



Section 2

Channels Linking ICT with Economic Growth

So far we have seen that there is a statistically clear correlation between ICT and economic growth, which has prompted many countries to formulate national ICT strategies aiming for economic revival. However, it is possible that the correlation between ICT and economic growth is merely superficial, and therefore, it is essential to carefully examine the theoretical relations and causal relationships.

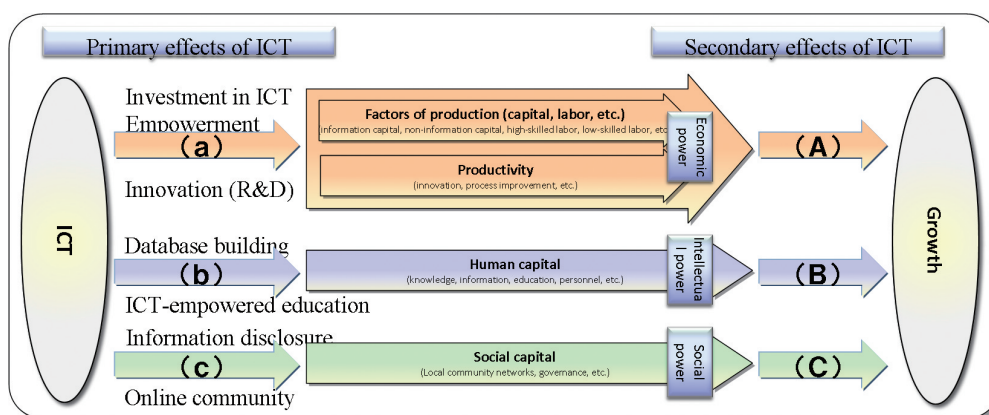
This section identifies the channels linking ICT with economic growth and examines them using specific data. This type of approach is important for planning and formulating policies. It is necessary to be thoroughly aware of the theoretical connections between policy goals and policy measures in order to effectively and efficiently implement policies with limited policy resources.

1. Three channels linking ICT with growth

Figure 1-4 shows an overview of the channels linking ICT with economic growth. Roughly speaking, four contributing factors to economic growth can be taken into consideration. They are firstly an increase input of ‘production factors’, such as capital and labor, secondly an increase in productivity, thirdly an accumulation of ‘human capital’, such as education and knowledge, and fourthly an accumulation of ‘social capital’, such as community ties and governance. The first and second factors mainly highlight

the production side of economic activities¹, and these factors will be considered channels of ‘economic power’ since they are closely related with each other. The third factor focuses on human resources/education and the sharing of knowledge and information, which are seen as ‘human capital’², and will be considered channels of ‘intellectual power’. The fourth factor focuses on bonds, such as trust and sense of security of the nation or local community, which are the foundation of our lives, and aspects of governance, such as fairness and transparency. They are seen as ‘social capital’⁴, and will be considered channels of ‘social power’.

Figure 1-4 Channels linking ICT with economic growth



¹ When a production coefficient is used, it is represented as $Y=A \cdot f(K,L)$ (where Y is production, A is technology level, K is capital, and L is labor). When a simple production coefficient called the Cobb Douglas model is used, you get $\dot{Y}=\dot{A}+\alpha\dot{K}+(1-\alpha)\dot{L}$ (where α is capital allocation ratio and $1-\alpha$ is labor allocation ratio). Economic growth rate is decomposed into the growth rates of (1) productivity, (2) capital and (3) labor. This method is called “growth accounting” and is widely used to decompose

the contributing factors to economic growth

² Sometimes referred to as ‘intellectual capital’ or ‘knowledge capital’

2. Channel ‘Economic power’

(1) Verification of a channel by increasing input of production factors (the first channel of ‘economic power’)

A. Capital

Figure 1-5 shows an international comparison (comparison between Japan, Europe and the U.S.) in terms of factor decomposition of economic growth. Factor decomposition was obtained by dividing capital into information capital and non-information capital and labor into labor hours and labor quality.

When looking at information capital within production factors--the first channel--contribution of information capital to GDP growth rate is positive in every cluster. However, if we look at the periods between 1980 and 1995 and between 1995 and 2005, we can see that the contribution of information capital to growth increased in Europe and U.S. (from 0.38 to 0.57 in Europe and from 0.52 to 0.77 in the United States), while it remained at the same level (0.46) in Japan. In other words, it is fair to conclude that although a channel from ICT to growth in the form of increased input of information capital does exist in major economies, such as Japan, Europe and U.S., this channel has not been fully utilized in Japan despite the IT revolution that started in 1995 with the spread of the Internet.

