Section 1
ICT and Economic Growth

1. Economic growth in "the age of information and knowledge"

(1) Advent of "the age of information and knowledge"

Economic growth seen from a super long-term perspective has come through "the age of agriculture" and "the age of industry." In the early years of the 21st century, we are now expected to see the advent of "the age of information and knowledge."

Each age saw a major change that had worked as a source of new economic growth. It was fertile vast land in "the age of agriculture" and capital equipment in "the age of industry." In the coming "age of information and knowledge," ICT is expected to bring about change, and information and knowledge will become a source of new economic growth.

In the age of information and knowledge, ICT and networks will make their way into various fields, bringing active exchanges of information and knowledge and creating various innovations based on new ideas and creativity. And how to utilize such diverse information and knowledge will come to have important implications.

(2) Progress of ubiquitous networks and "the age of information and knowledge"

As of now, we have no objective macro-level indicators to show an overall picture of the progress of ubiquitous networks. We are only recognizing the progress from individual situations and various data. Therefore, in order to analyze the impact of the progress of ubiquitous networks on the society and economy, it is important to try to develop "ubiquitous index" to indicate the progress of ubiquitous networks objectively.

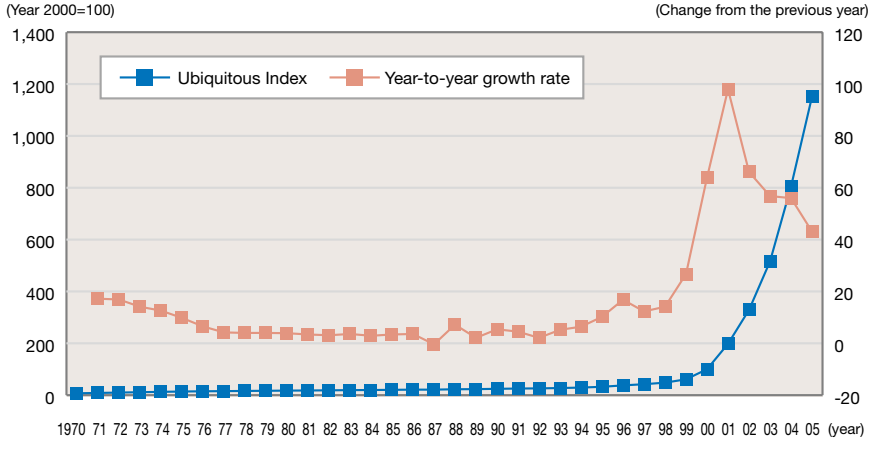
Below, we first develop ubiquitous index to show the progress of ubiquitous networks from the aspect of utilization and then analyze the impact of the progress of ubiquitous networks on economic growth, and lastly present the prospect for economic growth in 2010 that could be achieved if the potentials of ubiquitous networks were fully utilized.

(3) Development of ubiquitous index

Since the progress of ubiquitous networks causes major changes in their utilization, ubiquitous index needs to fully reflect the characteristics of ubiquitous network utilizations. For this reason, we used "expansion of spread" and "increased use" as two criteria to measure the progress of ubiquitous networks, selected data showing the two criteria, and, based on them, calculated "ubiquitous index" with the score as of 2000 being 100. Changes in calculated ubiquitous index show that ubiquitous networks have made rapid progress in Japan in the last several years **(Graph 1-1)**. The index began to rise sharply after 1995, when personal computers, the Internet and mobile phones began to spread in earnest. The year-to-year growth in the spread of ubiquitous networks hit a peak in 2001 buoyed by the global IT boom that began in the second half of the 1990s. Although the growth slackened slightly thereafter, it still remains at a high level.

Moreover, calculation of estimated ubiquitous index shows that year-to-year growth will begin to rise again after 2006. Ubiquitous networks made progress in the second half of the 1990s due to the "expansion of spread" and are expected to accelerate their progress toward 2010 on the strength of "increased use."

Graph 1-1 Changes in Ubiquitous Index



(Source) "Survey on Economic Growth by ICT"

(4) Progress of ubiquitous networks and economic growth

Next, in order to investigate the impact of the progress of ubiquitous networks, such as "expansion of spread" and "increased use," on economic growth based on the calculated ubiquitous index, they are analyzed by using macro production function model.

