Can ICT Economically Catalyze a Regional GDP Per Capita Convergence? － A Case Study of Major East Asian Countries －

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Abstract：ICT have played a significant role in the economic growth for developed and developing countries in the world and no region has been more dynamic in recent years than East Asia, which is one of the most important geographic regions based on ICT. In this point, firstly, historical background of major East Asian countries on ICT developments is given in this study by focusing on telecommunications sector. On the other hand, we examined Gross Domestic Product（GDP）per capita income distributions of major East Asian countries in our previous study and it is observed that there are some evidences for regional convergence as a weak Beta-convergence and a strong Sigma-convergence after 1992 within homogeneous regions of major East Asian countries. Even though there have been many important empirical and theoretical studies on GDP growth related with ICT in the literature, there is no specific focusing study on how ICT can affect GDP per capita convergence among countries and its correlations with GDP per capita growths within countries. For this reason, secondly, we used a sample equation for ICT developments for each country and analyzed the correlations of unit changes within countries according to the years that played an important part resulting in regional convergence in terms of Neoclassical Growth Model. As the methodology of the study, the multiple correlation coefficient（MCC）was used by indicating the standard coefficient of correlation. Also, multiple regression analysis of the study evaluated the value of the estimations on the dependent variables by using matrix data. Finally, as the findings it is observed that there is a remarkable correlation between GDP per capita growth and ICT developments of major East Asian Countries.

Key Words：ICT, East Asia, Regional Convergence, Neoclassical Growth Model, OLSM, GDP per capita

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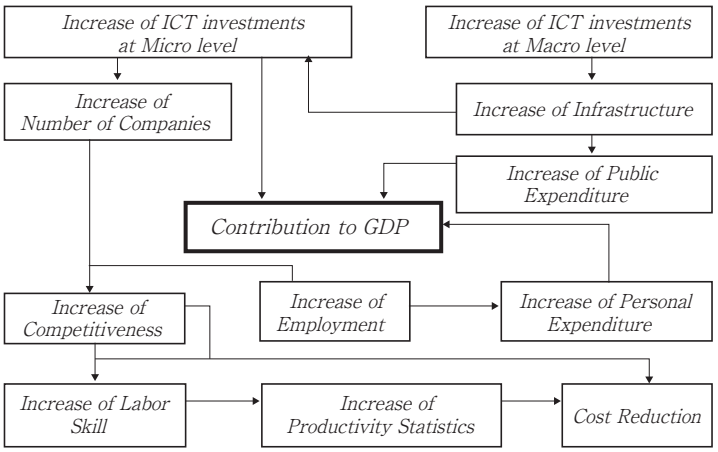
1. Introduction

1.1 Background of Study

The ICT sector takes a significant place in advancing the information economy and e-business. At the same time, ICT developments can be used as determining factor and/or instruments for e-business, including not only computer hardware and software but also fixed telephones, mobile telephones, telecommunication equipment and wireless transmission equipments. Therefore, ICT developments have very remarkable impacts on economic components and objectives (Roy S., 2005), which can be summarized under the six basic titles. These are Contribution to GDP, Productivity Statistics, Increased Employment, Cost Reductions, Competitiveness, and Labor Skills (UN, 2004). If these are examined together, it will be clearly seen that there is a significant relation and interaction with ICT improvements (Figure 1).

Figure 1. Interactions among ICT Investments and Economic Components



Source : Okur Dincsoy M., 2008, p.128

With this process, it can be also expected that there can be an increase in number of companies in the country. Basically, with the increase of number of companies, there will be two main effects on sectors. These are enforcement of competitiveness and increase of employment. In this regard, there will be three main effects of competitiveness, which are increase of labor skill, productivity statistics, and cost reduction. As well known, these three results are the most important element of impulse to trade. On the other hand, increase of

employment will naturally affect the personal expenditure together with improvement of life standards. Finally, these components will be part of contribution to GDP that will be analyzed in the following part of the study in terms of GDP per capita income growth.

Some studies also emphasize that economic growth is dependent upon the stock of capital-both human and physical-and technological progress. Human capital refers to the increase in labor productivity due to levels of education, skills and experience, and the health of people. Physical and technological progresses signify the instruments, which is utilized in the phases of production at any level. Thus, investment in ICT can be considered to improve national productivity and competitiveness, encouraging economic growth that ICT makes a positive contribution to economic growth（Ahmed M.E., 2007）.

Hereby, even though it is theoretically difficult to prove that governments have positive effects on per capita income growth in terms of growth models, role of governments will not be also out of the theoretical background of Neoclassical Growth Model（CBO, 1994）because it can be posited as policies affect per capita income in short run and limited. Besides, governmental policies on ICT can have fundamental influences on individual actions, which are related with neoclassical growth（Lowenberg A.D., 1990）, instead of direct effect on economic growth. In addition, governmental investments in infrastructure can be assumed as one of the market factors of service and/or production sectors within this context. In this point, a critique of this study on endogenous growth models（New Growth Theories）is to omit the advantage of ICT with globalization process on individual and company tendencies toward profitability increase ; and similarly, the assumption of perfect competition is also relaxed. As a result, the effect of governmental policies on individuals and technical progress within income can not be easily measured ; therefore, Catch-up Theory will be more leading factor in measuring the impact of ICT on income growths as an exogenous growth based on individual tendencies in the economies and constant technical progress between economies.