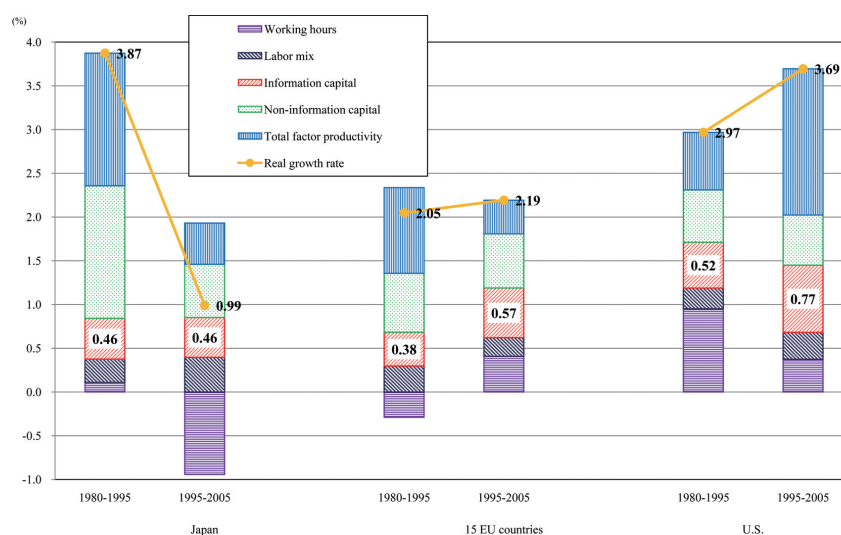
B. Labor

If we look at labor in figure 1-5, we can see that labor input generally has a positive effect in the U.S. and Europe but it has had a negative effect in Japan since 1995. ICT could support the labor force if the productive population, which is the core of labor force, is declining, as in the case of Japan’s aging population, which is accelerating at the world’s fastest rate. Figure 1-6 shows the relation between the Gender Empowerment Index, formulated by the United Nations Development Programme (UNDP), and the Internet subscriber ratio. This index indicates the rate of women’s participation in society, which tends to be high in Scandinavian countries and low in Africa and Asia. Penetration of the Internet has a positive relationship with this index and the more informatized the region is the more women participate in society. It is considered that an environment that fosters women’s work is developed alongside the spread of the Internet and mobile phones.

(2) Verification of channel by increasing productivity (the second channel of ‘economic power’)

Next, let us look at productivity--the second channel. In figure 1-5 above, an index called Total Factor Production (TFP)³ indicates productivity. Figure 1-7 shows the relationship between the increase rate of productivity and the increase rate of information capital input. This suggests that the higher the rate

Figure 1-5 Factor decomposition of economic growth (Japan, Europe and U.S. comparison)

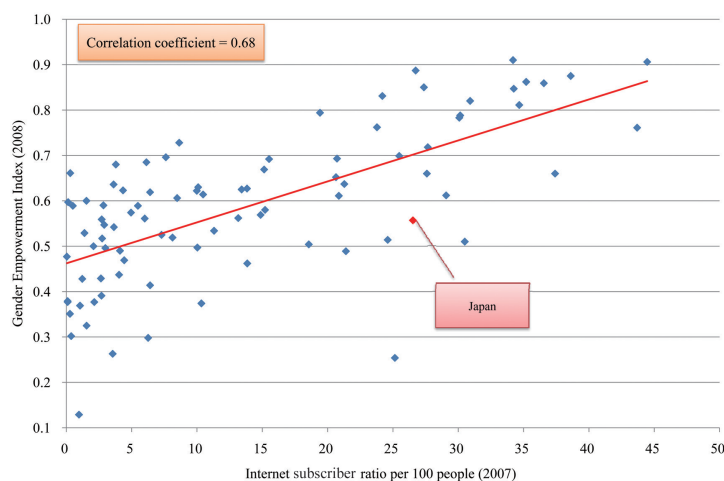


Compiled from EU KLEMS database

³ It is understood that Total Factor Productivity (TFP) refers to a part of economic growth that cannot be explained by an increase in capital input or labor input, and generally contains various factors, such as stock of knowledge, including tech-

nology renovation, management knowhow, corporate organization reforms, change in industrial structure. It is fair to say that an increase in productivity through ICT innovation mainly constitutes an increase in TFP.