Estimate equation :

$$\ln\left(\frac{Y}{L}\right) = \ln A + \alpha' \cdot \ln\left(\frac{K_{all}}{L}\right) + \beta \cdot \ln(K_i \cdot U) + \delta Dummy$$

Estimated result :

$$\ln(Y/L) = \underset{(-18.430)}{-0.8511} + \underset{(19.450)}{0.4296} \cdot \ln(K_{all}/L) + \underset{(2.830)}{0.0105} \cdot \ln(Ki \cdot U) + \underset{(3.560)}{0.0409} Dummy$$

Determination coefficient = 0.9956;
Durbin-Watson ratio = 1.6874

** Figures in the parentheses are t values*

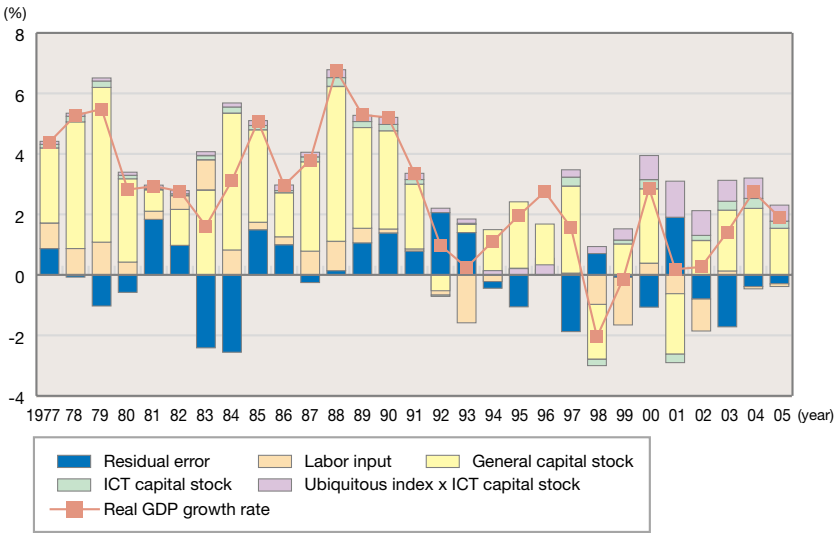
We can confirm from the estimated result that not only network economy by corporations' ICT capital but also ubiquitous networks are making positive contribution to the enhancement of productivity.

Furthermore, the estimated result shows that ubiquitous networks have been increasing their contribution to economic growth **(Graph 1-2)**.

(5) Development of ubiquitous networks and projected economic growth

A simulation of the contribution of the development of ICT capital and ubiquitous networks to economic growth shows that if the Japanese economy grows smoothly and the potentials of ubiquitous networks are fully utilized, Japan's real GDP growth rate will be about 1.0 to 1.1 points higher than in the case where such conditions are not met **(Graph 1-3)**.

Graph 1-2 Progress of Ubiquitous Networks and Their Contribution to Real GDP Growth



(Source) "Survey on Economic Growth by ICT"

Graph 1-3 Estimation of Contribution of Ubiquitous Effect to Real GDP Growth

* Case 1 is where the Japanese economy grows smoothly and the potentials of ubiquitous networks are fully utilized.

Case 2 is where the Japanese economy does not grow smoothly and the potentials of ubiquitous networks are not fully utilized.

(Source) "Survey on Economic Growth by ICT"

2. ICT investment and Economic Growth

(1) Increases in economic growth and labor productivity by ICT investment

A comparison of changes in ICT investment between Japan and the United States from 1990 to 2005 shows that while Japan's investment increased by about 1.9 times during the period, U.S. investment increased by about 6.2 times, more than 3 times faster than in Japan. During the same period, Japan's GDP increased 1.2 times, while U.S. GDP grew about 1.5 times **(Graph 1-4)**.