Under this theoretical background, as GDP per capita convergence evidences（weak Beta-convergence and strong Sigma-convergence after 1992）were observed in our previous study within homogeneous East Asian countries by statistically interpreting the evidence of direct effect of ICT, this study will empirically focus on direct effect of ICT developments on GDP per capita growths of countries in more micro level.

1.2 The Goal of the Study

The goal of this study is mainly to prove the effect of ICT developments on GDP per capita growths with a case study for major East Asian countries. The necessity of this study appeared from our previous studies' findings that indicated a regional convergence for these countries. For this reason, if the empirical correlation between ICT developments and GDP per capita growths in the countries is explained in matrix data, then effect of ICT developments on regional convergence can be easily showed among the countries because GDP per capita values of countries are principally used in time series and cross-country sectional data. In addition, this study focuses on the historical background of the development of telecommunication sectors of major East Asian countries in order to prove the findings in a more extensive perspective.

2. An Overview to Major East Asian Countries on Telecommunications Sector

When the Chinese government decided to reform its economic system in 1978, it soon realized that the poorly-developed telecommunications infrastructure had seriously deterred foreign FDI and had acted as stagnation for domestic economic growth. To cope with this, the Chinese government granted some preferential policies to the Ministry of Posts and Telecommunications, giving priority to the development of telecommunications.

The Ministry of Posts and Telecommunications formally announced that the telecommunications infrastructure in China was finally able to persuade the basic demand of the public and the economy in 1994. This was a critical turning point - the Chinese telecommunications market had turned from a sellers' market into a buyers' market. On 17 July 1994, a new operator, China Unicom, was officially constructed to compete with the obligatory operator in all services. This indicated the consequence of the decades-long monopoly of the Ministry of Posts and Telecommunications (MPT) . However, because of the state ownership of both China Telecom and China Unicom, the full benefits of liberalization could not be totally realized. In April 2000, under the interference of the regulator, China Unicom and China Telecom agreed to comply by the regulator's set tariff without provoking a price war (ITU, 2001a).

Although Hong Kong has been called the 'capital of capitalism', local fixed service and international telephone service were monopoly services until 1995 and 1998 respectively, due to the exclusive franchises held by Cable & Wireless HKT (CWHKT), previously known as Hong Kong Telecom. Compared with early mover countries, this was a very

late starting point. However, the Hong Kong government and its regulatory agency, Office of Telecommunications Authority (OFTA), have taken a strong and aggressive stance in promoting telecommunications deregulation. For instance, Hong Kong was the first region in the world to incorporate number portability into local fixed telephone service in July 1995 and the third region to provide number portability for mobile telephone service in March 1999. Currently, Hong Kong has one of the most sophisticated and competitive telecommunications markets in the world (ITU, 2001b).

In Indonesia, the international telecommunications business was transferred from Perumtel to Indonesian Satellite Corporation (Indosad) in 1980. Like many counties around the world, Indonesia has progressively liberalized its telecommunications sector over the last decade. Some of the steps it has taken are related to global trends, others are specific to the South East Asia region and few are clearly Indonesian. The choices have been influenced by the tension between desires to protect entrenched interests on the one hand and the need for private investment on the other. In this traditionally statist country, reluctance to reduce government control also has played a role. Today also, the government remains the largest shareholder in Telecommunication companies (ITU, 2002c).

In Japan, the Second Provisional Council on Administrative Reform (Rincho) announced in 1982 to introduce competition in all sectors of telecommunication services, as well as to privatize and "restructure" NTT. In 1985, three reform laws came into the agenda, which can be summarized as the Telecommunications Business Law, the NTT Law, and the Background Law for the Telecommunications Law. From all aspects, the privatization movement did not take place, which the government still holds a substantial share in NTT. This was a turning point for the Japanese telecommunications industry, as up until that point, NTT held an unchallenged monopoly.

On the other hand, once the privatization process had begun, the Ministry of Posts and Telecommunications (MPT) was able to focus more effectively on developing policies for ICT in Japan. The MPT and two other ministries were merged into the Ministry of Public Management, Home Affairs, Post and Telecommunications (MPHPT) in the administrative reform of central government in 2001 (ITU, 2005b).

ROK signed the World Trade Organization (WTO) agreement on basic telecommunication services that became effective in November 1997, committing the country to liberalization of its telecommunication sector. The nation's historical operator is Korea Telecom Corporation (KT).

