Chapter 3

Boosting Economic Growth and Competitiveness via ICT

This chapter examines Japan's route to economic growth through ICT, as well as the route to enhancing international competitiveness through the global deployment of ICT-dependent innovations.

Section 1

Current Status of Japan's ICT industry and Contributing to Economic Growth via the Thorough Application of ICT

This section analyzes the current status of the Japanese ICT industry and paradigm shifts expected to bring benefits, as well as examining the route to acceleration of ICT investment across all industries and economic growth through propagation of ICT utilization.

1. Current state of the ICT industry in Japan, and their contributions to growth

(1) The ICT industry as an engine of growth

    A. Market size of the ICT industries

In 2008, the market size of Japan's ICT industry[11] (amount of nominal domestic production) registered 96.5 trillion yen, accounting for approximately 10% of all markets, making it the largest of all industries (Figure 3.1).

Figure 3-1 Market size of major industries including the ICT industry (amount of nominal domestic production)
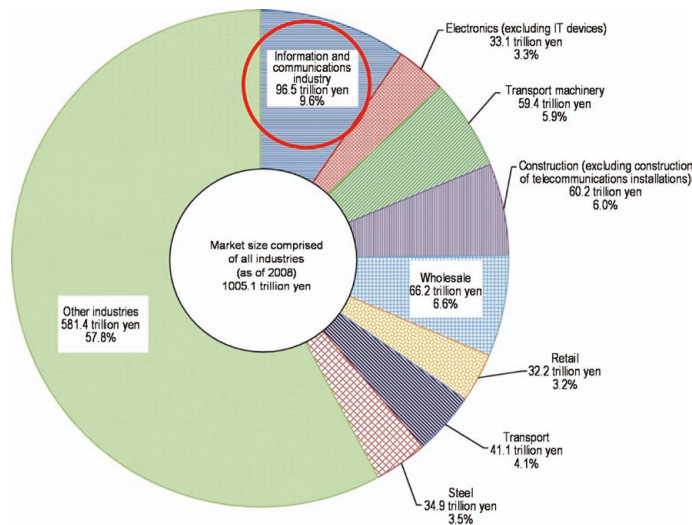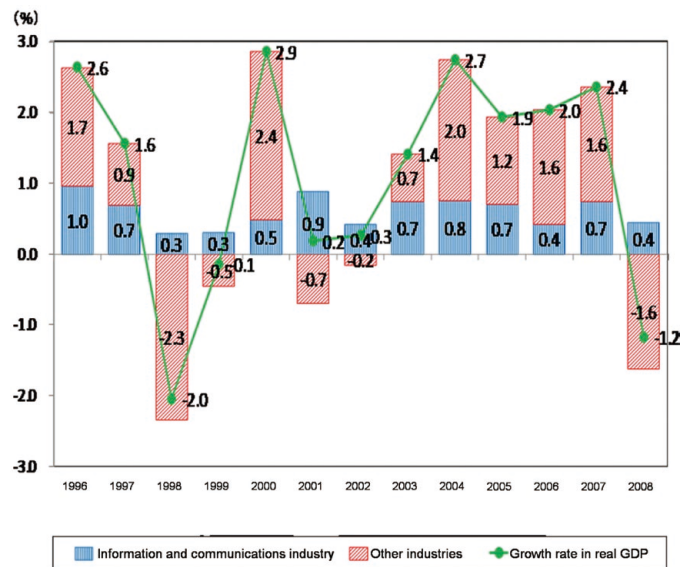

(Source) Ministry of Internal Affairs and Communications "Survey of Economic Analyses on ICT" (2010)

    B. Contribution of the ICT industry to economic growth

The contribution of the ICT industry to Japan's economic growth (growth rate in real GDP) is considerable, given that in 2008 when the economy as whole shrank due to the influence of the global recession, ICT was the only sector to grow. The average contribution rate of the ICT industry to economic growth over the five years from 2002 to 2007 was about 34%.

---

[11] Information and communications statistics database defines the ICT industry as an industry that conducts information and communications operations as its economic activity, such as production, collection, processing, accumulation, provision and transmission of information, and data are collected as a sum of eight sectors: namely, communications, broadcasting, information services, video/audio/text information production, ICTrelated manufacturing, ICT-related services, ICT-related construction, and research.