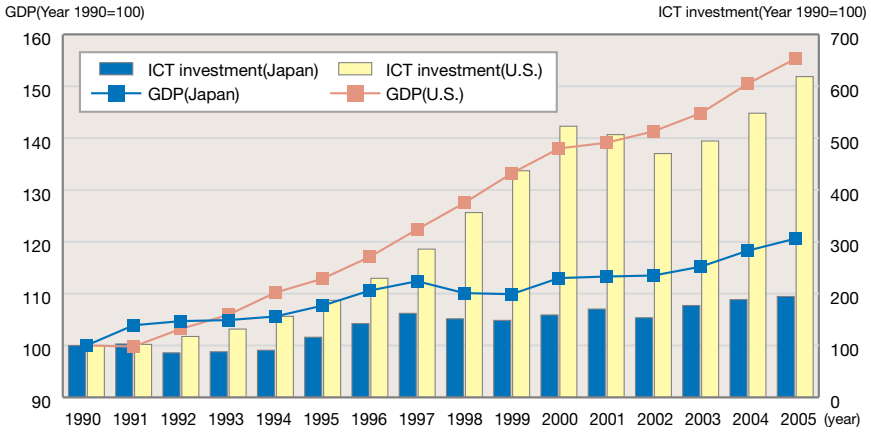
A comparison of the contribution of TFP to labor productivity between Japan and the United States **(Graph 1-5)** shows that U.S. labor productivity has consistently increased since 1990 and the contribution of TFP growth to labor productivity growth during the five years from 2000 to 2005 stands high at 2.20%. On the other hand, the growth rate of Japanese labor productivity has remained almost flat since 1990 and the contribution of TFP growth to labor productivity growth during the same five-year period stands at 1.00%.

The above results suggest that although Japan steadily increased ICT investment and accumulation of ICT capital, it lagged behind the United States in effectively utilizing them for innovation and that this may be the reason why Japan lagged behind the United States in enhancing its labor productivity.

(2) Factor analysis of increase in labor productivity

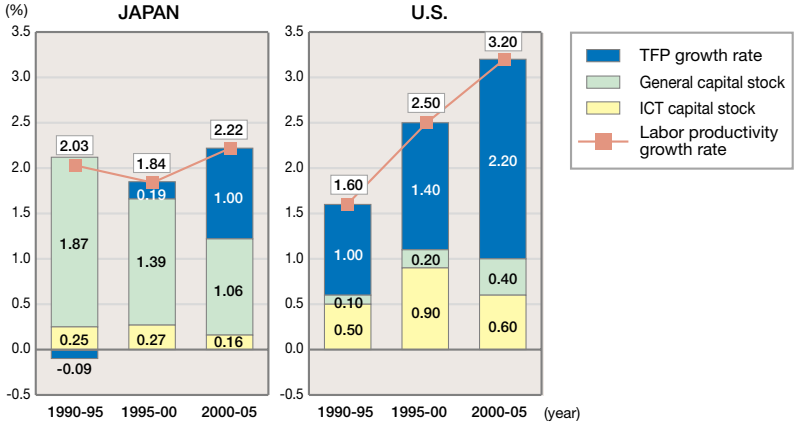
A comparison of the growth rate of labor productivity between the manufacturing industry and the service industry shows that the growth rate in the manufacturing industry in the past 10 years was 4.10%, while that in the service industry was 1.52% **(Graph 1-6)**. There is no big difference between the manufacturing industry and the service industry with regard to the contribution of ICT capital stock and general capital stock, respectively, to the growth rate. On the other hand, there is a big difference in the contribution of TFP to the growth rate between the two industries, with that to the manufacturing industry standing at 2.21% and that to the service industry at 0.14%. This is a major factor behind the contrasting result of labor productivity growth between the two industries.

Graph 1-4 Changes in ICT Investment and GDP in Japan and U.S.



(Source) "Survey on Economic Analysis of ICT"

Graph 1-5 Contribution of TFP Growth to Labor Productivity Growth



(Source) "Survey on Economic Analysis of ICT"

3. Status and Trends of the ICT Industry

(1) Status of the ICT industry as seen from the macro economy

A. Gross domestic product (GDP)

The real GDP of the ICT industry in 2005 increased 7.9% from the previous year to 66.8 trillion yen **(Graph 1-7)**. The real GDP of the ICT industry has been consistently increasing since 1995 and its average annual growth rate from 1995 to 2005 stood at 7.3%.