It began as the government-owned Korea Telecom Authority in January 1982. Its statute was changed in 1989 allowing it to be privatized and in November 1993, the government began selling its shares. ROK progressively liberalized its telecommunication sector during the 1990s (OECD, 2000b). The first market segment to be opened was international long distance with the entry of Dacom in December 1991. Onse Telecom entered the market in October 1997. National long distance services were opened to competition in January 1996 when Dacom extended its services to this sector of the market (KIEP, 2002). The Ministry of Information and Communications (MIC) is responsible for telecommunication and broadcasting policy and regulation. This mandate also extends to certain areas of IT. The MIC is active in promoting and developing the communication industry in ROK. Also, ROK's telecommunication market is arguably as open as any in the Asia-Pacific region. Market entry is contingent upon government approval and essentially depends on the nature of the service provider (KIEP, 1998). On the other hand, ROK ironically has low level local telephone line digitization in December 2001, which is one of the lowest in the world. It is, however, moving towards a next generation communication network. Indeed it may connect all its local telephone lines to digital exchanges in a few years (ITU, 2003).

The regulatory environment for telecommunications in Malaysia underwent a significant change with the enactment of the Communications and Multimedia Act (CMA) in 1998. The Act establishes a regulatory framework in support of national policy objectives for the communications industry. Services regulated under the Act include traditional broadcasting and telecommunications, as well as computer networks, and contents carried over those systems. The CMA seeks to provide a common set of regulatory provisions based on generic definitions of communications services. It is therefore suited to a converged environment where the same digital information can be transported over any electronic network (ITU, 2002a).

In Philippines, The National Telecommunication Commission (NTC) was created in 1979. This made the NTC one of the oldest telecommunication regulators in the world. Besides, the Philippine telecommunication market is distinctive in a number of ways. First, it is one of the few countries in the world where telecommunication services have historically been operated by private entities. Second is the innovative regulatory requirement laid out in the mid-1990s that called for mobile and telecommunication operators to install a specific number of fixed lines. Third is the explosive growth of mobile, making the nation among the first where mobiles surpassed fixed telephone lines. There has been a notable upturn in mobile growth since 1998

and occurred much faster in the Philippines than elsewhere in the region (ITU 2002d).

Singapore has one of the most advanced telecommunication networks in the world with very high levels of access. This has been possible due to the small size of country, essentially a large city, as well a rising levels of income and government commitment to telecommunication excellence. The telecommunication market has been characterized by progressive liberalization from a state-owned monopoly provider to full competition (ITU, 2001c). Therefore, Singapore opened all telecommunications markets to competition. It is clear that the main impetus for accelerating liberalization was the perception that Singapore risked falling behind its rivals in its effort to become the regional info-communications hub. Hong Kong, China, for example, had already moved forward with full liberalization earlier (ITU, 2005a).

The regulatory environment for telecommunications in Thailand, after in 1997, operations including postal and monetary, telegraph, telex, international telecommunications, radio communications and others were separated from and became the Communication Authority of Thailand (CAT). Subsequently the Post and Telegraph Department (PTD) was significantly reduced in size, though it retained responsibility for frequency management.

Thailand's subsequent network growth has been greatly affected by two factors. First, the policy shift in the early 1990s towards the award, by the Telephone Organization of Thailand (TOT) and CAT, of concessions to private owned companies to undertake network development under Build-Transfer-Operate (BTO) agreements. Second, the effects of the financial crisis of the late 1990s was severe, though Thailand had reached a fixed-line teledensity of almost ten and the number of mobile users was on the point of overtaking fixed-line users in 2001. After slow growth, and even decline in mobile, between 1997 and 1999, network growth was reestablished by 2002 (ITU, 2002b).

3. Methodology and Estimation Procedures

The multiple correlation coefficient (MCC) indicates the standard coefficient of correlation. Also, multiple regression analysis evaluates the value of the estimations of the dependent variables, which are squared correlation between the estimated and the real values. Thus, when we examine any economic problem or interactions among statistics, there can be important descriptive variables more than one. Also, we can formulate these variables in a linear function and estimate the parameters. In the case of k-1 explanatory variables as linear with error term can be showed as follows ;

$$Y= \beta_1+ \beta_2X_2+ \beta_3X_3+\cdots+ \varepsilon \quad (1)$$

To estimate the parameters of a linear correlation with k-1, we need to utilize from data observations. These observations indicate a sample taken from the mass. Number of observations will be n for each variable. Then ;

$$Y= \beta_1+ \beta_2X_{i2}+ \beta_3X_{i3}+\cdots+ \beta_kX_{ik}+ \varepsilon_i \quad i=1,2,3,\cdots,n \quad (2)$$

As seen in equation to, except β_1 there is a variable for each parameters. Including all observations and variables above it can be showed by matrix symbols as follows (Thelil, H., 1983) ;

$$Y=X\beta + \varepsilon \quad (3)$$

Observations of vector Y and matrix X are consist of known values, β and ε vectors include unknown elements. Here, error terms in ε have normal distribution (Ertek, T., 2000) ; and to estimate the parameters, Ordinary Least Squares Method (OLSM) can be used (Kutlar, A., 1998),

$$Y= b_1+b_2X_{i2}+b_3X_{i3}+\cdots+b_kX_{ik}+e_i \quad i=1,2,3,\cdots,n \quad (4)$$

In this point, as this study asserts that there have been very strong and effective correlations between GDP per capita and ICT developments of countries. Under the light of our previous studies' findings, there was a GDP per capita convergence tendency among major East Asian Countries. This finding was also very important in terms of countries' ICT developments, statistically. As an empirical study we will show the correlations in these countries that result in GDP per capita convergence in a further point.