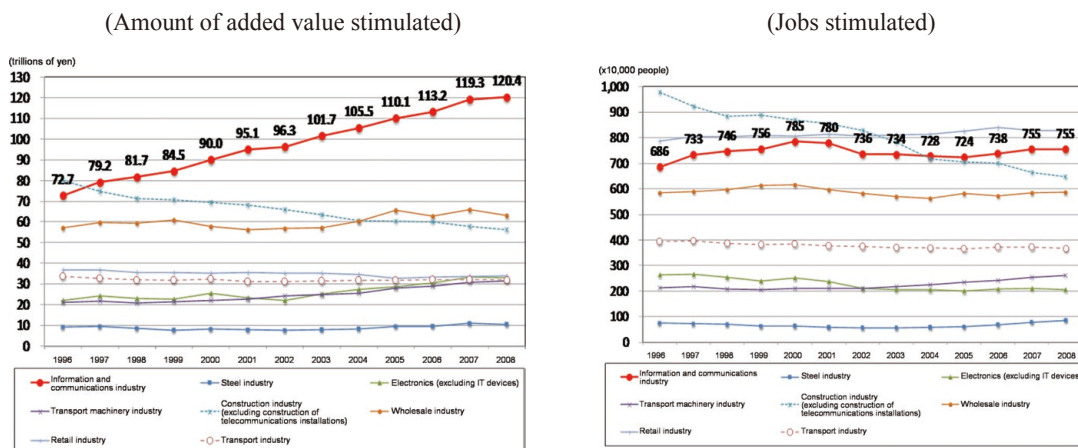**Figure 3-2 Contribution of ICT industry to the growth rate in real GDP**

(Source) Ministry of Internal Affairs and Communications "Survey of Economic Analyses on ICT" (2010)

(2) Ripple economic values from the ICT industry

Regarding the ripple economic values (amount of added value stimulated, jobs stimulated) of the ICT industry on all other industries, a look at the ripple economic values of production activities for each sector[12] shows that the amount of added value stimulated for the ICT industry was 120.4 trillion yen in 2008, giving it the top position among Japanese industries (Figure 3-3, left side). In terms of employment as well, the number of jobs stimulated by overall production activities for the ICT industry in 2008 was 7.55 million, second only to retail, and comparable to the retail and construction industries (Figure 3-3, right side).

Figure 3-3 Changes in ripple economic values of production activities in major industrial sectors (amount of added value stimulated, jobs stimulated)

(Amount of added value stimulated)　　　　　(Jobs stimulated)

(Source) Ministry of Internal Affairs and Communications "Survey of Economic Analyses on ICT" (2010)

---

[12] The "ripple effects of production activities" refers to the ripple (spillover) economic values of production activities in a particular industry on domestic industry as a whole

## 2. A paradigm shift in the ICT industries: cloud service trends

(1) Market size of cloud services industry

Cloud computing is among the fruits of development of technologies for utilization of the computer resources already existing on networks. Services incorporating cloud computing technology (cloud services) allow users to access computer resources "when they need, in just the amount they need," and constitute an ICT system utilization method radically different from anything that has gone before and is prompting an ongoing paradigm shift in the ICT sector.

According to the Smart Cloud Study Group Report (2010, MIC), the market size for cloud services is estimated at 390 billion yen as of 2009. The SaaS market makes up a large portion of this amount, accounting for 61.3%. Estimates for the future cloud service market indicate that by 2015 it will have more than quadrupled in size to 1.81 trillion yen (Figure 3-4).

Also, if support is provided for the widespread adoption of cloud services in government, medical care, education, agriculture, forestry and fisheries, and for the construction of a smart cloud infrastructure, it will be possible to generate a new market worth approximately 560 billion yen by 2015, meaning that the total size of the cloud services market will reach 2.37 trillion yen.