B. Contribution to the Japanese economy

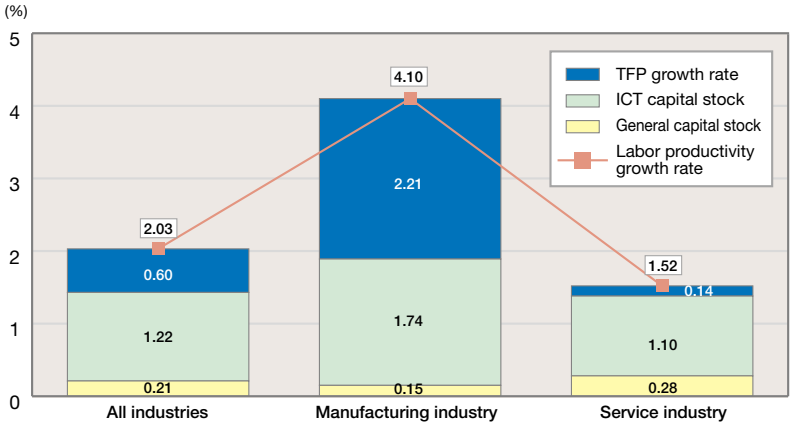
The ICT industry has been consistently making a positive contribution to the growth rate of Japan's real GDP since1996. In 2005, the industry had the largest impact on the nation's economic growth, contributing 0.9 percentage point to the 2.2% growth of the real GDP, or accounting for 42.2% of the growth **(Graph 1-8)**.

(2) Trends of the ICT industry

The ICT manufacturing industry has been maintaining a high level of production, shipment and inventory. Although the growth rates of production and shipment slowed down in the first half of 2005, they began to pick up again in early 2006. Inventory has been expanding further, showing a sign of buildup **(Graph 1-9)**.

The activities of the ICT service industry have remained on a moderate expansionary trend on the whole. In particular, contracts of system management and operation are brisk and software product and software businesses are on a rising trend. On the other hand, information-related machine and device leasing and mobile communications businesses, though they were on an increasing trend, are moving sideways in recent years **(Graph 1-10)**.

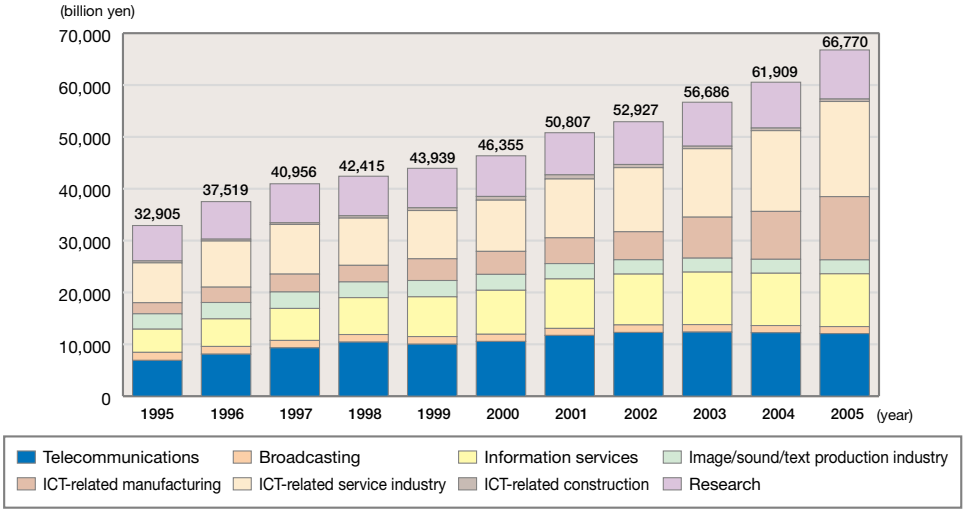
Graph 1-6 Contribution to Labor Productivity Growth (all industries, manufacturing industry, service industry)



* "Service industry" includes electric supply, gas supply, water supply and heat supply industries, commerce, financial and insurance businesses, and other service industries. "All industries" and "Service industry" do not include real estate industry.