For the theoretical background we estimate a sample equation as the input of ICT to the output of GDP per capita for each country. As explained before, OLSM will be used in this study to find the parameters of correlation in GDP per capita and ICT.

As the expenditure method is he most common approach to measuring and understanding GDP, the basic definition (for GDP per capita) in macroeconomics can be simply showed as follows (Eren, E., 2001a) ;

GDP per capita = C + I + G + (X-M) / Population (5)

C = Consumption

I = Gross investment

G = Government spending

X = Exports

M= Imports

On the other hand, the sample equation of this study for ICT developments effecting the contribution to GDP per capita (see also Figure 1) is as follows ;

$$Y = \beta_1+\beta_2X_2+\beta_3X_3+\varepsilon \quad (6)$$

Y = GDP per capita

X_2= Annual telecommunication investment (ATI) per person [(1)]

X_3= ICT expenditure (ICTE) per person [(2)]

ε = Error term

Additionally, in this correlation it is the important point that X_2 and X_3 affect individual tendencies [(3)] in GDP per capita growth of the countries related with regional convergence.

As we have primarily aimed to examine GDP per capita growths correlated with ICT developments, we need to rearrange the equation for unit changes (△) of GDP per capita, annual telecommunication investment per person and ICT expenditure per person. To show the correlation with GDP per capita, it will be as follows ;

$$\triangle Y = \beta_1+\beta_2\triangle X_2+\beta_3\triangle X_3+\varepsilon \quad (7)$$

$\triangle Y = Y_t-Y_{t-1}$

$\triangle X_2 = X_{t,2}-X_{t-1,2}$

$\triangle X_3 = X_{t,3}-X_{t-1,3}$

t = (1992, 1993, 1994,…, 2002)

Therefore, R^2indicates the Multiple Correlation Coefficient (MCC) and it is formulated as follows for the correlation function for △GDP per capita, △ATI per person, and △ICTE per person ;

$$R^2= [b'\ X'\ Y-1/n\ (\Sigma Y)^2]/[\Sigma Y^2-1/n\ (\Sigma Y)^2]= \quad (8)$$

$$[b_1\Sigma\triangle Y+ b_2\Sigma\triangle X_2Y+b_3\Sigma\triangle X_3Y-1/n\ (\Sigma\triangle Y)^2]/[\Sigma\triangle Y^2-1/n\ (\Sigma\triangle Y)^2]$$

Finally, with all calculations and estimation above, the ratio of R^2 x 100 will be explanatory variable of GDP per capita growth, which is influenced by ATI per person and ICTE per person.

4. Review of Literature and Discussion

One of the key predictions of the Neoclassical Growth Model is that spatial disparities in per capita income, which is a key indicator of social and economic welfare, should converge over the long run (Armstrong, H. and Taylor, J., 2001). This will occur because of the opposite relations between wage and labor. The Neoclassical Growth Model of Solow and Swan, based

on the assumption of diminishing returns to scale, implies conditional convergence of per capita output ; per capita growth decreases as an economy approaches its steady state level of output (Barro, R.J. and X. Sala-i-Martin, 1992). Thus, among economies that converge to the same steady state, this model implies absolute convergence of per capita output ; poorer economies catch up with richer ones.

The Neoclassical Growth Model also emphasizes the role of technological progress and labor productivity in maintaining a sustained long-run rate of growth as well. Besides, these conditions, of course, directly affect the dynamics of the growth process. In steady state, therefore, the growth rate of output is equal to the rate of population growth and the rate of technological progress. This shows that output per worker will grow at the rate of technological progress in a state of balanced growth over the long run. When regional economies are not structurally similar and steady states differ, they are not expected to converge to the same level that predicts a lower starting value of per capita income tends to generate a higher per capita growth rate (Gezici, F. and Hewings, G., 2001). In this point, population movements and tendencies are very important as a powerful impact on convergence, while capital accumulation and flows are mainly an anti-convergence force.

Furthermore, some studies on convergence have tried to explain the convergence process by the effects of some economic variables such as public investments (Fujita, M. and Hu, D., 2001), human and public capital (Lall and Yilmaz, 2000) and FDI as an indicator of globalization. In this regard, as focused on this study, ICT and its components will play a very determining role on this process with its recent developments.