Figure 3-4 Market size of cloud services industry (Estimated)
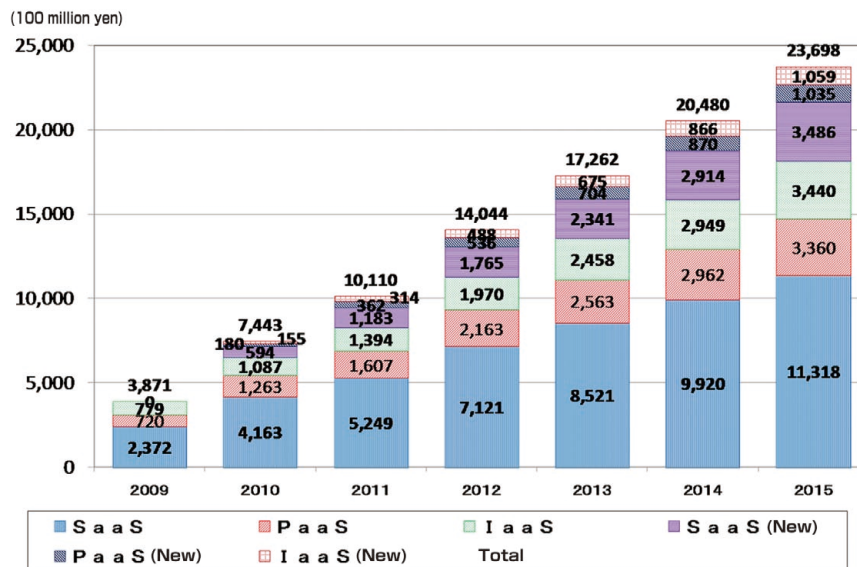
(Source) Smart Cloud Study Group Report (2010) Ministry of Internal Affairs and Communications

(2) Inter-industry configuration changes due to the development of cloud services

Figure 3-5 compares industry in 2008 and as projected in 2020, using the 2008 Inter-Industry Table and an RAS[13] Growth Projection for 2020 to which the projected cloud service market has been added, and shows how the ICT industry will be positioned in the inter-industry configuration in 2020 using the "index of power dispersion" and "Index of sensitivity dispersion."[14]

The "index of power dispersion" is an index of comparison of the amount of production (or of added value) generated in all sectors by the production activities of one sector when there is one unit of demand in said sector.[15] Meanwhile the "Index of sensitivity dispersion" is, conversely, an index of comparison of the amount of production (or of added value) generated in one particular sector by the production activities of all sectors when there is one unit of demand in each sector.[16] This means that industrial sectors in the "first quadrant" (where both index of power dispersion and Index of sensitivity dispersion have average values of 1 or over) are industries that play a

---

[13] The RAS method is a means of estimating input coefficients of inter-industry tables, and works by distributing the differences between known product outputs and the sums of the rows of the present intermediate matrix proportionally along the rows and then to distribute the differences between known industry outputs and the sums of the columns proportionally along the columns.

[14] An interim output table (transaction values) for 2020 is produced based on the input coefficients estimated using the RAS method, and adding the interim input for the size of the cloud services market (estimated) in 2020

[15] If a large amount of assets and services are input from the production activities of relevant fields (that is, if the interim input rate is high), it is easy to gauge large figures

[16] If there is a high rate of use in fields other than the relevant field (that is, if the input coefficients for other fields are high), it is easy to gauge large figures

vital role in the linked structure. In this comparison, the ICT industry is the only one to be in the first quadrant both by added value base and by production base and to be trending higher in value, and it is safe to say that this industry will continue to exert a major presence in the future as well. With the progress of cloud services, the ICT industry will absorb aspects of other sectors and will also feed on the growth of other sectors, making the industry an indispensable engine of sustainable economic growth for Japan.