Figure 1-6 Internet subscriber ratio and empowerment of women



NB. Targeting 88 countries with both data

Internet subscriber ratio per 100 people (2007): Compiled from the ICT statistics database of the ITU;

Gender Empowerment Index: Compiled from the Human Development Report 2007/2008, UNDP (2008)

of increase in information capital input is, the higher the rate of growth of productivity is.

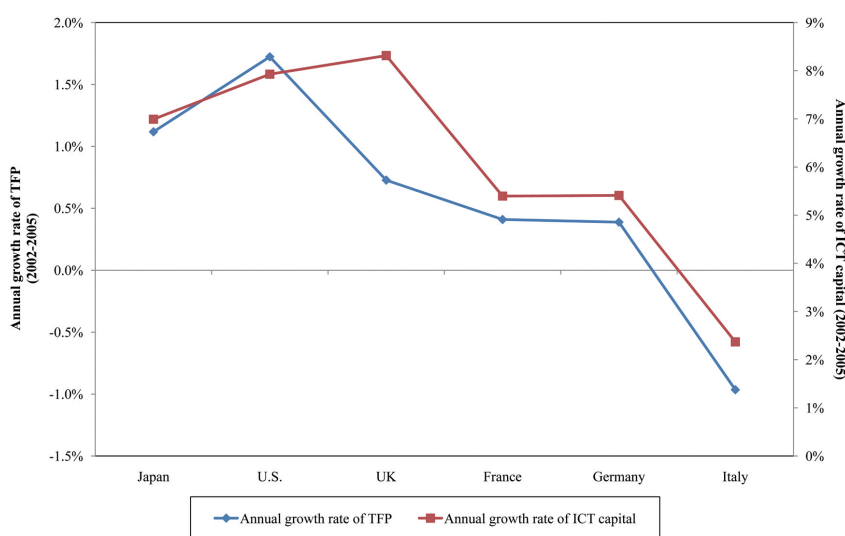
As seen above, it is clear that there is a channel of economic power connecting ICT and economic growth but it has not been fully utilized in Japan since 1995. Therefore, future growth strategies in the mid and long term need to clearly consider and strengthen this channel.

3. Channel of 'Intellectual power'

(1) Accumulation of human capital and growth

The channel of 'intellectual power' refers to the contribution of the accumulation of human capital to growth. Specifically, human capital comprises education human resources and knowledge/information. The most notable characteristics of human capital are that

Figure 1-7 Relationship between growth rate of information capital input and increase rate of productivity (Comparison between Japan, Europe and U.S.)



Compiled from EU KLEMS database

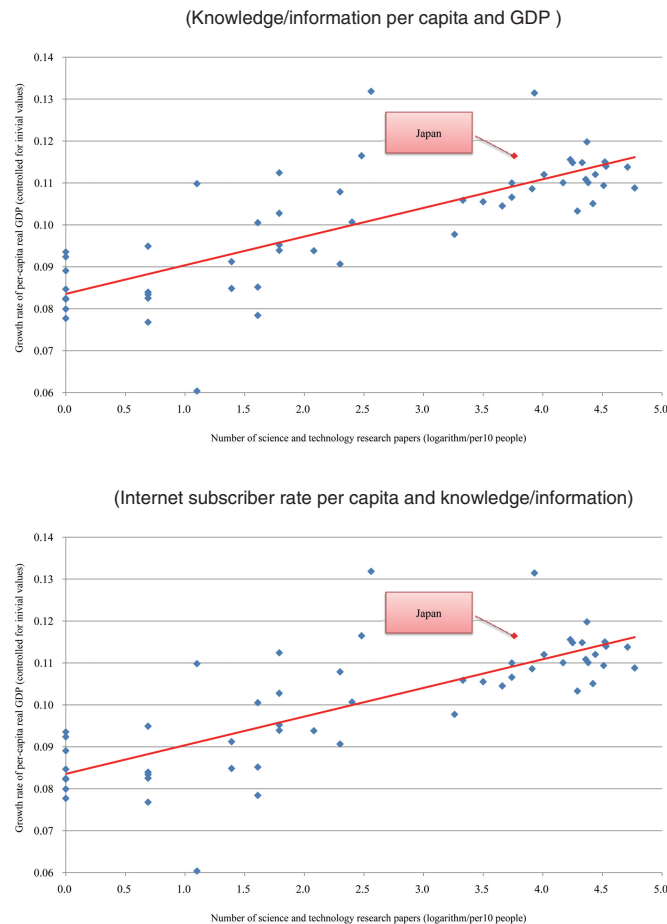
it is more or less seen as a public commodity, unlike physical capital, such as facilities and equipment. The level of education and human resources is after all knowledge or information and is characterized as something that can be used simultaneously by anyone and that anyone cannot prevent others from using. Because of this, it is highly external and the effect of the accumulation of human capital is widespread. The optimal utilization of this will make sustainable growth possible⁴ without necessarily lowering the profits of the investments of society as a whole. It can be a model to more accurately explain the mechanism of the knowledge economy of today, where innovation-led intellectual production has become an engine