Hereby, no approach on ICT has any doubt that it has had a significant impact on most countries in the world, especially in the ways of communication, working, and learning (Vu K., 2004a). However, it is still a challenge to assess how and how much ICT has contributed to economic growth at the country as well as the global levels. K. M. Vu mentioned in this study that the impact of ICT investment on economic growth by assessing the impact of ICT on economic growth for 50 major ICT spending countries, which together account for over 90% of the global ICT market. He found that the key determinants of the variance of ICT contribution to growth across economies include education, institutional quality, openness, and English fluency. Furthermore, ICT investment has a significant impact on economic growth not only as traditional investment, but also as a boost to efficiency in growth : A higher level of ICT capital stock per capita allows an economy to achieve a higher growth rate for given levels of

growth in labor and capital inputs (Vu K., 2004b).

Of course, ICT is not a multi-dimensional cure to all the socio-economic problems including regional or national. However, ICT can be a powerful tool to facilitate and enable affordable solutions to economic development, individual development, and social development in emerging economies and to those populations who are socio-economically deprived (Reddy R., Arunachalam V. S., Tongia R., Subrahmanian E., Balakrishnan N., 2004).

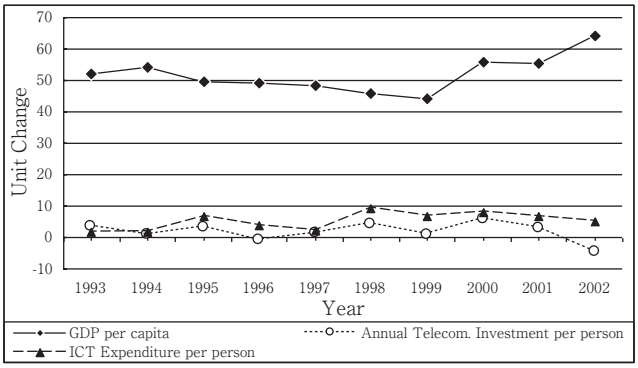
For these reasons, this study has examined that ICT and its components are closely linked with socio-economic components in macro and micro levels, especially with GDP per capita components, in the developing world ; and efficient ICT policies that help poor regions (countries) obtain regional convergence. In this point, as explained in 'Methodology and Estimation Procedures', separately analyzing unit changes of variables with per capita distributions of countries will give more different dimension than other studies to understand what factors affect GDP per capita convergence among countries.

5. Data Analyses and Findings

For data analysis, ITU and WDI are used and calculated for unit changes of all variables. In addition to these calculations, a further estimation was sampled for GDP per capita as showed in equation 7.

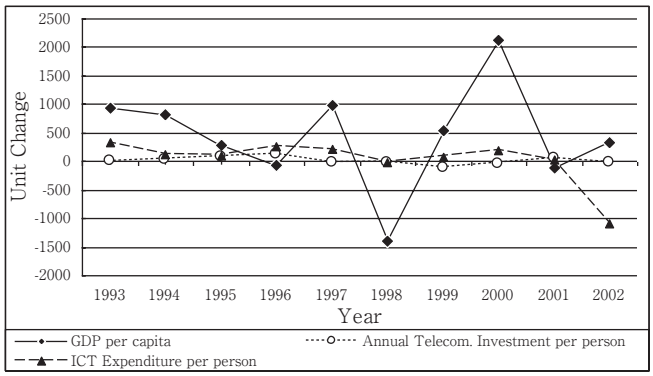
As seen in Figures 2-10, except for China all major East Asian countries' GDP per capita deeply affected by 1997 Asian crisis with negative growths. Also, as ICTE per person growths, only unit change in Japan is at the lowest level in 2002 (lower than GDP per capita in 1997 crisis). Similarly two other countries are Hong Kong and Singapore that significantly reached the lowest level in ATI per person in 2002 (not lower than GDP per capita in 1997 crisis). In terms of ATI per person, all countries approximately showed similar tendencies by recording small unit changes which mean ICTE per person changes will be more dominant factor in the matrix correlation.

Figure 2. China



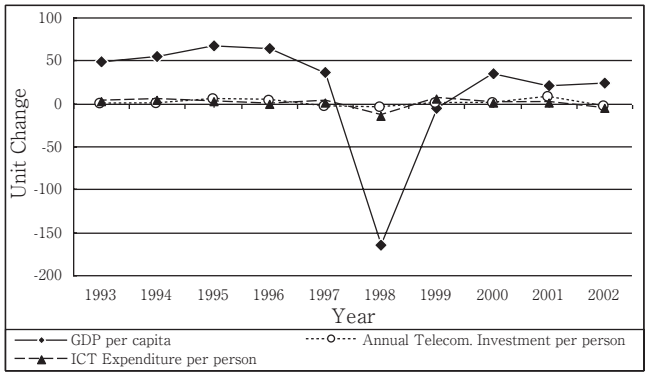
Source : ITU (2004) and WB (2004)