Figure 3-5 Change in Index of Power Dispersion and Index of Sensitivity Dispersion between 2008 and a 2020 projection with cloud penetration added

(Added value base)
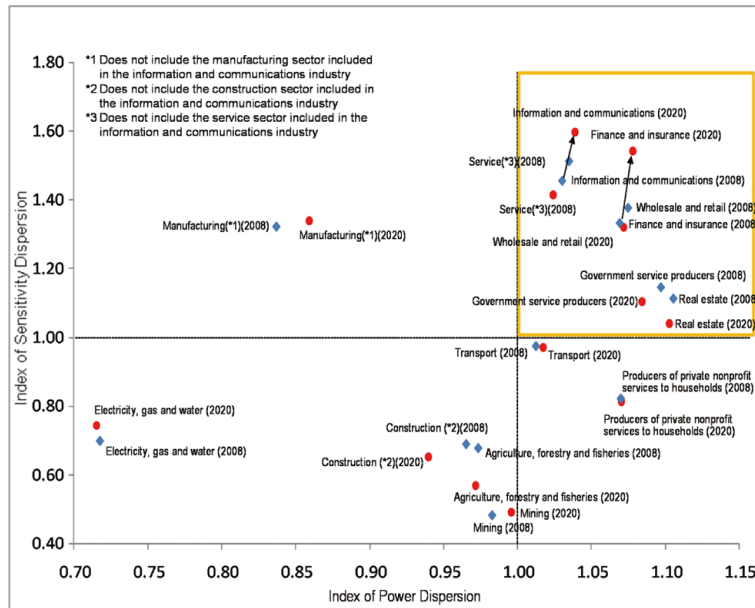
(Production base)
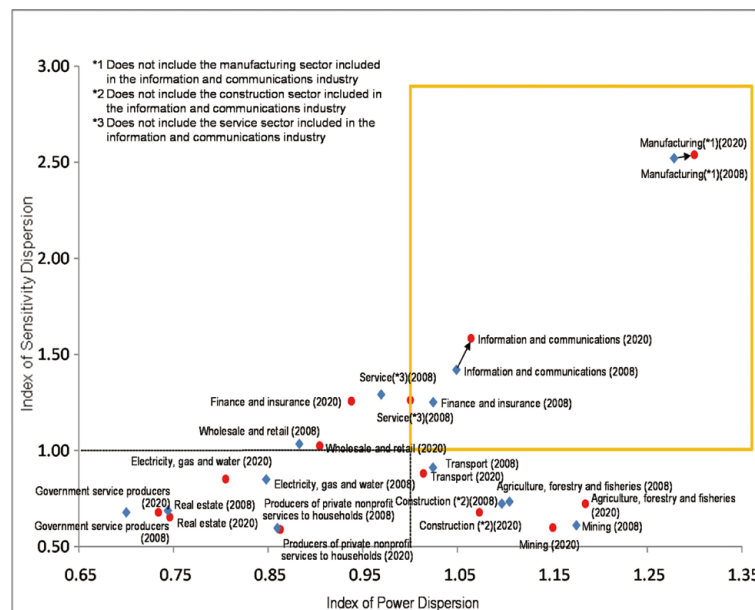
(Source) Ministry of Internal Affairs and Communications "Survey of Economic Analyses on ICT" (2010)

3. Economic growth through acceleration of investment in digitization and utilization of ICT

(1) Contribution of ICT capital and ICT utilization capabilities to economic growth

The growth of ICT capital makes a direct contribution to industrial growth in response to elasticity of production (Figure 3-6). Some of the contribution is in the form of external effects, and is included[17] in total factor productivity[18]. Also, there may be factors of technological change that are not sufficiently embodied at present, not only in ICT capital but in labor as well. For example, the growth of human capital that accompanies acquisition of knowledge and techniques related to ICT capital and utilization of ICT services, may make a contribution to growth through total factor productivity.

Figure 3-6 ICT and economic growth
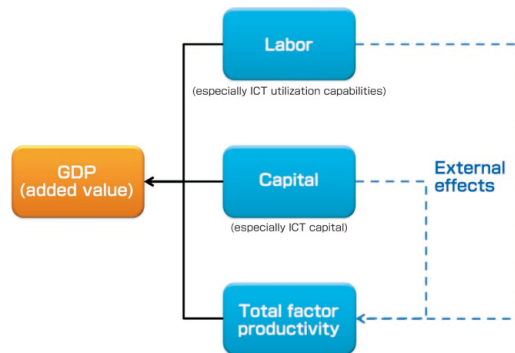
(Source) Ministry of Internal Affairs and Communications "Survey of International Comparative Analyses of ICT capital Contributions in Industry Growth" (2010)

(2) International comparison of ICT capital

A. Changes in ICT capital (all industries)

Figure 3-7 shows the changes in ICT capital[19] for all industries since 1995, based on the EU KLEMS database[20], for 10 countries – Japan, South Korea, the US, the UK, Sweden, Finland, Denmark, Germany, the Netherlands and France. It can be seen that the growth of Japanese ICT capital since 1995 is at the very bottom, along with France et al.