(Source) "Survey on Economic Analysis of ICT"

Graph 1-7 Transition of Real GDP of ICT industry



(Source) "Survey on Economic Analysis of ICT"

4. Trends of the Japanese Economy as Seen from ICT-Related Demand (Consumption, Investment, Export)

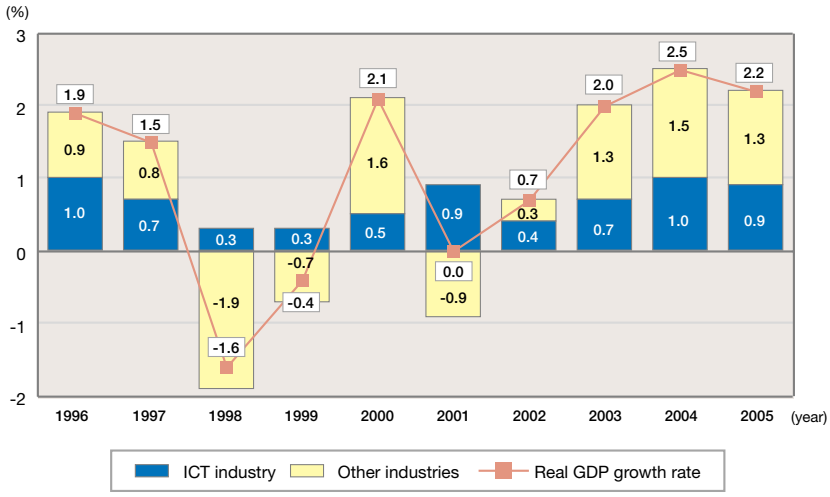
(1) Trends of the Japanese economy as seen from ICT-related domestic demand

ICT-related consumption's contribution to consumption expenditure shows that ICT-related consumption has been making a positive contribution in almost all quarters since 2001, indicating that ICT-related consumption has been contributing to the increase of total consumption expenditure **(Graph 1-11)**. As to the contribution of ICT-related investment to businesses' capital investment, machinery orders, which serve as a leading indicator for business investment, show that ICT-related machinery orders have been making a positive contribution to total machinery orders in almost all quarters from 2003 to the first half of 2006, indicating that ICT-related investment has been contributing to the increase of total investment since 2003 **(Graph 1-12)**

(2) Trends of the Japanese economy as seen from ICT-related external demand

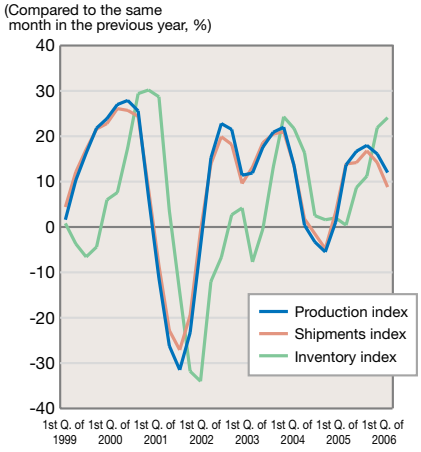
ICT-related exports show that while Japan's ICT-related exports to the United States have been on a decreasing trend since 2000, its ICT-related exports to China have been increasing sharply since 1999 **(Graph 1-13)**. Japan's ICT-related exports to other Asian countries are also increasing, albeit moderately.

Graph 1-8 Contribution of ICT industry to real GDP growth rate



(Source) "Survey on Economic Analysis of ICT"

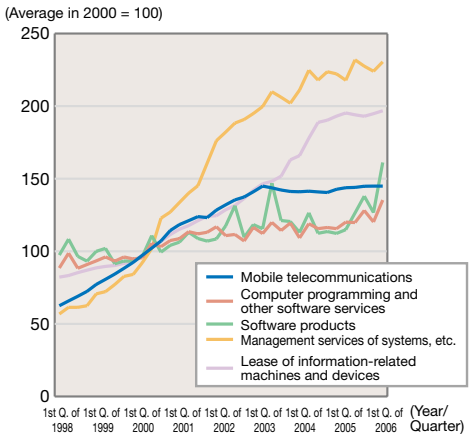
Graph 1-9 Production, shipments, and inventory status in the ICT manufacturing industry



* Calculating original indexes of production index, delivery index, and inventory index

Source: "Indices of Industrial Production," Ministry of Economy, Trade and Industry

