilizing ICT”, “regulatory reform”, “enhancement of cooperation and facilitation of digital/Internet economy”, “empowering people for improvement of standards of living”, “building trusted environment”, “regional cooperation and sharing policy experiences”, “corporate social responsibility (CSR)”, etc.

### III. IDI and ICT Development in APEC

#### 1. ICT Development Index

The International Telecommunication Union (ITU), the United Nations (UN) specialized agency for information and communication technologies (ICTs), endeavors to improve access to ICT, especially for underserved communities in the world as one of its main focuses. For this purpose, ITU developed a composite index called the ICT Development Index (IDI) to monitor information society developments worldwide. The IDI has the following characteristics.<sup>13</sup>

(i) The IDI is a composite index combining 11 indicators (refer to Table 4) to measure and compare the development of information society by country with a single number between 0 and 10.

\* However, the 11 indicators seem to have been selected considering the availability of official and comparable data of countries in the world. With regard to the three sub-sectors, it seems to be that the indicators under the ICT use sub-index are not so differentiated from those under the ICT access sub-index. To put it in another way, the former can be regarded as somewhat more advanced indicators of ICT access. Furthermore, the indicators under the ICT skills sub-index are not specifically designed to measure human capability to use ICT, but they rather indicate general intellectual capacity of individuals or duration of education.

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<sup>13</sup> Refer to ITU (2013).

(ii) The IDI measures the level and evolution over time of ICT development in more than 150 countries in the world including APEC member economies.

\* 2002, 2007, 2008, 2010, 2011, and 2012 index values are currently available (for Chinese Taipei, only 2002 and 2007 index values are available and for Papua New Guinea, 2012 index value is unavailable).

(iii) The IDI evaluates diverse aspects of ICT development such as access, utilization, and human skills (refer to Table 4 and Figure 1).

\* Sub-indexes of ICT access (infrastructure), ICT use, and ICT (human) skills as well as the overall index are available.

**Table 4. ICT Development Index - Indicators, Reference Values and Weights**

Sub-sector	Indicators	Reference value	Weight for sub-sector (%)	Weight for IDI (%)
ICT access	1. Fixed-telephone subscriptions per 100 inhabitants	60	20	40
	2. Mobile-cellular telephone subscriptions per 100 inhabitants	190	20	
	3. International Internet bandwidth (bit/s) per Internet user	621,834*	20	
	4. Percentage of households with a computer	100	20	
	5. Percentage of households with Internet access	100	20	
ICT use	6. Percentage of individuals using the Internet	100	33	40
	7. Fixed (wired)-broadband subscriptions per 100 inhabitants	60	33	
	8. Wireless-broadband subscriptions per 100 inhabitants	100	33	
ICT skills	9. Adult literacy rate	100	33	20
	10. Secondary gross enrolment ratio	100	33	
	11. Tertiary gross enrolment ratio	100	33	

Note: \* This corresponds to a log value of 5.79, which was used in the normalization step.

Source: ITU (2013).

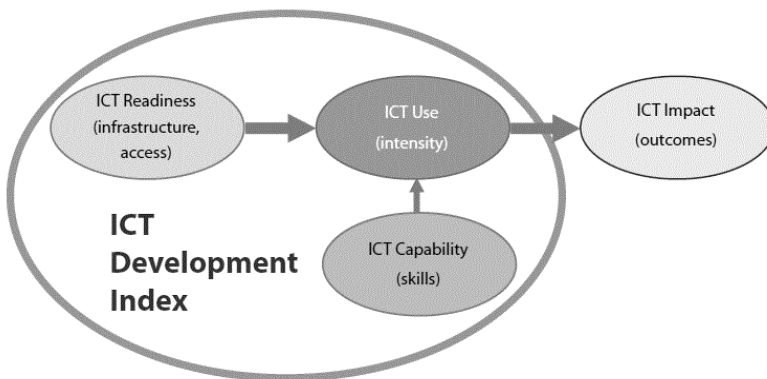
(iv) The IDI encompasses the former Digital Opportunity Index (DOI) and ICT Opportunity Index (ICT-OI).

The IDI is based on the recognition that ICT can be a development enabler. The ICT development process or a country's transition to an information society can be explained by the following three-stage model, which is central to the IDI's conceptual framework (refer to Figure 1).<sup>14</sup>

- (i) ICT readiness stage: network infrastructure diffusion and access to ICT
- (ii) ICT intensity stage: use of ICT in socio-economic activities
- (iii) ICT impact stage: results of ICT utilization

ICT Development following these three stages is thought to be closely related with ICT infrastructure, ICT utilization, ICT skills, and their combinations. The

**Figure 1. Evolution Toward an Information Society - ICT Development Index**



Source: ITU (2013).

<sup>14</sup> ITU (2013), p. 17.

IDI exactly reflects the three factors, the three development stages, and the conceptual framework related to them.

## **2. ICT Development in APEC**

The overall ICT development status of the APEC region can be examined by utilizing the ICT Development Index (IDI). Based on the IDI sub-structure, three main factors of ICT development, ICT access (or infrastructure), ICT use (intensity of), and ICT skills (or human capacity), can be also evaluated separately. IDI results are available for 19 APEC member economies except Chinese Taipei and Papua New Guinea (PNG) for the year of 2002, 2007, 2008, 2010, 2011, and 2012 and have been published by the ITU.

### **1) Overall ICT development - IDI 2002-2012**

In general, significant progress is observed throughout the APEC region during 2002-2012. The simple average of the IDI for 19 APEC member economies (except Chinese Taipei and PNG having no IDI value for 2012) is 5.79 in 2012, improved from 3.45 in 2002. Even with the overall progress, considerable gaps in ICT development among the APEC member economies have still remained. That is, IDI average values for the APEC member economies range between 3.34 and 8.57 in 2012, shifted from between 1.54 and 5.83 in 2002. For comparison, the simple average IDI values for the entire world is 4.35 in 2012 (157 countries), improved from 2.48 in 2002 (154 countries). In addition, the range of IDI values for the 157 countries is between 0.99 and 8.57 in 2012 compared to that of 154 countries in 2002 between 0.51 and 6.05.



**Table 5. ICT Development Index of APEC Member Economies**

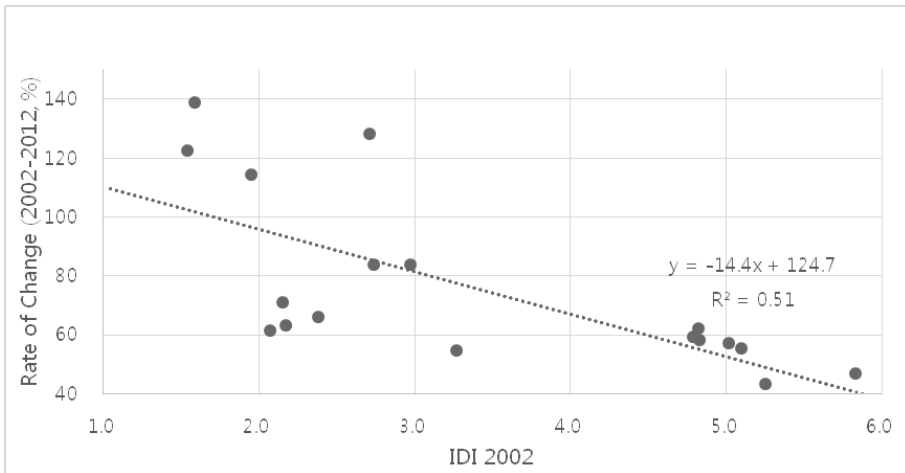
APEC ECONOMY / YEAR	2002	2012	Rate of change, %
Australia	5.02	7.90	57.4
Brunei	3.27	5.06	54.7
Canada	5.33	7.38	38.5
Chile	2.97	5.46	83.8
China, PR	1.95	4.18	114.4
Hong Kong, China	5.10	7.92	55.3
Indonesia	1.54	3.43	122.7
Japan	4.82	7.82	62.2
Korea	5.83	8.57	47.0
Malaysia	2.74	5.04	83.9
Mexico	2.38	3.95	66.0
New Zealand	4.79	7.64	59.5
Papua New Guinea	1.05	NA	NA
Peru	2.15	3.68	71.2
Philippines	2.07	3.34	61.4
Russian Federation	2.71	6.19	128.4
Singapore	4.83	7.65	58.4
Chinese Taipei	4.82	NA	NA
Thailand	2.17	3.54	63.1
United States	5.25	7.53	43.4
Viet Nam	1.59	3.80	139.0
REFERENCE			
AVERAGE	3.45	5.79	74.2
Standard Deviation	1.55	1.91	30.1
Correlation with 2002-2012 rate of change (%)	-0.72	-0.53	NA

Source: ITU (2013) and previous issues.