Figure 3-7 Changes in ICT capital (all industries / international comparison)
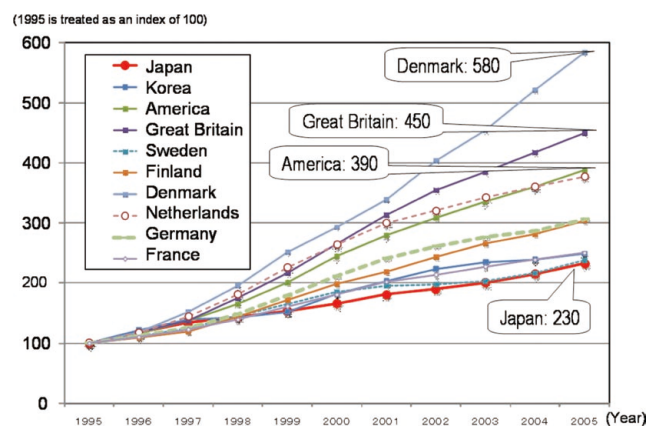

(Source) Ministry of Internal Affairs and Communications "Survey of International Comparative Analyses of ICT capital Contributions in Industry Growth" (2010) and EU KLEMS Database (Release 2008, Additional files)

---

[17] For example, in Stiroh (2002), as well as Shinozaki (2003), Kazunori Minetaki & Kiyohiko G. Nishimura (2010) and many others
[18] Total-factor productivity (TFP) is a variable which accounts for effects in total output not caused by inputs. In economics, this would consist of economic growth not accounted for by increases in capital investment and labor, and is generally understood to include technological advances, knowledge stock of management know-how, changes in the industrial structure, etc. The increase in productivity due to ICT innovation is thought to be largely expressed through this TFP
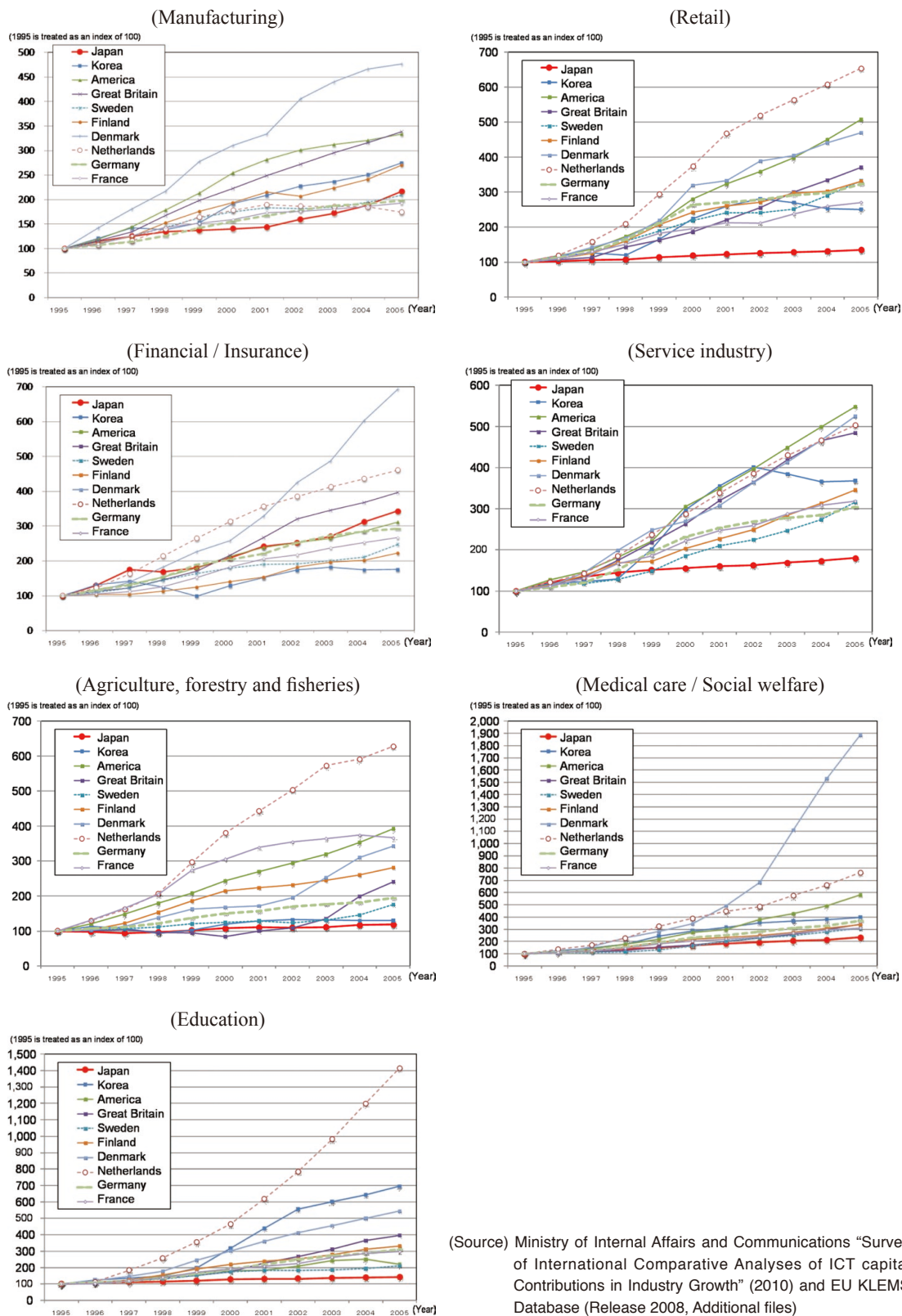[19] ICT capital in the EU KLEMS databse includes three types, calculation devices, communications devices, and software
[20] The EU KLEMS database is produced from industry-specific data collected from each of 20 countries, including EU countries and Japan, South Korea, the US, etc., on capital (K), labor (L), energy (E), materials (M), and services (S).