for growth.

The following are the specific ways in which ICT contributes to the accumulation of human capital in this channel:

- Education/human resources: Through improvements in educational effects and the penetration of remote education with the use of ICT, the enrolment rate/advancement rate in higher education and participation rate in life-long education will increase
- Knowledge/information: Network such as the Internet, etc, will promote sharing knowledge/information, which can be easily used by anyone

Figure 1-8 Relationship between knowledge/information and economic growth and ICT



⁴ The theory that emphasizes this point is the so-called New Economy theory, which attracted a lot of attention in Japan as

an economy with increasing returns to scale.

(2) Verification of the channel of ‘intellectual power’

The relationship between human capital and economic growth has been widely studied since the 1990s in research in labor economics and economic growth theory. A certain consensus has already been reached that an accumulation of human capital--mainly using education level (literacy rate, enrollment rate, years of education) as a surrogate variable⁵--contributes to an increase in income or economic growth⁶.

For example, there tends to be a positive correlation between per-capita GDP--after controlling various factors that may have impact on growth other than human capital--and the Educational Level Index⁷ formulated by the UNDP. Furthermore, there may be insufficient previous research⁸ on the relationship between human capital, in the sense of knowledge/information, and economic growth. Since it is difficult to measure knowledge/information. But the upper graph in figure 1-8 shows, when the number of science and technology papers is used as a rough surrogate variable reflecting science and technology knowledge, a correlation with per-capita GDP has been observed.

Then, what kind of relationship is there between ICT and human capital? With the penetration of remote education using satellite communications and the Internet, etc., it is understood that the base of learners has expanded and the level of education has been effectively raised with an improvement in educational effectiveness through digital materials. At the same time, the sharing of knowledge and information has drastically progressed with an advancement of networks, such as the Internet and corporate LAN, and everyone must have felt the benefits of such “externality”.

The lower graph in figure 1-8 shows a positive correlation between the aforementioned number of science and technology papers and the Internet subscriber ratio. A similar result was obtained when the ICT competitiveness index of the World Economic Forum was used instead of the internet subscriber ratio. This

suggests that there is a close relationship between the penetration of ICT and the accumulation of human capital, such as educational level and technology-related knowledge.

It is still necessary to conduct further examination into and case studies on the existence of causal relations of the channel from ICT to human capital, such as education human resources and knowledge/information. Nonetheless, we intuitively know that the use of ICT effectively contributes to the accumulation of human capital. The World Bank supports the incorporation of ICT into education in developing countries by including ‘ICT and education’ in its program called ‘Education for the Knowledge Economy’.

In the current age of the knowledge economy, intellectual production is increasingly becoming an engine for growth. In order to ensure that ICT leads to economic growth at the policy level, we must emphasize measures that would accelerate the accumulation of human capital through education human resources, and knowledge/information, for example, through the informatization of education and establishment of digital archives, while giving due consideration to the presence of this channel.

4. Channel of ‘Social power’

(1) Accumulation of social capital and growth

The channel of ‘social power’ refers to the contribution of social capital to growth. There are several specific definitions of social capital, but here we refer broadly to the ‘quality of a country or local community--the foundations of our lives. Specifically, we consider two areas: local community bonds (trust, reciprocity, networks⁹) and governance (voice and accountability, political stability and absence of violence/terrorism, government effectiveness, regulatory quality, rule of law, control of corruption). Characteristics of social capital include high externality, as in the case of human capital, as well as strong cultural and societal aspects that cannot be

⁵ UNDP annually compiles and releases indices related to human resources development of the world (human resources development index and gender empowerment index). See UNDP (2008) Human Development Report for details.