Figure 3. Hong Kong



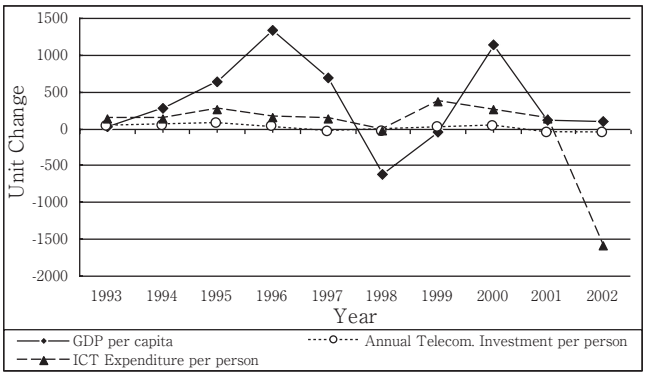
Source : ITU (2004) and WB (2004)

Figure 4. Indonesia



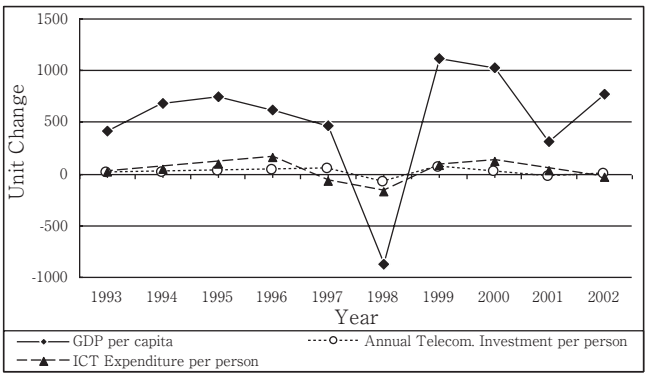
Source : ITU (2004) and WB (2004)

Figure 5. Japan



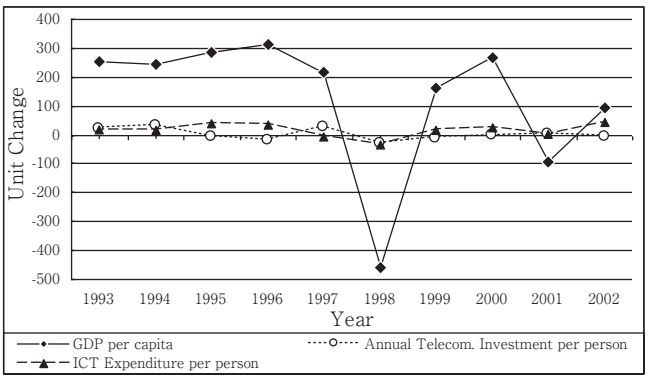
Source：ITU（2004）and WB（2004）

Figure 6. ROK



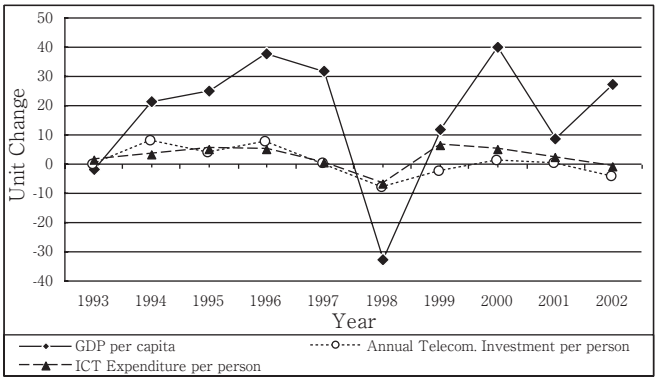
Source：ITU（2004）and WB（2004）

Figure 7. Malaysia



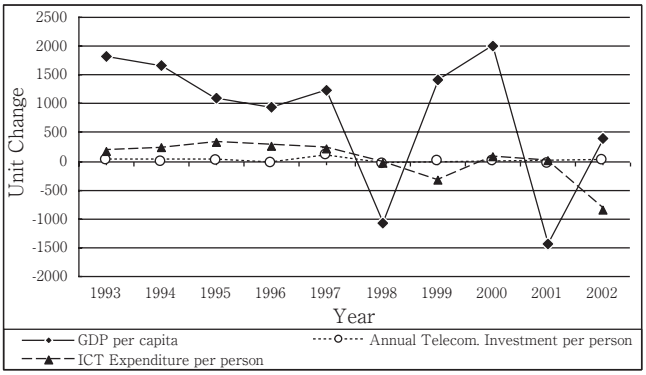
Source：ITU（2004）and WB（2004）

Figure 8. Philippines



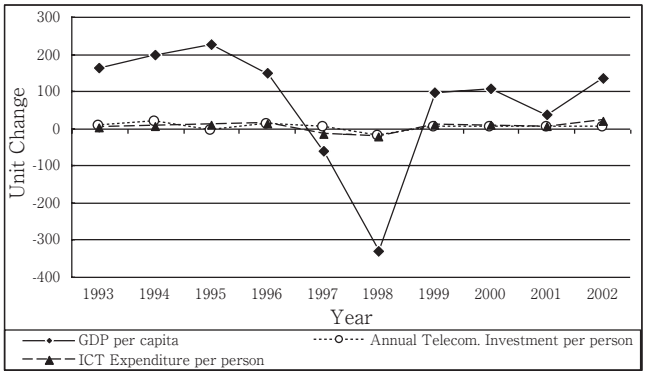
Source : ITU (2004) and WB (2004)

Figure 9. Singapore



Source : ITU (2004) and WB (2004)

Figure 10. Thailand



Source : ITU (2004) and WB (2004)

As the findings of the study, Table 2 was briefly given below. β_1, β_2 and β_3 variables for parameters in Intercept, ATI per person and ICTE per person, respectively.