By individual APEC member economy, Korea has the highest IDI value (8.57) in 2012 followed by Hong Kong, China (7.92), Australia (7.90), Japan (7.82), Singapore (7.65), and New Zealand (7.64). For comparison, the Philippines records the lowest IDI value (3.34) in 2012 followed by Indonesia (3.43), Thailand (3.54), Peru (3.68), Viet Nam (3.80), and Mexico (3.95). Again, IDI data are not

**Figure 2. IDI 2002 and the Rate of Change (2002-2012)**

(Unit: %, index between 0 and 10)



Source: by author with IDI statistics of the ITU.

available for PNG and Chinese Taipei in 2012. There exist huge gaps in ICT development in terms of IDI values among the APEC member economies, ranging from the lowest 3.34 to the highest 8.57 in 2012. However, at the same time, remarkable progress was made in ICT development during 2002 and 2012 in every APEC member economies. The progress seems to be converging rather than diverging among the APEC member economies in that IDI values in 2002 and the rate of changes in IDI value during 2002 and 2012 are significantly negatively correlated. Or the correlation coefficient is -0.72 for the APEC member economies (refer to Table 5 and Figure 2).

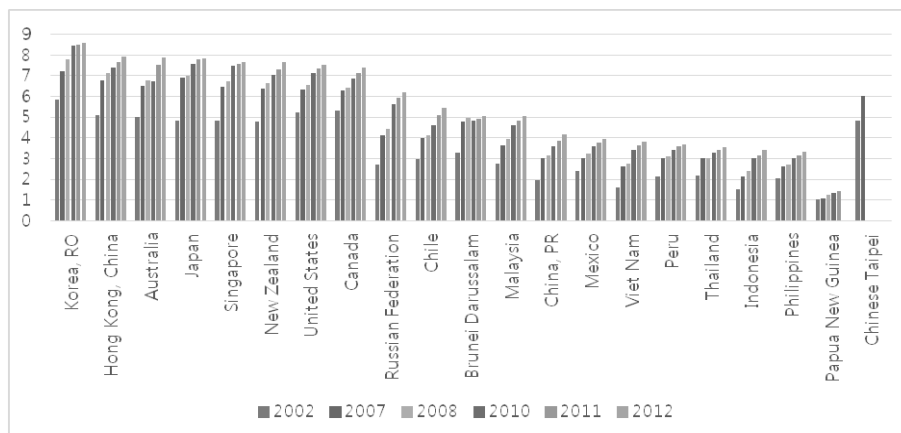
For the purpose of analysis, this study divides the APEC member economies into three groups—the Leader Group, Middle Group, and Follower Group—in terms of IDI values or ICT development stages in 2012 (refer to Table 7).

(i) The first group or the “Leader Group” is comprised of Korea, Hong Kong, Australia, Japan, Singapore, New Zealand, US, and Canada with IDI values between 7.4 and 8.6 in 2012. Their rates of change in IDI value between 2002 and 2012 range from 38.5% to 62.2%.

(ii) The second group or the “Middle Group” includes Russia, Chile, Brunei, and Malaysia with IDI values between 5.0 and 6.2 in 2012. The rates of change in IDI value for the second group between 2002 and 2012 range from 54.7% to 128.4%, significantly higher than those of the first group.

(iii) The third group or the “Follower Group” consists of China, Mexico, Viet Nam, Peru, Thailand, Indonesia, Philippines with IDI values between 3.3 and 4.2 in 2012. The rates of change in IDI value for the third group between 2002 and 2012 run from 61.4% to 139.0%, significantly or slightly higher than those of the first and second group.

In sum, there exist huge gaps in ICT development considering the wide discrepancy in IDI values among APEC member economies, although significant progress is also evident in ICT development during 2002 and 2012 in every APEC member economies. The progress seems to be converging among the APEC member economies in that there was a significantly negative correlation between IDI values in 2002 and the rates of change in IDI value during 2002-2012. That is, the rates of change in IDI value between 2002 and 2012 are much higher in the Middle Group and the Follower Group than in the Leader Group, which implies that the relative gaps among the APEC member economies have generally been reduced. The rates of change in IDI value during 2002-2012, however, are about the same between the Middle Group and the Follower Group, which seems to imply that the relative gap between the two groups has not been reduced effectively. In addition, some member economies, especially Viet Nam

**Figure 3. ICT Development Index in APEC - IDI 2002-2012**

Source: by author with data from ITU (2013) and previous issues.

(the rate of change in IDI value between 2002 and 2012 is 139.0%), Russia (128.4%), Indonesia (122.7%), and China (114.4%) have achieved extraordinary progress. It is therefore necessary for the APEC countries to recognize and share their success factors and policy experiences for further APEC cooperation.

**Table 6. Basic Statistics on ICT Development Index (IDI)**

	APEC*		World	
	2002	2012	2002	2012
Maximum	5.83	8.57	6.05	8.57
Minimum	1.54	3.34	0.51	0.99
Simple average	3.50	5.79	2.48	4.35
Standard deviation	1.49	1.91	1.45	2.19
Number of countries (economies)	19	19	154	157

Note: \* Among APEC member economies, Chinese Taipei and PNG are not included since they have no IDI value data for 2012.

Source: by author with data from ITU (2013) and previous issues.

**Table 7. APEC Member Economies in IDI**

Sub-Group	APEC member economy*	Range of index value in 2012	Rate of change (% , 2002-2012)
Leader Group	Korea, Hong Kong, Australia, Japan, Singapore, New Zealand, US, Canada	8.57 - 7.38	38.5 - 62.2
Middle Group	Russia, Chile, Brunei, Malaysia	6.19 - 5.04	54.7 - 128.4
Follower Group	China, Mexico, Viet Nam, Peru, Thailand, Indonesia, Philippines	4.18 - 3.34	61.4 - 139.0

Note: \* Among APEC member economies, Chinese Taipei and PNG are not included since they have no IDI value data for 2012.

Source: by author with data from ITU (2013) and previous issues.

For comparison, the simple average of the IDI for over 150 countries in the world has significantly increased from 2.48 in 2002 to 4.35 in 2012. The ICT development gap, however, seems to be enlarged in absolute terms with the range of IDI values changed and broadened from 0.5 - 6.1 in 2002 to 1.0 - 8.6 in 2012.

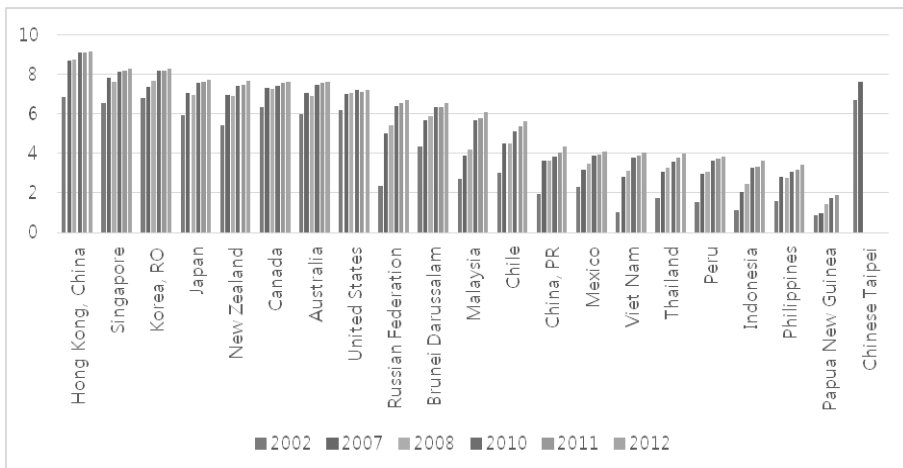
## **2) ICT infrastructure development - IDI Access Sub-Index 2002-2012**

The IDI Access Sub-Index, representing infrastructure development, in the APEC region during 2002-2012 exhibited quite similar patterns and trends as the IDI, the composite index. That is, ICT access showed great progress during the period of 2002-2012. The simple average of IDI Access Sub-Index values for the APEC member economies has risen from 3.89 in 2002 to 6.11 in 2012. Despite the overall progress, considerable gaps have still remained in ICT access among the economies. To be specific, IDI Access Sub-Index values of the APEC member economies range between 3.41 and 9.18 in 2012, up from between 1.05 and

6.86 in 2002. For comparison, the simple average of IDI Access Sub-Index values for the whole world is 4.74 in 2012 (157 countries), improved from 2.68 in 2002 (154 countries). In addition, the range of IDI Access Sub-Index values for the 157 countries is between 1.12 and 9.18 in 2012, an increase from the range between 0.29 and 7.68 in 2002.

The APEC member economies can be also classified into three groups in terms of ICT infrastructure development stages or IDI Access Sub-Index values (refer to Table 9). The economies that fall into each of the three groups are exactly the same as those in each of the three groups based on the overall IDI composite index, reflecting the fact that the largest weight, 40%, is given to the IDI Access Sub-Index among other sub-indexes comprising the IDI. In addition, what it could also imply is that ICT infrastructure development is relatively more important for overall ICT development than other factors in IDI sub-indexes such

**Figure 4. ICT Access Development in APEC - IDI Access Sub-Index 2002-2012**



Source: by author with data from ITU (2013) and previous issues.