B. Changes in ICT capital (by industry)

The changes in ICT capital for various individual industries are shown in Figure 3-8. While Japanese ICT capital shows slow growth overall, it is particularly behind in the retail, individual services (food and drink, accommodations, self-owned business, etc.), agriculture, forestry and fisheries, medical care and social welfare and education sectors, where it was lowest among all countries surveyed.

Figure 3-8 Changes in ICT capital by industry (international comparison)

(Manufacturing)

(Retail)

(Financial / Insurance)

(Service industry)

(Agriculture, forestry and fisheries)

(Medical care / Social welfare)

(Education)

(Source) Ministry of Internal Affairs and Communications "Survey of International Comparative Analyses of ICT capital Contributions in Industry Growth" (2010) and EU KLEMS Database (Release 2008, Additional files)

(3) The effects of ICT utilization capability on labor productivity

As ICT constitutes a new type of capital and technology, the degree to which it impacts production volumes depends on whether it is utilized effectively. With this in mind, we will undertake a quantitative analysis of the impact of acquisition of knowledge and techniques related to ICT capital and ICT utilization, etc., on labor productivity.

A. Status of implementation of ICT education

As ICT is a field of constant innovation, simply using ICT devices and services does not always achieve the desired effect, a fact that has been pointed out since the 1990s in the US[21], which got a head start on ICT progress. It has also been pointed out that Japanese corporations and the Japanese economic system's inability to take advantage of all the growth potential ICT had to offer was partially responsible for the economic stagnation of the 1990s[22]. Figure 3-9 shows the results of a survey on the extent to which ICT education is being implemented, and they that outside of the finance and insurance industries, as many as 40% to 60% of corporations conduct no ICT education whatsoever. While the finance and insurance industries have a high rate of ICT education implementation compared to other industries, more than 30% of corporations in these fields as well carry out no ICT education at all.