⁶ There are many previous studies, including Barro (1991), “Economic Growth in a Cross Section of Countries” The Quarterly Journal of Economics, vol. 106(2)

⁷ An index developed by the UNDP, consisting of adult literacy rate the enrollment rate in elementary and secondary education of different countries.

⁸ There are previous studies, including Chen and Dahlman (2004), which use such data as patents and science and technology papers.

⁹ According to Robert Putnam, social capital “refers to features of social organization, such as trust, norms and networks, that can improve the efficiency of society by facilitating coordinated

actions.” He makes distinctions between ‘thick trust’ in one’s intimate personal relations and ‘thin trust’ in the generalized others and the latter is more important from the perspective of social capital since it leads to the promotion of wider cooperative actions. In norms, he places particular importance on reciprocity, and generalized reciprocity (sustained exchange relations containing a misbalance in the value of exchanged goods in every moment but with an expectation of striking a balance in the future) is more important than balanced reciprocity (the exchange of goods of the same value at the same time). There are vertical network between, for example, boss and subordinates and horizontal network found in, for example, volunteer groups. In the aspect of social capital the latter is more effective. See Social Capital: For Profound Human Relations and Virtuous Circle of Civil Activities, Cabinet Office (2002) for details.

traded on the market, such as a sense of security, trust, transparency and fairness. These factors are hard to measure; however, it is known from previous studies that they have a substantial impact on economic growth when analyses are conducted using surrogate variables. It is intuitively understood that the aforementioned channel of economic power does not sufficiently explain economic growth and therefore, an examination of social capital, in addition to human capital, would help us better understand the mechanism of economic growth in the today's global competition.

The following are examples of specific ways in which ICT contributes to the accumulation of social capital in this channel:

- Local community bonds: Through the use of ICT, local community bonds will deepen and trust and stability in society will increase
- Quality of systems and organizations: Through the use of ICT, transparency of organizations and systems will increase and ineffective economic activities will be eliminated.

(2) Examination of the 'channel of social power'

With respect to the relationship between bonds in the local community (social capital) and economic growth, various verification studies have been conducted¹⁰ since Robert Putnam presented the concept of social capital in his work *Making Democracy Work* in 1993. The history of verification studies is rather short, but many studies report correlations with economic growth using the responses of different countries to the question "Can people be trusted?" in the World Values Survey¹¹ as surrogate variables. For example, there is a positive correlation between the growth rate of per-capita GDP--after controlling various factors that might have an impact on growth other than social capital and trust in the World Values Survey as a surrogate variable of social capital. Also, there are many studies on the relationship between governance and economic relations¹². As a result, the World Bank operates a website called 'Governance Matters'¹³ and annually formulates and discloses indicators regarding governance of countries worldwide. For example, the upper graph in figure 1-9 gives an example of the relationship between ' (comprehen-

sive) degree of governance', which gives the simple mean values of six indicators developed by the World Bank, and the growth rate of per-capita GDP, and shows a positive correlation between the two.

Now the question is what kind of relationship is there between ICT and social capital. First of all, for local community bonds, Putnam (1993) contends that it is important for people to have direct contact with each other and that online networks without direct contact supplement networks based on face-to-face communication, and concludes that online networks in themselves are not important for creating bonds. He points out that one of the major reasons for the decline in these bonds in the United States is the effect of television¹⁴. On the other hand, there is a growing need for community activities that promote information sharing on the Internet and online donation. Thus one cannot deny the importance of the Internet for local community bonds with which one can establish and maintain human connections without restrictions of place or time and irrespective of the number of people involved. One study shows a positive relation between the use of the Internet and participation in volunteer groups or political activities. It is thus not easy to predict whether ICT will have positive or negative impact on local community bonds.

ICT is also believed to play an effective role in governance. It is intuitively understood that the spread of the Internet drastically increased information distribution and raised awareness of information disclosure and accountability, thus improving the transparency of politics, administration and corporations. Also, there is no doubt that one individual can easily send and receive information through the Internet, which provides great potential for improving the governance of an organization or a system.

Recently the so-called alpha bloggers have gained great influence on public opinion, together with the mass media. However, it is also necessary to bear in mind that there is a danger of people overreacting to opinions on the Internet, leading to radical action in the real world, as seen in Korea and China.