**Table 8. Basic Statistics on IDI Access Sub-Index**

	APEC*		World	
	2002	2012	2002	2012
Maximum	6.86	9.18	7.68	9.18
Minimum	1.05	3.41	0.29	1.12
Simple average	3.89	6.11	2.68	4.74
Standard deviation	2.22	1.90	2.03	2.25
Number of countries (economies)	19	19	154	157

Note: \* Among APEC member economies, Chinese Taipei and PNG are not included since they have no IDI value data for 2012.

Source: by author with data from ITU (2013) and previous issues.

as ICT utilization and ICT human capacity during 2002-2012. Or to put it differently, most of the APEC member economies seem to be in the ICT readiness stage of ICT development denoted in Figure 1. The rates of change in IDI Access Sub-Index values between 2002 and 2012 are the highest in the Follower Group followed by the Middle Group and the Leader Group, which implies that the relative gaps in ICT access or infrastructure development among the APEC member economies have been reduced. In addition, some APEC member economies have achieved extraordinary progress in ICT access during 2002-2012

**Table 9. APEC Member Economies in IDI Access Sub-Index**

Sub-Group	APEC member economy	Range of index value in 2012	Rate of change (% , 2002-2012)
Leader Group	Korea, Hong Kong, Australia, Japan, Singapore, New Zealand, US, Canada	9.18 - 7.24	16.6 - 41.4
Middle Group	Russia, Chile, Brunei, Malaysia	6.73 - 5.65	49.9 - 185.2
Follower Group	China, Mexico, Viet Nam, Peru, Thailand, Indonesia, Philippines	4.36 - 3.41	76.4 - 284.8

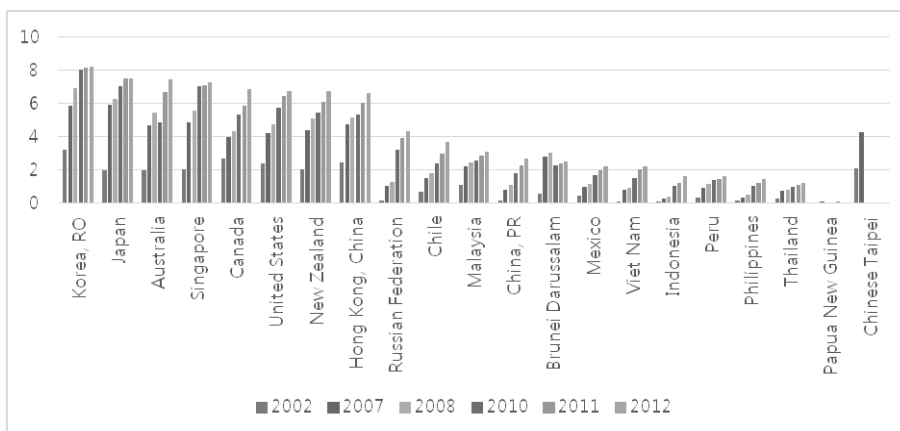
Source: by author with data from ITU (2013) and previous issues.

including Viet Nam (the rate of change in IDI Access Sub-Index value during 2002-2012 is 284.8%), Indonesia (226.1%), Russia (185.2%), Peru (153.3%), Thailand (129.9%), China (123.6%), and Malaysia (123.1%).

### 3) ICT utilization development - IDI Use Sub-Index 2002-2012

ICT Use Sub-Index values of the APEC member economies recorded a very low level in 2002, but demonstrated rapid progress during 2002-2012 compared to the IDI composite index and other sub-indexes. The simple average of ICT Use Sub-Index values of the APEC member economies stands at 4.43 in 2012, increased from 1.19 in 2002. It seems to be that ICT utilization based on ICT infrastructure led ICT development during the period of 2002-2012. However, there is a huge and enlarged gap in ICT Use Sub-index values among the APEC member economies with difference ranging between 0.06 and 3.21 in 2002 and

**Figure 5. ICT Utilization Development in APEC - IDI Use Sub-Index 2002-2012**



Source: by author with data from ITU (2013) and previous issues.



**Table 10. Basic Statistics on IDI Use Sub-Index**

	APEC		World	
	2002	2012	2002	2012
Maximum	3.21	8.22	3.21	8.25
Minimum	0.06	1.23	0.00	0.03
Simple average	1.19	4.43	0.54	2.85
Standard deviation	1.07	2.53	0.78	2.37
Number of countries (economies)	19	19	154	157

Note: \* Among APEC member economies, Chinese Taipei and PNG are not included since they have no IDI value data for 2012.

Source: by author with data from ITU (2013) and previous issues.

between 1.23 and 8.22 in 2012.

Again, the APEC member economies can be categorized into three groups in terms of ICT utilization development stages or IDI Use Sub-Index values (refer to Table 11). The countries comprising each of the three groups are the same as those falling in each of the three groups for the IDI composite index except for China, which has moved from the Follower Group to the Middle Group. This seems to reflect the fact that the IDI use sub-index is given the weight of 40% in forming the IDI composite index and that most of the APEC member economies

**Table 11. APEC Member Economies in IDI Use Sub-Index**

Sub-Group	APEC member economy	Range of index value in 2012	Rate of change (% , 2002-2012)
Leader Group	Korea, Hong Kong, Australia, Japan, Singapore, New Zealand, US, Canada	8.22 - 6.62	155.8 - 283.2
Middle Group	Russia, Chile, Brunei, Malaysia, China	4.34 - 2.53	185.3 - 3000.0
Follower Group	Mexico, Viet Nam, Peru, Thailand, Indonesia, Philippines	2.23 - 1.23	373.1 - 3600.0

Source: by author with data from ITU (2013) and previous issues.

have been actively utilizing ICT infrastructure and services. In addition, China shows stronger performance in ICT utilization than in other factors related to ICT development.

Some APEC member economies, especially those in the Middle and Follower group, have achieved extraordinary progress compared to those in the Leader group. Some of the examples include Viet Nam (the rate of change in IDI Use Sub-Index value during 2002-2012 is 3,600.0%), Russia (3,000.0%), Indonesia (2,242.9%), China (1,488.2%), and the Philippines (873.3%). APEC needs to focus its efforts on reducing the gap in ICT use among its member economies. Related policies and experiences of those successful member economies might serve as a good reference for APEC cooperation in ICT development.

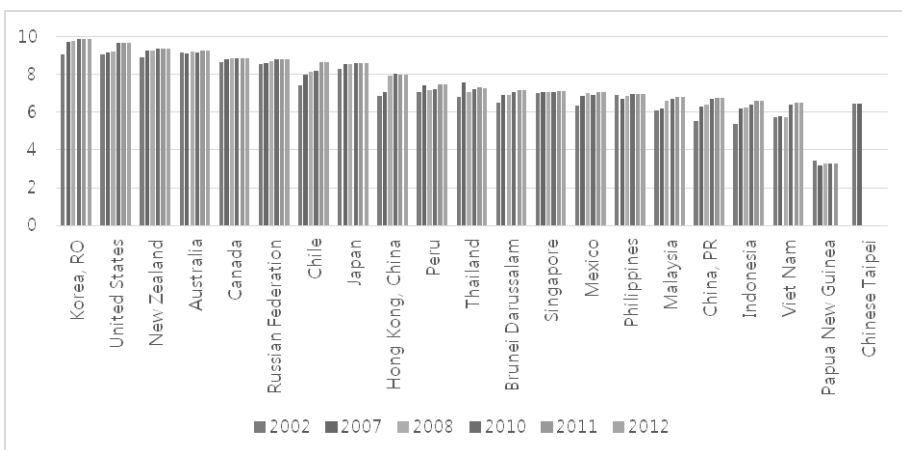
#### **4) ICT human capacity development - IDI Skills Sub-Index 2002-2012**

IDI Skills Sub-Index values of the APEC member economies were very high in 2002 and slowly progressed during 2002-2012 relative to the IDI composite index and other sub-indexes. The simple average of IDI Skills Sub-Index values for the APEC member economies is 7.94 in 2012, increased from 7.33 in 2002. The gap between APEC countries in IDI Skills Sub-Index values has also been narrowed, recording the difference ranging between 6.5 and 9.9 in 2012, a slight improvement from the range between 5.4 and 9.2 in 2002. In general, slow progress was observed regarding ICT human capacity in every APEC member economies, but Indonesia (the rate of change in IDI Skills Sub-Index value during 2002-2012 is 23.3%), China (22.4%), Chile (16.6%), and Hong Kong (16.5%) made greater progress.

The APEC member economies can also be classified into three groups in

terms of ICT human capacity development stages or IDI Skills Sub-Index values (refer to Table 13). The countries belong to each of the three groups are somewhat different from those comprising each of the three groups of the IDI composite index and other sub-indexes, which seems to reflect the fact that the weight of the IDI use sub-index is relatively small (20%) compared to that given to other sub-indexes. It could also mean that ICT human capacity is relatively more homogenized in most of the APEC member economies than ICT infrastructure and services. In addition, Russia, Chile, Peru, and Thailand are those who obtained better results in ICT human capacity than in other ICT development sub-indexes, whereas Hong Kong, Singapore, and Malaysia showed weak performance in ICT human capacity. In sum, with regard to ICT human capacity, there exists a relatively small gap (homogeneity) among the APEC member economies and slower progress was observed. However, the indicators under the

**Figure 6. ICT Human Capacity Development in APEC - IDI Skills Sub-Index 2002-2012**



Source: by author with data from ITU (2013) and previous issues.