Figure 3-9 Implementation status of ICT education
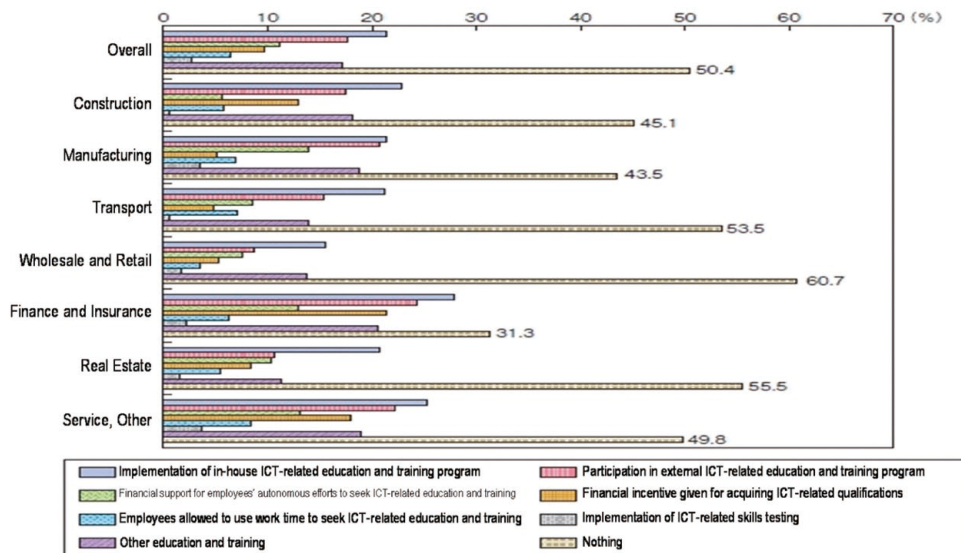
(Source) Ministry of Internal Affairs and Communications "Survey of International Comparative Analyses of ICT capital Contributions in Industry Growth" (2010) and "Communications Usage Trend Survey" (2009)

B. Estimation of the effects of ICT utilization capabilities on labor productivity

Figure 3-10 shows the results of an estimate of the effects of implementation, or lack thereof, of ICT education,n and levels of ICT knowledge and skill, on labor productivity, based on the data from the MIC Survey on ICT Utilization, and using a model where labor productivity is the explained variable and where the explanatory variables include response regarding presence or absence of ICT education. These results show that in addition to "amount of capital," "Percentage of terminal deployment," "introduction of non-contact IC cards," and "net procurement," "implementation of ICT education" and "CIO establishment" are also significant indicators.

---

[21] Black and Lynch (1997) Bresnahan et al. (1999) and Brynjolfsson and Hitt (2000), and others have demonstrated that ICT is complementary to the nature of corporate organization and educational level of the work force, and coupled with ICT investment, has a positive effect on productivity. Meanwhile, Basu et al. (2003) have adopted a similar perspective in comparing the UK, where the effects of ICT are slow to appear, with the US
[22] Shinozaki (2003)

Figure 3-10 Effects of ICT education on labor productivity (Estimated results based on regression analysis)

Dependent variable: labor productivity = (operating income + labor costs + depreciation) / number of employees

Explained variable: expected sign	Factor	[Standard Error]	P Value	
Capital (small = 1 to large = 8) +	2.0807	[0.2143]	0.0000	***
Percentage of terminal deployment -	−0.8885	[0.2491]	0.0000	***
ASP, SaaS utilization (yes = 1, no = 2) -	−1.1194	[0.9738]	0.2510	
Electronic tag introduction (yes = 1, no = 3) -	1.0733	[1.3173]	0.4150	
Non-touch IC card introduction (yes = 1, no = 3) -	−1.3218	[0.6265]	0.0350	**
Introduction of devices with new network functions (yes = 1, no = 3) -	0.2362	[0.7523]	0.7540	
Introduction of GPS, etc. (yes = 1, no = 3) -	0.2811	[0.9450]	0.7660	
Net procurement (yes = 0, no = 1) -	−1.4876	[0.7982]	0.0630	*
BtoB Net sales (yes = 0, no = 1) -	−1.6930	[1.6076]	0.2920	
BtoC Net sales (yes = 0, no = 1) -	−0.4046	[1.0689]	0.7050	
Telework (yes = 1, no = 2) -	1.7470	[1.3346]	0.1910	
ICT education implementation (points for principal components) +	0.7015	[0.2943]	0.0170	**
CIO establishment (yes = 1 to no = 4) -	−0.9247	[0.5587]	0.0980	*
Constant terms	3.3236	[6.1350]	0.5880	
Freely adjusted coefficient of determination = 0.1387 Sample size = 1,414				