As seen in Table 2, level of β_1 is very high in Singapore (781.0), Hong Kong (473.6), ROK (398.2), and Japan (385.8) because they have relatively higher GDP per capita distribution with the correlation of β_2 and β_3. However, level of GDP per capita growths are the most determining factor in regional convergence instead of GDP per capita levels.

In β_2 column, only China and Hong Kong have negative coefficients ; and also China is the country that has more different composition (by no crossing data with GDP per capita) than other countries (see Figure 2). Obviously, the most different point of China from other countries is its population that has a powerful impact on the regional convergence as output of the number of workers to the abroad and input of the capital into the country(4). In other words, any positive growth (increase) in ATI per person negatively affects GDP per capita growth of China and Hong Kong because of their negative coefficients. Conversely, Singapore (12.5) and ROK (8.1) have the highest two coefficients which mean any increase in ATI per person positively affects GDP per capita growth (as explained contribution to GDP per capita).

Table 2. Estimated Coefficients of Major East Asian Countries for 1992-2002

Countries	β_1		β_2		β_3		R^2
China	53.2	(12.9)	−0.8	(−1.1)	0.01	(0.02)	0.2
Hong Kong	473.6	(1.5)	−4.6	(−0.9)	0.6	(0.7)	0.1
Indonesia	20.2	(1.5)	1.9	(0.4)	8.9	(3.1)	0.7
Japan	385.8	(2.0)	5.0	(0.9)	−0.008	(−0.02)	0.2
ROK	398.2	(4.3)	8.1	(2.6)	2.5	(2.0)	0.8
Malaysia	6.0	(0.1)	5.5	(2.6)	7.5	(4.3)	0.8
Philippines	10.7	(1.6)	1.3	(0.9)	**2.7**	(1.4)	0.5
Singapore	781.0	(2.2)	12.5	(1.4)	**0.6**	(0.5)	0.3
Thailand	29.4	(1.1)	5.8	(1.8)	**8.5**	(3.0)	0.8

Note : 1. Figures in parentheses are t-values and indicate significant at 5% level.

2. β_1, β_2, and β_3 are parameters of Intercept, Annual telecommunication investment per person, and ICT expenditure per person respectively.

Even though the underdeveloped and the developing countries' ATI per person are lower than the developed countries, ICTE per person coefficients of the underdeveloped and the

developing countries (in β_3) such as Indonesia (8.9), Thailand (8.5), Malaysia (7.5), Philippines (2.7), and ROK (2.5) are significantly higher than developed ones. It also indicates the significance of ICTE per person with any increase resulting in more contribution to GDP per capita and regional convergence (as also mentioned before ICTE per person changes will be more dominant factor in the matrix correlation).

As also mentioned before, the ratio of R^2 x 100 will be explanatory variable of GDP per capita growth, which is related with ICT developments. The changes of GDP per capita in China, Hong Kong, Indonesia, Japan, ROK, Malaysia, Thailand, Singapore, and Philippines are correlated with ATI per person and ICTE per person by % 20, % 10, % 70, % 20, % 80, % 80, % 50, % 30,and % 80 respectively. Lower levels of Hong Kong, Japan, and Singapore are very remarkable as they are the most developed countries in the region. It also shows the low level of ICT effect relatively on their GDP per capita growth because of low level of explanatory variable.

6. CONCLUSION

It is realized in this study that ICT investments, particularly developments in telecommunication sector, and ICTE affect the growth rate of per capita output depending on the improvements and usage of technology. Thus, it can guide people and governments to focus on ICT policies, which increase contribution to GDP, employment, health, productivity, and education. In deed, many different factors may control regional developments and economic growth, and it is very difficult to explain all factors with Neoclassical Growth Model and Convergence Theory, but some instruments like ICT can be used for a better growth score resulting in regional convergence as observed in this study for major East Asian countries.

Footnotes

1. ATI per person is the one of the elements of GDP per capita related with Gross Investment (I).
2. ICTE per person is the one of the elements of GDP per capita primarily related with Consumption (C) and secondarily Government spending (G).
3. As the part of our previous studies individual tendencies are a determining factor in Neoclassical Growth Model as an Exogenous Growth Model.
4. This will occur because of the opposite relations between wage and labor and it can be

simply explained as capital flows always take a trend toward underdeveloped regions because of cost anxiety, and conversely labor force flows show a trend toward developed regions because of income anxiety.

References

Armstrong, H. and Taylor, J.（2001）：Regional Economics and Policy. Third Edition, USA, pp.68-88.