**Table 12. Basic Statistics on IDI Skills Sub-Index**

	APEC		World	
	2002	2012	2002	2012
Maximum	9.17	9.86	9.45	9.86
Minimum	5.36	6.49	0.82	1.51
Simple average	7.33	7.94	5.95	6.59
Standard deviation	1.29	1.14	2.17	2.12
Number of countries (economies)	19	19	154	157

Note: \* Among APEC member economies, Chinese Taipei and PNG are not included since they have no IDI value data for 2012.

Source: by author with data from ITU (2013) and previous issues.

**Table 13. APEC Member Economies in IDI Skills Sub-Index**

Sub-Group	APEC member economy	Range of index value in 2012	Rate of change (% , 2002-2012)
Leader Group	Korea, Australia, Japan, New Zealand, US, Canada, Russia, Chile	9.86 - 8.62	1.3 - 16.6
Middle Group	Hong Kong, Peru, Thailand, Brunei, Singapore,	7.98 - 7.12	1.4 - 1.65
Follower Group	Malaysia, China, Mexico, Viet Nam, Indonesia, Philippines	7.09 - 6.49	0.4 - 23.3

Source: by author with data from ITU (2013) and previous issues.

IDI Skills Sub-Index need to be more specific to “ICT” skills (e.g. ICT literacy rather than literacy in general). APEC, with its diverse membership, is in an appropriate position to contribute to this end.

### 5) IDI and sub-indexes - summary

The APEC member economies classified into three groups in terms of the IDI and sub-indexes in 2012 can be summarized as in Table 14. In terms of the IDI, the Leader Group includes Korea, Hong Kong, Australia, Japan, Singapore,

New Zealand, the U.S., and Canada (8 member economies), the Middle Group consists of Russia, Chile, Brunei, and Malaysia (4 member economies), and the Follower Group is China, Mexico, Viet Nam, Peru, Thailand, Indonesia, and the Philippines (7 member economies) (Chinese Taipei and PNG are not included since they have no IDI value data for 2012). There is no change in the countries comprising the three groups for the IDI, the IDI access sub-index and the IDI use sub-index except that China has moved from the Follower Group to the Middle Group in the IDI use sub-index. It could be said that China has been strong in ICT utilization when comparing with its performance in other factors of ICT development during 2002-2012. For the IDI skills sub-index, the member countries included in each of the three groups are somewhat different from the case of the IDI and other sub-indexes and what it implies is that the overall level of ICT human capacity is more even throughout the APEC member economies than that of ICT infrastructure and services. In addition, it might reflect the fact that the indicators included in the IDI skills sub-index are not so specific to measure ICT human capacity but more appropriate to assess general intellectual capacity such as literacy rate and educational attainment. Russia, Chile, Peru, and Thailand seem to be strong in ICT human capacity relative to other aspects of ICT development. In contrast, Hong Kong, Singapore, and Malaysia seem to be weak in ICT human capacity relative to other aspects of ICT development.

The relationship between the IDI and sub-indexes can be analyzed in aggregate terms by correlation coefficient. Overall, there is a very close correlation between the IDI and the IDI access sub-index, between the IDI and the IDI use sub-index, and between the IDI access sub-index and the IDI use sub-index. The correlation coefficients recorded 0.98, 0.97, and 0.95 in 2002 and changed to 0.97, 0.99, and 0.92 in 2012, respectively. These numbers might imply the fact that the

**Table 14. Sub-groups of APEC Member Economies in IDI and Sub-Indexes**

Sub-Group / Index	IDI composite index	IDI Access Sub-index	IDI Use Sub-index	IDI Skills Sub-index
Leader Group	Korea, Hong Kong, Australia, Japan, Singapore, New Zealand, US, Canada	Korea, Hong Kong, Australia, Japan, Singapore, New Zealand, US, Canada	Korea, Hong Kong, Australia, Japan, Singapore, New Zealand, US, Canada	Korea, Australia, Japan, New Zealand, US, Canada, <i>Russia (+), Chile (+)</i>
Middle Group	Russia, Chile, Brunei, Malaysia	Russia, Chile, Brunei, Malaysia	Russia, Chile, Brunei, Malaysia, <i>China (+)</i>	<i>Hong Kong (-), Peru (+), Thailand (+), Brunei, Singapore (-)</i>
Follower Group	China, Mexico, Viet Nam, Peru, Thailand, Indonesia, Philippines	China, Mexico, Viet Nam, Peru, Thailand, Indonesia, Philippines	Mexico, Viet Nam, Peru, Thailand, Indonesia, Philippines	<i>Malaysia (-), China, Mexico, Viet Nam, Indonesia, Philippines</i>

Note: APEC member economies in italics mean that their sub-group is not the same as the one they belong in terms of the IDI. In addition, (+) and (-) mean that the country marked with (+) has moved upward (for example, from the “Follower Group” to the “Middle Group” or from the “Middle Group” to the “Leader Group”), while the country marked with (-) has moved in the downward direction when comparing with which group the country is in under the IDI.

Source: by author with data from ITU (2013) and previous issues.

improvement in ICT utilization is the result of the diffusion of ICT infrastructure following technology development during 2002-2012. In contrast, we can only observe a moderate correlation between the IDI and the IDI skills sub-index, and between the IDI skills sub-index and other IDI sub-indices. The correlation coefficients are in between 0.66 and 0.80. When comparing the correlation coefficients of 2002 data with 2012 data, we can find that the correlation coefficient between the IDI and the IDI use sub-index, and that between the IDI and the IDI skills sub-index have somewhat increased, whereas the correlation coefficient between the IDI and the IDI access sub-index has slightly decreased. In addition, the correlation coefficient between the IDI skills sub-index and the IDI access sub-index, as well as that between the IDI skills sub-index and the IDI use sub-index have risen, whereas a decrease in the correlation coefficient between the

IDI access sub-index and the IDI use sub-index was witnessed. What these results might reflect is the trend in which the importance of ICT utilization and ICT human skills have more considerably increased than that of ICT infrastructure.

**Table 15. Correlation Coefficients Among IDI and Sub-Indexes**

**(1) APEC Member Economies, 2002**

	IDI	Access sub-index	Use sub-index	Skills sub-index
IDI	1.00	0.98	0.97	0.76
Access sub-index	0.98	1.00	0.95	0.64
Use sub-index	0.97	0.95	1.00	0.66
Skills sub-index	0.76	0.64	0.66	1.00

Source: by author with data from ITU (2009).

**(2) APEC Member Economies, 2012**

	IDI	Access sub-index	Use sub-index	Skills sub-index
IDI	1.00	0.97	0.99	0.80
Access sub-index	0.97	1.00	0.92	0.68
Use sub-index	0.99	0.92	1.00	0.78
Skills sub-index	0.80	0.68	0.78	1.00

Source: by author with data from ITU (2013).

## IV. ICT Development and Economic Growth<sup>15</sup>

### 1. Reference Studies and Motivation

Even with the “Solow’s Paradox” in the early stage of the Internet and ICT development, there exist general expectations or beliefs in innovative growth spurred by ICT by now.<sup>16</sup> A number of empirical studies have tried to verify this and have been performed to analyze if ICT has contributed to economic growth and productivity improvement since the commercial diffusion of the Internet in the 1990’s.<sup>17</sup> Those studies can be roughly classified into two groups taking two different approaches. One is so called a growth accounting approach focusing on the relations between inputs of the Internet or ICT as information capital and the corresponding outputs. The other is a macroeconomic approach focusing on the effects of ICT development on overall economy overarching the consumer, industry and government sectors.

Some examples are as follows. Oliner and Sichel (2000) assessed the role of ICT in the rebound of the U.S. economy in the late 1990’s. That is, they examined the growth contribution of computer equipment and related inputs with a growth accounting approach. They estimated that ICT capital and the production

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<sup>15</sup> The statistical analysis in this part is adapted from the author’s previous publication (Chapter 2 of Nam and Lee (2013)) and modified from a viewpoint of the APEC member economies.

<sup>16</sup> Solow, Robert (1987), “We’d better watch out”, *New York Times: Book Review*, July 12, p. 36. “... You can see the computer age everywhere but in the productivity statistics. ...”

<sup>17</sup> Refer to Kretschmer (2012) for comprehensive literature survey and also refer to Nam, Sang-yirl, Yurimi Lee and Hyun-shin Park (2011).



of computers accounted for about two-thirds of the one percent point improvement in the U.S. productivity growth between the first and second halves of the 1990's. Oulton (2001) measured the contribution of ICT to the growth of both aggregate output and aggregate input with a growth accounting approach in the U.K. since 1989. It was found that the contribution of ICT had been increasing over time, i.e., ICT capital deepening accounted for 25% of the growth of labor productivity over 1989-1998 and 48% over 1994-1998.