※ ***: 1 % significant **: 5% significant *: 10% significant

(Source) Ministry of Internal Affairs and Communications "Survey of International Comparative Analyses of ICT capital Contributions in Industry Growth" (2010) and "Communications Usage Trend Survey" (2009)

(4) Simulation of ICT utilization promotion and accelerated investment in digitalization scenario

This simulation includes [1] a baseline scenario applying the 1995 – 2005 growth rates for various factors to the 10-year period ending in 2020, and [2] an accelerated ICT investment scenario where ICT investment is doubled and ICT utilization promoted through education and other measures (the amount of ICT investment from the baseline scenario is doubled, and improvements in labor quality due to ICT education, etc. are taken into account), and was conducted by applying growth accounting analysis[23] to the 10 years ending in 2020[24]. The outcome of quantitative estimates of the contribution of ICT capital growth (based on the EU KLEMS database) on industrial growth through total factor productivity, and estimates of the impact of ICT utilization on labor productivity (based on the MIC Survey on ICT Utilization) were used in the simulation.

Figure 3-11 shows the results of the simulation. According to these results, the annualized growth rate of total real added value, by industry (real GDP) in 2020 stands at about 1.7% with the baseline scenario, and about 2.5% for the ICT utilization promotion and accelerated investment in digitalization scenario. When the two scenarios are compared, the ICT utilization promotion and accelerated investment in digitalization scenario shows a 0.8% higher rate of growth than the baseline scenario, indicating that promotion of accelerated ICT investment and utilization acts to stimulate growth in a range of industries. For Japan, which will continue to face a decline in the working-age population due to the low birth rate, it is clear that ICT investment can be an effective economic growth strategy.

---

[23] Growth accounting analysis is a method that breaks down growth in volume of production over a set period into that resulting from input for each production factor and contribution from growth of total factor productivity

[24] A previous study using a simulation along the same lines is the Jorgenson and Motohashi (2004) macroeconomic growth forecast for Japan over the period from 2002 to 2012. Jorgenson and Motohashi (2004) set forth multiple future scenarios related to the contribution to economic growth of various factors including labor input, capital input and total factor productivity. By totaling the various factor contributions in each scenario, an economic growth forecast for each scenario is obtained and compared with the others. The simulation in this MIC report makes reference to the Jorgenson and Motohashi (2004) simulation as appropriate. However, while the Jorgenson and Motohashi (2004) study focuses on the Japanese macro economy, the MIC simulation focuses on individual industries. It differs from the Jorgenson and Motohashi (2004) study in that it calculates the added value for each industry and adds the total added value for all industries to that of the Japanese macro economy.

Figure 3-11 Industry-specific Economic Growth due to ICT Utilization Promotion and Accelerated Investment in Digitalization Simulation (Real GDP Growth Rate and Annualized Rate)

Industry	Growth rate from 2010 to 2020	
	Baseline	Acceleration and promotion scenario
Agriculture, forestry and fisheries	−1.1%	−0.7%
Mining	0.4%	0.8%
Manufacturing	2.5%	4.1%
Construction	−3.0%	−2.7%
Electricity, gas and water	2.9%	3.4%
Wholesale and retail	0.1%	0.6%
Finance and insurance	1.2%	2.2%
Real estate	1.2%	1.5%
Transport and communications	2.2%	2.6%
Service	2.9%	3.2%
Government service producers	1.0%	1.5%
Producers of private nonprofit services to households	3.0%	3.4%
Total	1.7%	2.5%

(Source) Ministry of Internal Affairs and Communications "Survey of International Comparative Analyses of ICT capital Contributions in Industry Growth" (2010)