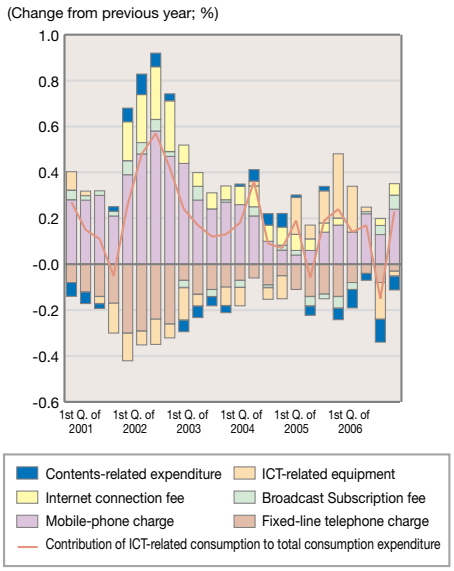
Graph 1-10 Activity status of the ICT service industry



Source: "Indices of Tertiary Industry Activity," Ministry of Economy, Trade and Industry

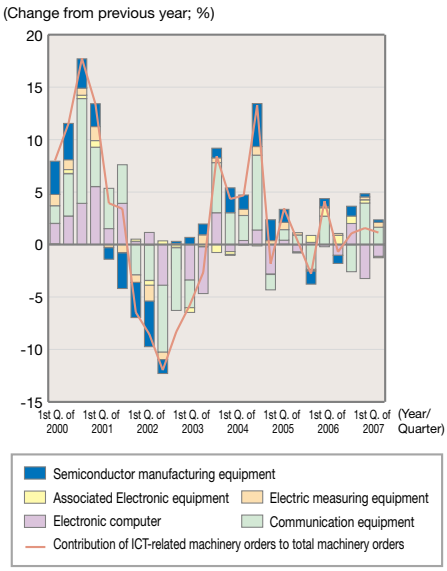
ICT-related exports to China show that Japan's exports of semiconductors and other electronic components, and intermediary goods for audio and visual equipment, have increased significantly **(Graph 1-14)**. This indicates that the trading structure of the Japanese ICT industry has been shifting to exports of semiconductors and other electronic components, intermediary goods for audio and visual equipment, from exports of final goods, such as electronic computers and communication equipment. As to Japan's trading partners, the United States had been the main partner, but in recent years, Asian countries, especially China, have become Japan's important export counterparts.

Graph 1-11 Contribution of ICT-Related Consumption to total Consumption Expenditure



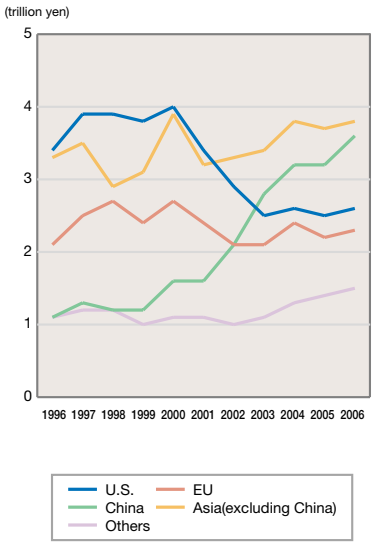
Source: "Family Income and Expenditure Survey," Ministry offf Internal Affairs and Communications

Graph 1-12 Contribution of ICT-Related Machinery Orders to Total Machinery Orders

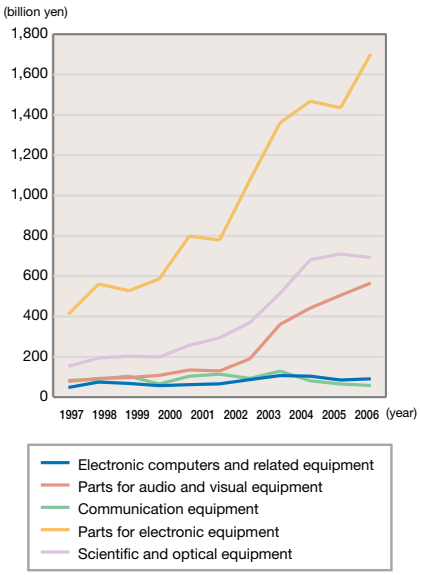


Source: "Orders Received for Machinery," Cabinet Office

Graph 1-13 Changes in ICT-Related Exports from Japan



Graph 1-14 Changes in ICT-Related Exports to China from Japan



Source for both graph 1-13 and 1-14, "Trade Statistics" Ministry of Finance

5. Economic Ripple Effects of the ICT Industry

(1) ICT industry's added-value induction effects

The added value induced by the ICT industry in 2005 increased 4.2% from the previous year to about 42 trillion yen. During the 10-year period from 1995 to 2005, the added value induced by many industries decreased or remained flat, but the added value induced by the ICT industry kept increasing except for 2002, indicating that the share of the ICT industry in the whole economy has increased **(Graph 1-15)**.