Some economy-wide and cross-country studies have been conducted as well. As examples, EIU (2004), Qiang and Rossotto (2009), and Choi and Yi (2009). EIU (2004) examined the link between ICT and economic growth with a cross-section growth model for 60 countries (26 developed and 34 less-developed countries) during the period of 1995 and 2002. It tried to explore why the U.S. outpaced European countries in productivity growth and to identify the success factors to improve the benefits of ICT. It is estimated that ICT accounted for about 0.4 percent points of the 0.52 point difference in GDP per capita growth rates between the U.S. and three eurozone countries (Germany, France, and Italy) between 1995 and 2002. It is suggested that Europe needs to make significant progress in areas such as ICT skills, innovation, and competition to close the gap. Qiang and Rossotto (2009) tried to estimate the impact of broadband penetration on the average growth rate of per capita GDP between 1980 and 2006 using an endogenous growth model. It is a cross-country analysis of 120 countries, including both developed and developing. They estimated that each 10 percent point increase in broadband penetration (per 100 people) would bring about a 1.21 percent point increase in per capita GDP growth for developed countries (statistically significant at 1 percent significance level) and a 1.38 percent point increase in per capita GDP growth for developing countries (statistically significant at 10

percent significance level but not at 5 percent significance level), respectively. Choi and Yi (2009) adopted and analyzed an endogenous growth model incorporating the Internet variable (the ration of the Internet users to the total population) using cross-country panel data (for 207 countries from 1991 to 2000). The estimated result is that when the Internet user-total population ratio increases by 1 percent point, the growth rate would increase by between 0.049 percent point and 0.059 percent point (0.055 percent point with GMM estimation to consider any endogeneity of the explanatory variables).

Even with many previous studies on ICT development and economic growth, they need to be updated for at least two reasons. First, we experienced rapid development with the diffusion of ICT infrastructure and services utilization in fairly recent years or practically during the last decade in a global level. Second, we need to consider as many diverse aspects of ICT development as possible including infrastructure, services, and human factors rather than solely depend upon infrastructure or, more specifically, access to the Internet or broadband. For these reasons, the ICT Development Indexes (IDI) of ITU are utilized in this study. The IDI is a composite index encompassing ICT access, utilization, and human skills with accumulated data for over 150 countries in the world over the period of 2002-2012.<sup>18</sup>

In this study, our focus is on the APEC member economies and regional cooperation in APEC. Two mutually complementary approaches are adopted and applied. One is a production function-based country level cross-section approach where the level of ICT development denoted by the IDI is considered the third input factor in addition to labor and capital. The other is an endogenous growth

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<sup>18</sup> Currently, IDI data are available for 2002, 2007, 2008, 2010, 2011, and 2012. Refer to ITU (2009), ITU (2010), ITU (2011), ITU (2012), and ITU (2013).

model-based approach taken by Barrow (1997) and Choi and Yi (2009), which includes mid- to long-term trends of ICT development (the IDI) as an explanatory variable for the long term growth rate of per capita income. The main results of two approaches for 155 countries with IDI availability are as follows. First, 1 percent point improvement in ICT development or the Internet economy denoted by the IDI would bring about a 0.10 percent point increase in per capita income (GDP) growth rate in reference to the mid- to long-term trends of 2002-2011. Second, 1 percent improvement in ICT development or the Internet economy denoted by the IDI would bring about a 0.53-0.57 percent increase in GDP growth in reference to the production function-based cross-country analysis for 2011. The former can be interpreted to reflect relatively mid- to long-term trends whereas the latter can be considered to show short-term trends or the current structure.

## 2. Production Function Approach

The relationship between ICT development and economic growth can be estimated by utilizing a production function and considering ICT development denoted by the IDI the third input factor in addition to labor and capital. To simplify our analysis, the Cobb-Douglas production function is adopted and estimated with cross-country data on 155 countries for the year of 2011 with IDI data availability. We also try to estimate the equation with the one-year lagged input of ICT ( $ICT(-1)$ ) as well as the ICT input of the same year to avoid the endogeneity problem. Besides, an APEC member economy dummy variable is added to estimate any APEC specific effects.

$$GDP_i = F(K_i, L_i, ICT(-1)_i)$$

where  $GDP_i$  is gross domestic product,  $K_i$  is capital stock,  $L_i$  is labor input, and  $ICT(-1)_i$  is the level of ICT input in country  $i$  in the previous year, respectively.

With the characteristics of homogeneity of degree one, all the variables of the Cobb-Douglas production function can be denoted by per capita or per unit of labor form. In addition, the Cobb-Douglas production function is linearized by taking logarithm and estimated with the ordinary least squares (OLS) method. One of the estimated results (equation) is as follows,

$$\log(YP_i) = 2.404^{**} + 0.778^{**} \log(KP_i) + 0.575^{**} \log(IDI(-1)_i) \quad R^2=0.967$$

$$(0.196) \quad (0.045) \quad (0.114)$$

where  $YP_i$  is per capita GDP,  $KP_i$  is capital-labor ratio, and  $IDI_i$  is ICT Development Index for country  $i$  for 128 (155) countries in 2011,  $\log$  denotes the logarithm transformation, the numbers in the parenthesis under each estimate denote standard errors, (-1) after the variable name denotes the lagged variable with the previous year's value, and \*\* indicates significance at the 1% level.

From the estimation results, it is found that 1% improvement in ICT development or the Internet economy denoted by the IDI would bring about from a 0.53% (with the same year's ICT input) to 0.57% (with one-year lagged ICT input) increase in per capita GDP growth in reference to the cross-country analysis for 2011. Therefore, the effects are estimated to be somewhat larger when ICT input is denoted with one year lag. The estimates are also significantly larger compared with other preceding studies in that a 10% point increase in Internet users or broadband subscribers would bring about a 0.5-1.4% point increase in

GDP growth, and a 10% increase in electronic commerce would bring about a 3.1% point increase in productivity in the wholesale and retail sector.<sup>19</sup> Besides, the APEC dummy variable (D\_APEC) is added in the equation to check, if any, APEC member economy specific characteristics. As a result, we are not able to identify any significant APEC specific characteristics. This result seems to reflect the fact that the APEC member economies are very diverse in terms of economic development, geographic distribution, ICT development and can be said, in some sense, a reduced form of the world economy.

**Table 16. Estimation Results - Production Function Approach (2011)**

Dep. Variable/ Indep. Variables	(1) YP		(2) YP		(3) YP		(4) YP	
	Estimated coefficient	Standard error	Estimated coefficient	Standard error	Estimated coefficient	Standard error	Estimated coefficient	Standard error
Constant	2.404**	0.196	2.387**	0.198	2.291**	0.188	2.274**	0.190
KP	0.778**	0.045	0.782**	0.045	0.798**	0.044	0.802**	0.045
IDI					0.528**	0.114	0.524**	0.114
IDI(-1)	0.575**	0.114	0.572**	0.115				
D_APEC			-0.055	0.072			-0.053	0.073
Goodness of Fit ( $R^2$ )	0.967		0.964		0.966		0.966	
Number of Observation (total)	128 (155)		128 (155)		128 (155)		128 (155)	

Notes: 1. All the variables are transformed by logarithm.

2. (-1) denotes one year lagged variable and D\_APEC is the APEC dummy variable (that is, 1 for APEC member economies and 0 otherwise).

3. \*\* indicates significance at the 1% level.

<sup>19</sup> Refer to the Boston Consulting Group (2010).

### 3. Endogenous Growth Model Approach

As an alternative and complementary to the production function approach, the endogenous growth model was applied based on Choi and Yi (2009), and Barrow (1997) with ICT development (or the IDI) as an additional explanatory variable denoting technological progress.

$$growth\_yp_i = g(GDP_{pc2002i}, I\_KF/GDP_i, GE/GDP_i, inflation_i, IDI_i)$$

where  $growth\_yp_i$  is annual average rate (percent) of growth in per capita GDP for country  $i$  during 2002-2011,  $GDP_{pc2002i}$  is per capita GDP (in US dollar and transformed by logarithm) for country  $i$  in the initial year of 2002,  $I\_KF/GDP_i$  is fixed capital investment relative to GDP (percent) in country  $i$ ,  $GE/GDP_i$  is government expenditure relative to GDP (percent) in country  $i$ ,  $inflation_i$  is inflation rate in country  $i$ ,  $IDI_i$  is ICT Development Index (adjusted to have value between 0 and 100) of country  $i$ . All the variables except  $GDP_{pc2002i}$  is measured as the average of available data during 2002-2011. Again, the APEC member economy dummy variable will be added to estimate any APEC specific effects.

One of the estimated results (equation) is as follows,

$$yp_i = 5.608^{**} - 1.275^{**} YP_i + 0.203^{**} KFP_i - 0.078^* GP_i + 0.075^* inf_i$$

$$(1.888) \quad (0.293) \quad (0.031) \quad (0.037) \quad (0.036)$$

$$+ 0.101^{**} IDI\_100_i$$

$$(0.025)$$

$$R^2=0.388$$

where  $yp_i$  is the rate of growth for per capita GDP,  $KFP_i$  is fixed capital investment-GDP ratio,  $GP_i$  is government expenditure-GDP ratio,  $inf_i$  is inflation rate, and  $IDI_{100}_i$  is ICT Development Index with scale adjusted between 0 and 100 for country  $i$  for 142(155) countries, all variables are annual average during 2002 and 2011 except that  $YP_i$  is per capita GDP (in US dollar and transformed by logarithm) in 2002, the initial year of analysis. The numbers in the parenthesis under estimate denote standard errors, and \* and \*\* indicate significance at the 5% and 1% level, respectively.