Let us now look at data relating to the relationship between ICT and social capital described above. Focusing on governance, the aforementioned 'degree of governance was used as a surrogate variable and a positive relation with the Internet subscriber ratio was also found. A similar result was obtained when the

¹⁰ There are many previous studies using country and region-based data, including Knack and Keefer (1997), "Does Social Capital Have an Economic Payoff? A Cross-Country Investigation," *The Quarterly Journal of Economics*, Vol. 112, No. 4.

¹¹ The World Values Survey Association conducts the World Values Survey and discloses survey results on points such as "neighbors can be trusted".

¹² There are many previous studies using country and regional-level data, including the World Economic Outlook -Growth and Institutions, IMF (2003).

¹³ See Governance Matters 2008, World Bank (2008) for details

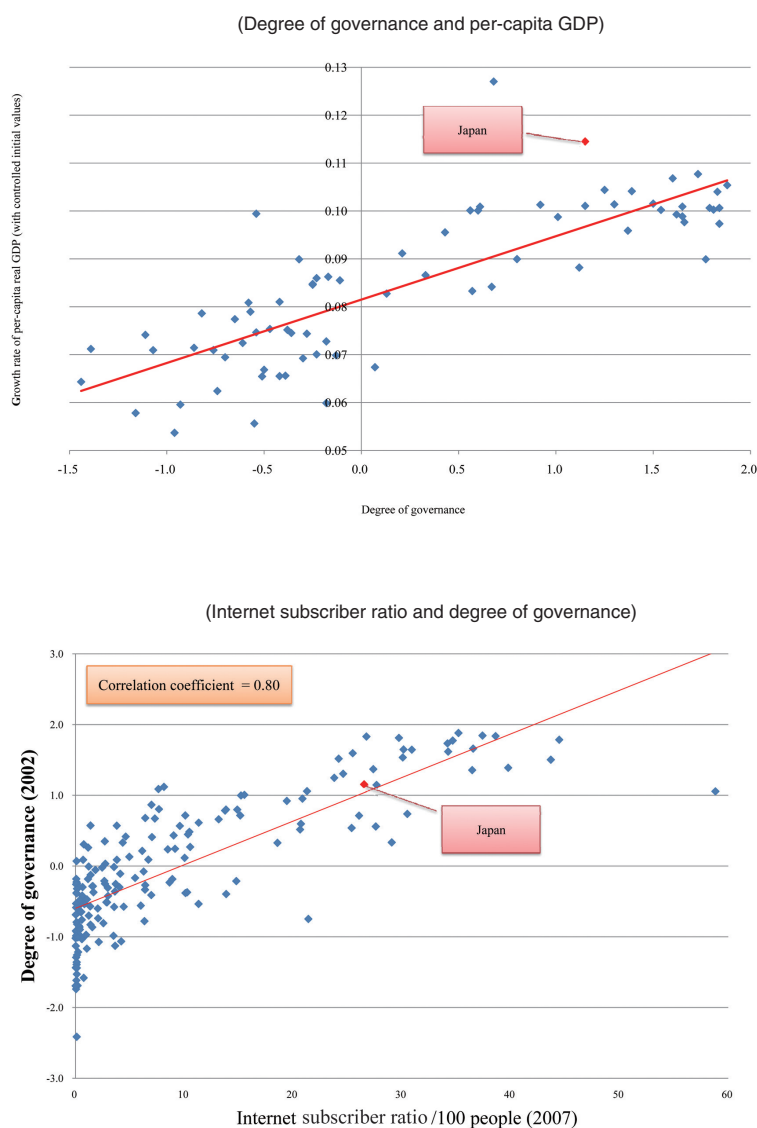
¹⁴ Fukuyama (1999) too points out that ties cannot be established by electronic network alone without human contact. See Cabinet Office (2002)

ICT competitiveness index developed by the WEF was used as a variable for ICT. This suggests that the dissemination of ICT is closely related to the level of social capital, namely, local community bonds and governance.

In order to ensure that a connection is established between ICT and economic growth in terms of policy,

policy makers should place importance on measures that would accelerate the accumulation of social capital by, for example, promoting regional informatization programs to strengthen bonds in the local community as well as information disclosure to improve governance of organizations and systems.

Figure 1-9 Relationship between the degree of governance and economic growth and ICT



Degree of governance: Compiled from Governance Matters 2008, World Bank
Internet penetration rate/100 people: Compiled from ITU's ICT statistics database