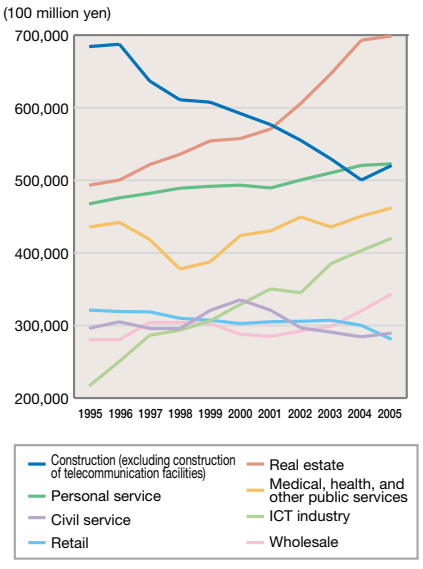
The number of jobs induced by the ICT industry during the same 10-year period remained almost unchanged. Furthermore, the number of jobs induced by each sector of the ICT industry shows that the number of jobs induced by the ICT-related manufacturing sector, which had accounted for the largest share, decreased sharply, indicating that this is a major factor behind the sluggish increase in the number of jobs induced by the ICT industry as a whole **(Graph 1-16)**.

6. Analysis of Regional ICT Industries

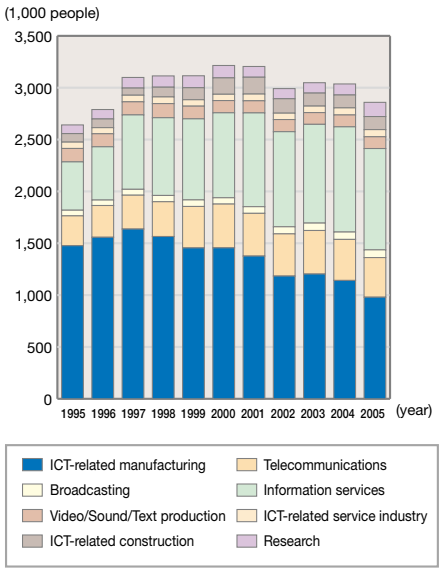
We have investigated the share of the regional real domestic output by the ICT-related manufacturing sector and ICT-related service sector in the national real domestic output by the same industries. With regard to the manufacturing sector, the study shows that although the share of the Kanto area was the largest both in 1990 and 2000, its share has been shrinking. On the other hand, the shares of the Chubu, Kyushu and Tohoku areas have increased, indicating that the manufacturing sector has been shifting production from Kanto to other areas. With regard to the service sector, the study shows that the share of Kanto area was the largest both in 1990 and 2000 and that the share has been increasing. On the other hand, the shares of other areas have decreased or remained flat, indicating that the accumulation of the service sector in the Kanto area has been increasing.

Furthermore, a study of the relationship between the ICT service sector in Kanto and the ICT-related manufacturing sector in 8 areas other than Kanto shows that the output of the ICT-related manufacturing sector in the 8 areas other than Kanto that was induced by final demand for the ICT service sector in Kanto increased consistently from 1990 to 2000. The growth rate of the output induced by such final demand had been 45.7% in 5 years from 1990 to 1995 and jumped 102.4% in the next 5 years from 1995 to 2000. The output of the ICT service sector in Kanto that was induced by final demand for the ICT manufacturing sector in the 8 areas other than Kanto also increased consistently from 1990 to 2000. The growth rate of the output induced by such final demand had been 1.5% in 5 years from 1990 to 1995 and surged 97.2% in the next 5 years from 1995 to 2000. This suggests that in the ICT industry, a large mechanism may be at work to bring about production inducement effects to the whole of Japan through inter-regional economic ripple effects. It can be said that the growth of the ICT industry in Japan is contributing to an integrated development of regional economies.

Graph 1-15 Changes in the Added Value Induced by Major Industries



Graph 1-16 Changes in the Number of Jobs of Each Sector Induced by ICT Industry



(Source for graphs 1-15 and 1-16) "Survey on Economic Growth by ICT"