From the estimation results, it is found that 1% point improvement in ICT development or the Internet economy denoted by the IDI (adjusted to have a value between 0 and 100) would bring about a 0.10% point increase in per capita GDP growth rate in reference to the cross-country analysis during 2002-2011. These results are consistent with previous studies, which found that a 10% point increase in Internet users or broadband subscribers would bring about a 0.5-1.4% increase in GDP growth. For other variables, per capita GDP in the initial year is negatively correlated with the growth rate of per capita GDP, which implies that per capita income gaps among different countries would converge in the long run. Besides, fixed capital investment relative to GDP might have positive effect on the growth rate of per capita GDP in the long run. In contrast, government expenditure relative to GDP seems to have negative (crowded out) effect on the growth rate of per capita GDP in the long run, but with less statistical significance relative to other variables. Inflation, on the other hand, would have positive effect on the growth rate of per capita GDP in the long run. All of these results are much similar to those of previous studies and confirm that ICT development would have significant effect on the growth rate of per capita GDP in the extended time period. However, no significant APEC specific characteristics are

**Table 17. Estimation Results - Endogenous Growth Model Approach (2002-2011)**

Dep. Variable/ Indep. Variables	(1) yp		(2) yp		(3) yp		(4) yp	
	Estimated coefficient	Standard error	Estimated coefficient	Standard error	Estimated coefficient	Standard error	Estimated coefficient	Standard error
Constant	5.608**	1.888	5.601**	1.902	6.976**	1.779	6.990**	1.788
YP	-1.275**	0.293	-1.274**	0.294	-1.385**	0.291	-1.386**	0.292
KFP	0.203**	0.031	0.203**	0.031	0.205**	0.031	0.205**	0.031
GP	-0.078*	0.037	-0.077*	0.039	-0.080*	0.037	-0.082*	0.039
inf	0.075*	0.038	0.075*	0.038				
IDI_100	0.101**	0.025	0.101**	0.025	0.102**	0.025	0.103**	0.025
D_APEC			0.024	0.547			-0.081	0.550
Goodness of Fit (R <sup>2</sup> )	0.388		0.388		0.370		0.370	
Number of Observation (total)	142 (155)		142 (155)		142 (155)		142 (155)	

Notes: 1. All the variables are annual average (percent) during 2002 and 2011 except that YP is per capita GDP (in US dollar and transformed by logarithm) in 2002, the initial year of analysis.

2. D\_APEC is the APEC dummy variable (that is, 1 for APEC member economies and 0 otherwise).

3. \* and \*\* indicate significance at the 5% and 1% level, respectively.

found as for the case of the production function approach.

#### 4. ICT Development and Potential Economic Growth in APEC

To identify the potential effect of ICT development or the Internet economy in APEC, the estimation results of the endogenous growth model approach are utilized.<sup>20</sup> In addition, three different scenarios of ICT development are intro-

<sup>20</sup> The similar analysis can be done with the estimation results of the production function approach. However, the estimates of the IDI coefficient seem to be much larger relative to those from previ-



duced for more flexible analysis.

(i) Scenario I - The level of ICT development in terms of the IDI improves by 30% from the current level (2012) in each APEC member economy.

(ii) Scenario II - The level of ICT development in terms of the IDI improves by 30% of the gap between the current and perfect level (10.0) in each APEC member economy.

(iii) Scenario III - The level of ICT development in terms of the IDI improves to the perfect level (10.0) in each APEC member economy.

For each scenario, the potential effects of ICT development on economic growth can be analyzed. As in the previous analysis, the APEC member economies can be classified into three different groups (the Leader Group, the Middle Group, and the Follower Group) according to their level of ICT development or the IDI. The impacts of ICT development on APEC as a whole can be measured by the weighted average of those on the three groups with their economy size (GDP). That is, this process has been performed on from individual member economies to three groups and then APEC as a whole. The potential impacts estimated from the simulation analysis are as follows.

APEC as a whole, per capita GDP is estimated to grow about 2.0%, 1.1% and 3.5% for Scenario I, II and III, respectively. It needs to be noted that these are additional changes in average annual rate of per capita GDP growth and hence not one-time changes but permanent shifts.

For Scenario I, however, the economic development gap will be enlarged by

the APEC sub-group (Leader, Middle, and Follower) with the growing ICT development gap. For Scenario II and III, the economic development gap among the APEC member economies will be reduced as ICT development proceeds, naturally much larger effects with Scenario III than with Scenario II. Therefore, APEC cooperation needs to encourage ICT development in the APEC region to preferably follow the path of Scenario II or Scenario III rather than that of Scenario I. In other words, APEC needs to make efforts to reduce the ICT development gap among member economies, especially in ICT utilization, together with continued efforts to narrow the gap in ICT infrastructure, which made great progress in the previous decade.

**Table 18. Simulation Results - Impacts on per Capita GDP Growth**

(Unit: %)

Scenario/Group	APEC Total	IDI Leader Group	IDI Middle Group	IDI Follower Group
Scenario I	1.99	2.33	1.82	1.23
Scenario II	1.06	0.71	1.22	1.81
Scenario III	3.52	2.38	4.08	6.05
REFERENCE				
Economic growth rate (2002-2012 annual average, %)	3.20	0.92	4.54	8.23
Rate of IDI changes (2002-2012, %)	68.7	48.6	103.8	106.6

Notes: 1. Scenario I denotes the situation when the level of ICT development in terms of the IDI improves by 30% from the current level (2012) in each APEC member economy, or  $(1.3 * IDI)$ .

2. Scenario II denotes the situation when the level of ICT development in terms of the IDI improves by 30% of the gap between the current and perfect level (10.0) in each APEC member economy, or  $(IDI + 0.3 * (10.0 - IDI))$ .

3. Scenario III denotes the situation when the level of ICT development in terms of the IDI improves to the perfect level (10.0) in each APEC member economy, or  $(IDI = 10.0)$ .

4. For comparison, economic growth is the annual average rate (%) and IDI change is the rate of change (%) between 2002 and 2012.

## V. Implications for APEC Cooperation

The scope of APEC cooperation is evolving and broadening to address the current and emerging issues of the Asia-Pacific region. One of the recent emphases of APEC is to play a role as an engine of global economic growth with its dynamic nature. For this purpose, APEC is focusing on innovation and economic growth, and the Internet economy as a new source of growth and job creation. Or to put it in another way, APEC is promoting connectivity (in the realms of physical, institutional, and people-to-people) and accelerating regional economic integration.<sup>21</sup> This trend can be also found in the theme and priorities of APEC 2014. In addition, China, as the host economy of APEC 2014, proposed “Developing the Internet Economy through Enhanced ICT Cooperation”.

Having these trends of APEC in mind, this study tried to examine ICT development in the APEC member economies with the ICT Development Index of ITU. The ICT Development Index, as a composite index encompassing ICT infrastructure, ICT use, and ICT human skills, is a useful tool for analyzing the current status of ICT development and cooperation efforts in APEC with its diverse member economies. Some findings and implications from the analysis are as follows.

First, even though there exist huge gaps among countries, ICT as a whole has developed significantly in APEC and the gaps among the APEC member economies have been reduced in general during 2002-2012. The progress seems to be

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<sup>21</sup> Refer to APEC (2014b).

converging rather than diverging among the APEC member economies in that IDI values in 2002 and the rate of changes in IDI value during 2002 and 2012 are significantly negatively correlated. Or the correlation coefficient is  $-0.72$  for the APEC member economies.

Second, with regard to the subcategories of ICT development, ICT access or infrastructure diffusion also showed very similar trends to the overall ICT development in the region, possibly due to significant investments in ICT infrastructure in most of the APEC member economies during the period of 2002 and 2012. The close relationship between the IDI and the ICT access sub-index seems to imply that ICT infrastructure development is relatively more important for overall ICT development than other IDI sub-indexes such as ICT utilization and ICT human capacity during 2002-2012. In other words, most of the APEC member economies seem to be in the ICT readiness stage of ICT development as shown in Figure 1.

Third, overall, ICT utilization of APEC member economies started from a very low level in 2002, but demonstrated rapid progress during 2002 and 2012 relative to the IDI and other sub-indexes. It seems to be that ICT utilization based on ICT infrastructure development led the overall ICT development during the period of 2002-2012. However, there exist huge and enlarged gaps in ICT Use Sub-Index values among the APEC member economies, ranging between 0.06 and 3.21 in 2002 and between 1.23 and 8.22 in 2012. In sum, the ICT utilization sub-section has also improved significantly but with an enlarged gap among the APEC member economies, and there seems to be a time lag between progress in ICT utilization and ICT access or infrastructure development. This trend might suggest that there needs to be more focused cooperation efforts on reducing the gap in ICT use, especially, for example, services, software and ICT culture,

among the APEC member economies.