Ahmed, E.M.（2007）：Factors Contributing to ASEAN5 Productivity Intensification.6th International Conference of the Japan Economic Policy Association, December 8-9, Hosei University, Tokyo, Japan,pp.2-6

Barro, R.J. and X. Sala-i-Martin（1992）：Convergence. Journal of Political Economy, 100, pp. 223-251.

CBO,（1994）：Recent Developments in the Theory of Long-Run Growth：A Critical Evaluation, October 1994 pp.12-15.

Eren, E.,（2001）：Makro Iktisat（in Turkish）. Macro economy. Third Edition, Istanbul, pp. 12-20.

Ertek,T.,（2000）：Ekonometriye Giris（in Turkish）. Introduction to Econometrics. Second Edition, Turkey, pp.187-211.

Fujita, M. and Hu, D.,（2001）：Regional Disparity in China 1985-1994：The Effects of Globalization and Economic Liberalization", Annals of Regional Science 35, pp. 3-37.

Gezici, F. and Hewings, G.（2001）：Regional Convergence and the Economic Performance of Peripheral Areas in Turkey, Review of Urban & Regional Development Studies, 16, pp.1-7.

ITU,（2001a）：International Telecommunication Union, Fixed-Mobile Internet Connection：The Case of China and Hong Kong, pp.6-11.

ITU,（2001b）：International Telecommunication Union, Fixed-Mobile Internet Connection：The Case of China and Hong Kong, pp.11-13.

ITU,（2001c）：International Telecommunication Union, The e-City：Singapore Internet Case Study, April 2001, pp.4-6.

ITU,（2002a）：International Telecommunication Union, Multimedia Malaysia：Internet Case Study, March 2002, pp.9-10.

ITU,（2002b）：International Telecommunication Union, Bits and Baths：Thailand Internet Case Study, March 2002, pp.5-6.

ITU,（2002c）：International Telecommunication Union, Kretek Internet：Indonesia Case

Study, March 2002, pp.4-5.

ITU, (2002d) : International Telecommunication Union, Pinoy Internet : Philippines Case Study, March 2002, pp.5-6.

ITU, (2003) : International Telecommunication Union, Broadband Korea : Internet Case Study, March 2003, pp.2-7.

ITU, (2005a) : International Telecommunication Union, Ubiquitous Network Societies : The Case of the Republic of Singapore (in English), ITU New Initiatives programme, 6-8 April 2005, UNS-07, pp.6-10.

ITU, (2005b) : International Telecommunication Union, Ubiquitous Network Societies : The case of Japan (in English), ITU New Initiatives programme, 6-8 April 2005, UNS-07, pp.10-13.

ITU, (2004) : International Telecommunication Union, CD data version 2004.

KIEP, (1998) : Korea Institute for International Economic Policy Korea's trade and Industrial Policies : 1948-1998, Why the Era of Active Policy is Over, Chan-Hyun Shon, Junsok Yang, Hyo-Sung Yim, Working Paper 05, pp.36-49.

KIEP, (2002) : Korea Institute for International Economic Policy, Trade Integration and Business Cycle Co-movements : the Case of Korea with Other Asian Countries, Kwanho Shin and Yunjong Wang, August 2002, Working Paper 08, pp.16-19.

Kutlar, A., (1998) : Ekonometriye Giris (in Turkish). Introduction to Econometrics. First Edition, Turkey, pp.63-84.

Lall, S. and Yilmaz, S., (2001) : Regional Economic Convergence : Do policy instruments make difference?, Annals of Regional Science 35, pp.153-166.

Lowenberg, A.D., (1990) : Neoclassical Economic Economics as a Theory of Politics and Institutions. Cato Journal, Vol. 9, No. 3, winter 1990, pp.619-622

OECD, (2000b) : Organization for Economic Co-Operation and Development), Information Technology Outlook 2000, ICTs, E-Commerce and the Information Economy, Information Society, pp.23-55.

Okur Dincsoy, M., (2008) : A Statistical Analysis of ICT Developments and Regional GDP per capita Convergence in Major East Asian Countries, Journal of Humanities and Social Sciences, Okayama University 26, p.128.

Roy, S., (2005) : Globalization, ICT and Developing Nations, Challenges in the Information Age. First Edition, London, pp.120-130.

Thelil, H., (1983) : Handbook of Econometrics, linear Algebra and Matrix Methods in

Econometrics, Volume I, North- Holland Publishing Company, pp.7-10.

UN,（2004）：Economic and Social Commission for Asia and The Pacific, Good Practices in Information and Communication Technology Policies in Asia and The Pacific, Promotion of Enabling Policies and Regulatory Framework for Information and Communication Technology Development in the Asia-Pacific Region, United Nations publications, US, pp.190-195.

Vu, K.,（2004a）：Embracing the ICT Revolution to Promote Economic Growth in Developing Countries：Policy Challenges, pp.3-7.

Vu, K.,（2004b）：Measuring the Impact of ICT Investments on Economic Growth, pp.3-4.

WB,（2004）：World Development Indicators, CD data version 2004.