Fourth, the IDI Skills Sub-Index started from a very high level with relatively small gaps among the APEC member economies in 2002, and showed slow progress between 2002 and 2012 relative to the IDI and other sub-indexes. ICT human capacity seems to be relatively more homogeneous in most of the APEC member economies than ICT infrastructure and services development. In addition, Russia, Chile, Peru, and Thailand showed stronger performance in ICT human capacity relative to other sub-indexes of ICT development. In sum, regarding ICT human capacity, there exist relatively small gaps (homogeneity) among the APEC member economies and slow progress was observed. However, the indicators included in the IDI Skills Sub-Index need to be more specific to measure “ICT” skills, for example, ICT literacy rather than literacy in general. APEC, with its diverse member economies, seems to be in an appropriate position to contribute to this end.

Fifth, from the analysis of the correlation between the IDI and the IDI sub-indexes in aggregate terms between 2002 and 2012, we can observe a very close correlation between the IDI and the IDI access sub-index, between the IDI and the IDI use sub-index, and between the IDI access sub-index and the IDI use sub-index. The results might imply that the enhancement in ICT utilization is the result of the diffusion of ICT infrastructure following technology development during the period of 2002 and 2012. In addition, if we compare the correlation between 2002 and 2012, the correlation coefficient between the IDI and the IDI use sub-index, and between the IDI and the IDI skills sub-index have somewhat increased but that between the IDI and the IDI access sub-index has decreased. In addition, the correlation coefficient between the IDI skills sub-index and the IDI access sub-index, and between the IDI skills sub-index and the

IDI use sub-index have risen whereas that between the IDI access sub-index and the IDI use sub-index has gone down. These results might reflect the trends in which the importance ICT utilization and ICT human skills has been increasing more significantly relative to that of ICT infrastructure.

Sixth, ICT development is expected to bring about significant progress in economic growth in each APEC member economy as well as APEC as a whole. ICT development can greatly affect the future trends of economic growth and convergence among the APEC member economies, hence strengthening APEC regional cooperation. This study updates previous studies on ICT and economic growth by considering factors not just related to ICT infrastructure such as access to the Internet or broadband, but comprehensive aspects of ICT development including ICT infrastructure, ICT utilization, and ICT human skills. Besides, two complementary approaches are applied, i.e., the endogenous growth model reflecting long-term trends and the production function approach reflecting the more recent structure. The impact of ICT development on economic growth is estimated to be much larger with the recent structure than with long-term trends. However, there needs to be further research to verify the relationship more accurately.

Seventh, in sum, APEC needs to make efforts to reduce the ICT development gap among member economies, especially in ICT utilization, together with continued efforts to reduce the gap in ICT infrastructure, which is regarded as an achievement of the previous decade. APEC can share the experience of member economies with extraordinary progress in ICT development between 2002 and 2012, such as Viet Nam, Russia, Indonesia, China, Philippines, Peru, Malaysia, etc. APEC needs to identify and share their success factors and policy experiences.

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## Appendix

**Table A1. ICT Development Index – World and APEC Member Economies  
(2002-2012)**

COUNTRY / YEAR	2002	2007	2008	2010	2011	2012
Albania	1.92	2.74	2.99	3.48	3.80	4.11
Algeria	1.61	2.47	2.41	2.86	2.98	3.07
Antigua and Barbuda			5.32	5.35	5.70	5.74
Argentina	3.06	4.13	4.16	4.72	5.06	5.36
Australia	5.02	6.51	6.78	6.75	7.54	7.90
Austria	4.64	6.25	6.41	6.74	7.10	7.36
Azerbaijan	1.71	2.77	2.97	3.83	4.62	5.01
Bahrain	3.30	4.95	5.16	5.19	5.79	6.30
Barbados			5.47	5.91	6.01	6.65
Belarus	2.53	3.77	3.93	5.08	5.57	6.11
Belgium	4.91	6.10	6.31	6.60	6.85	7.16
Benin	0.76	1.20	1.27	1.49	1.57	1.60
Bhutan	1.17	1.48	1.58	1.92	2.19	2.40
Bolivia	2.03	2.39	2.54	2.93	3.08	3.28
Bosnia and Herze- govina	2.33	3.38	3.58	4.21	4.49	4.71
Botswana	1.70	2.08	2.25	2.50	2.83	3.00
Brazil	2.55	3.49	3.72	4.17	4.59	5.00
Brunei Darussalam	3.27	4.77	4.97	4.85	4.93	5.06
Bulgaria	2.74	4.42	4.75	4.87	5.50	5.83
Burkina Faso	0.68	0.93	0.98	1.06	1.11	1.18
Cambodia	1.07	1.53	1.63	1.88	2.05	2.30
Cameroon	1.12	1.37	1.40	1.54	1.66	1.72
Canada	5.33	6.30	6.42	6.87	7.14	7.38
Cape Verde	1.67	2.27	2.50	2.90	3.18	3.53
Central African Republic				0.96	1.00	1.00
Chad	0.65	0.73	0.80	0.85	0.94	1.01
Chile	2.97	3.99	4.14	4.63	5.08	5.46
China	1.95	3.03	3.17	3.58	3.86	4.18
Colombia	2.13	3.27	3.39	3.73	3.89	4.20

COUNTRY / YEAR	2002	2007	2008	2010	2011	2012
Comoros	0.91	1.41	1.44	1.64	1.68	1.70
Congo, Dem. Rep.	0.92	1.13	1.04	1.18	1.30	1.31
Costa Rica	2.54	3.31	3.45	3.94	4.47	5.03
Congo, Rep.	1.10	1.36		1.55	1.58	1.66
Cote d'Ivoire	1.01	1.37	1.43	1.62	1.66	1.70
Croatia	3.19	4.95	5.43	5.54	6.14	6.31
Cuba	1.94	2.62	2.62	2.66	2.66	2.72
Cyprus	3.78	4.91	5.02	5.64	5.71	5.86
Czech Republic	3.74	4.92	5.42	5.89	6.30	6.40
Denmark	5.78	7.18	7.46	8.01	8.18	8.35
Djibouti		1.48	1.56	1.65	1.71	1.77
Dominican Republic	1.97	2.73	2.84	3.19	3.36	3.58
Ecuador	1.97	2.73	2.87	3.41	3.73	4.08
Egypt, Arab Rep.	1.81	2.44	2.73	3.44	3.65	3.85
El Salvador	1.74	2.45	2.57	2.89	3.06	3.25
Eritrea	0.96	1.03	1.03	1.08	1.15	1.20
Estonia	3.93	5.86	5.81	6.36	6.74	7.28
Ethiopia	0.78	0.97	0.94	1.09	1.22	1.24
Fiji	2.00	2.69	2.82	3.08	3.79	3.99
Finland	5.38	6.70	6.92	7.89	7.99	8.24
France	4.37	6.09	6.48	7.08	7.26	7.53
Gabon	1.48	2.08	2.10	2.40	2.46	2.61
Gambia, The	0.96	1.50	1.59	1.75	1.79	1.88
Georgia	2.13	2.87	2.96	3.75	4.24	4.59
Germany	5.02	6.60	6.87	7.18	7.33	7.46
Ghana	1.10	1.54	1.68	1.81	2.30	2.60
Greece	3.94	5.28	5.70	5.88	6.21	6.45
Guinea		0.85	1.16	1.25	1.19	1.26
Guyana			2.73	3.02	2.96	3.08
Honduras	1.31	2.32	2.42	2.71	2.70	2.74
Hong Kong SAR, China	5.10	6.78	7.14	7.39	7.66	7.92
Hungary	3.49	5.18	5.47	5.53	5.91	6.10
Iceland	5.88	7.06	7.12	7.96	8.12	8.36
India	1.19	1.62	1.72	1.98	2.13	2.21
Indonesia	1.54	2.15	2.39	3.01	3.14	3.43
Iran, Islamic Rep.	1.93	2.73	2.96	3.35	3.61	3.79
Ireland	4.36	6.14	6.43	6.99	7.10	7.25
Israel	4.24	5.93	6.20	6.41	6.70	7.11
Italy	4.38	5.91	6.10	6.13	6.43	6.57

COUNTRY / YEAR	2002	2007	2008	2010	2011	2012
Jamaica	2.79	3.52	3.06	3.42	3.54	3.68
Japan	4.82	6.89	7.01	7.57	7.77	7.82
Jordan	2.36	2.98	3.29	3.61	3.90	4.22
Kazakhstan	2.18	3.17	3.39	4.65	5.41	5.74
Kenya	1.21	1.52	1.74	2.07	2.23	2.46
Korea, Rep.	5.83	7.23	7.80	8.45	8.51	8.57
Lao PDR	1.08	1.60	1.64	1.84	1.99	2.10
Latvia	3.30	4.95	5.31	5.80	6.00	6.36
Lebanon	2.53	3.02	3.12	4.11	4.62	5.37
Liberia				1.20	1.27	1.39
Lithuania	3.17	5.22	5.44	5.88	5.79	5.88
Luxembourg	4.62	6.98	7.34	7.64	7.76	7.93
Macao SAR, China	4.41	5.73	5.84	7.38	7.57	7.65
Madagascar	0.96	1.27	1.20	1.41	1.28	1.28
Malawi	0.95	1.20		1.37	1.41	1.43
Malaysia	2.74	3.66	3.96	4.63	4.81	5.04
Maldives	1.96	3.11	3.54	3.92	4.31	4.53
Mali	0.75	1.08	1.11	1.24	1.43	1.54
Malta	4.04	5.48	5.68	6.30	6.85	7.25
Mauritius	2.45	3.30	3.43	3.95	4.23	4.55
Mexico	2.38	3.03	3.26	3.60	3.78	3.95
Moldova	2.13	3.11	3.57	4.24	4.46	4.74
Mongolia	1.97	2.61	2.90	3.36	3.59	3.92
Morocco	1.37	2.33	2.60	3.19	3.59	3.79
Mozambique	0.77	0.97	1.10	1.26	1.26	1.31
Myanmar	1.64	1.60		1.65	1.70	1.74
Mauritania	1.00	1.43	1.50	1.53	1.70	1.76
Macedonia, FYR	2.65	3.40	4.20	4.90	4.93	5.19
Namibia	1.58	1.95	2.06	2.27	2.60	2.85
Nepal	1.01	1.27	1.28	1.55	1.63	
Netherlands	5.43	7.06	7.30	7.60	7.85	8.00
New Zealand	4.79	6.38	6.65	7.03	7.31	7.64
Nicaragua	1.37	2.08	2.09	2.31	2.39	2.54
Niger	0.51	0.86	0.79	0.88	0.93	0.99
Nigeria	1.09	1.36	1.54	1.75	1.96	2.18
Norway	5.64	6.78	7.12	7.39	7.97	8.13
Oman	2.12	3.17	3.45	4.75	4.80	5.36
Pakistan	0.89	1.45	1.59	1.71	1.78	1.83
Panama	2.42	3.39	3.52	4.21	4.38	4.61

COUNTRY / YEAR	2002	2007	2008	2010	2011	2012
Papua New Guinea	1.05	1.06	1.24	1.36	1.44	
Paraguay	2.02	2.46	2.66	2.94	3.10	3.21
Peru	2.15	3.03	3.12	3.43	3.58	3.68
Philippines	2.07	2.61	2.69	3.04	3.14	3.34
Poland	3.34	4.95	5.29	6.09	6.22	6.31
Portugal	3.87	5.32	5.70	5.86	6.07	6.32
Qatar	2.84	4.25	4.50	5.94	6.41	6.54
Romania	2.48	4.11	4.67	4.89	5.05	5.35
Russian Federation	2.71	4.13	4.42	5.61	5.94	6.19
Rwanda	0.99	1.11	1.18	1.50	1.54	1.66
Saudi Arabia	2.13	3.76	4.13	4.81	5.46	5.69
Senegal	0.95	1.34	1.46	1.76	1.88	2.02
Serbia		3.85	4.51	5.04	5.38	5.34
Seychelles		3.44	3.56	4.00	4.36	4.75
Singapore	4.83	6.47	6.71	7.47	7.55	7.65
Slovak Republic	3.51	4.86	5.30	5.63	5.85	6.05
Slovenia	4.47	5.77	6.19	6.54	6.60	6.76
Solomon Islands				1.67	1.91	1.97
South Africa	2.11	2.64	2.71	3.20	3.67	3.95
Spain	4.10	5.84	6.18	6.31	6.65	6.89
Sri Lanka	1.75	2.32	2.41	2.74	2.92	3.06
St. Lucia				4.36	4.28	4.43
St. Vincent and the Grenadines		4.10		4.58	4.71	4.81
Swaziland	1.32	1.78	1.80	2.06	2.27	2.44
Sweden	6.05	7.27	7.53	8.21	8.41	8.45
Switzerland	5.42	6.83	7.06	7.48	7.62	7.78
Syrian Arab Republic	1.69	2.65	2.66	3.01	3.13	3.22
Tanzania	0.96	1.05	1.23	1.52	1.57	1.65
Thailand	2.17	3.03	3.03	3.29	3.42	3.54
Togo	1.03	1.27	1.36	1.59	1.65	
Tonga				2.94	3.09	3.23
Trinidad and Tobago	2.50	3.61	3.99	4.42	4.54	4.73
Tunisia	1.86	2.74	2.98	3.42	3.58	3.70
Turkey	2.41	3.63	3.81	4.17	4.47	4.64
Turkmenistan	1.96	2.27	2.15	2.44	2.49	
Tuvalu				2.23	2.46	
Uganda	0.92	1.21	1.24	1.53	1.72	1.81
Ukraine	2.50	3.56	3.83	4.20	4.38	4.64
United Arab Emirates	3.27	5.20	5.63	5.41	5.68	6.41

COUNTRY / YEAR	2002	2007	2008	2010	2011	2012
United Kingdom	5.27	6.70	7.03	7.35	7.63	7.98
United States	5.25	6.33	6.55	7.11	7.35	7.53
Uruguay	2.90	3.96	4.21	4.89	5.38	5.76
Uzbekistan	1.75	2.06	2.22	2.77	3.02	3.12
Vietnam	1.59	2.61	2.76	3.41	3.65	3.80
Zambia	1.08	1.26	1.44	1.53	1.64	1.77
Yemen, Rep.	1.04	1.48	1.49	1.70	1.76	1.89
Zimbabwe	1.29	1.43	1.49	1.89	2.16	2.52
Venezuela, RB	2.18	3.33	3.73	3.78	4.00	4.17

Notes: 1. Bold denotes APEC member economies.

2. Denote the most recent data if the index value has updated.

Source: ITU (2013) and previous issues.

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## 국문요약

정보통신기술(ICT)과 인터넷 경제(Internet economy)의 발전은 APEC의 출범(1989년) 초기부터 아태지역 협력의 주요 관심대상 가운데 하나였다. APEC은 아태정보사회(Asia-Pacific Information Society, APIS)의 구축을 촉진하기 위한 목적으로 1990년 정보통신 실무그룹(Telecommunications and Information Working Group, TEL 또는 TELWG)을 설립하고, 회원경제간 관련 협력을 지속적으로 추진해오고 있다. 이 연구는 APEC 회원경제들을 대상으로 ICT 발전 또는 인터넷 경제가 가져올 경제적 혜택—아태지역의 혁신적 발전 촉진, 새로운 경제성장의 원동력 제공 등—에 관심을 가지고 분석하는 것을 목적으로 한다. 먼저 APEC과 TELWG의 활동과 중점 추진사업 등을 개관해보고, APEC 회원경제들의 ICT 및 인터넷 경제 발전 현황과 추이를 국제전기통신연합(ITU)의 ICT 발전지수(ICT Development Index, IDI)를 통하여 분석하였다. ICT 발전지수는 이전의 관련 국제 비교지수들이 주로 인터넷 또는 브로드밴드 가입자 수와 같은 정보통신 기반구조의 보급 측면만을 고려하고 있는 것과 달리, 정보통신 기반구조 및 서비스의 이용과 활용을 위한 인적역량 등을 동시에 균형적으로 고려하고 있다는 점에서 차별화된다. APEC 회원경제들에 대한 현황분석을 바탕으로 향후 추가적인 ICT 발전이 경제성장 또는 경제전반의 생산성 증가 등에 미칠 잠재적 영향을 분석하고, 아태지역 협력에 주는 시사점을 정리하였다. 이를 통하여 얻을 수 있는 주요 시사점은 다음과 같다. APEC 회원경제들간에 전반적인 ICT 발전과 특히 ICT 기반구조의 보급 면에서 아직 상당한 격차가 남아 있으나, ICT 발전지수가 작성·발표된 2002~12년의 기간 동안 모든 APEC 회원경제들에서 상당한 발전이 있었고 회원경제들간의 격차가 감소한 것으로 파악된다. 한편 ICT 이용과 관련된 세부분야에서는 같은 기간 동안 모든 APEC 회원경제들에서 상당한 발전이 있었으나, 회원경제들간의 격차가 더욱 심화된 것으로 나타났다. 따라서 향후 APEC의 협력이 있어서는 지금까지 ICT 기반구조 보급 면에서의 상당한 발전과 회원경제간 격차의 감소 추세를 지속적으로 유지하는 것과 함께 ICT 이용 면에서 격차의 심화 추세에 대응하고 해소하기 위한 노력을 더욱 강화해야 할 것이다. 이와 관련하여 APEC 회원경제들의 추가적인 ICT 발전은 아태지역 전체뿐 아니라 개별 회원경제들의 경제성장과 생산성 증가에도

중요한 영향을 미칠 것으로 나타났다. 향후 아태지역의 ICT 발전을 위한 협력에 있어서는 특히 지난 2002~12년의 기간 동안 상대적으로 매우 빠른 발전을 달성한 베트남, 러시아, 인도네시아, 중국, 필리핀, 인도네시아, 말레이시아 등의 성공요인과 정책경험을 분석하고 공유할 필요가 있다고 판단된다.

**핵심용어:** ICT 발전, 인터넷 경제, APEC, 아태지역 협력



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## **저서 및 논문**

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