Chapter 1 Intensification of International Competition and the Need for Innovation

We are currently in the era where development of IT enables intellectual labor, such as research and development, to easily cross borders. The BRICs countries such as China and India with excellent human resources have achieved significant economic growth to become major suppliers in finance and services. These countries also greatly affect the balance of demand and supply in energy and grain; they are profoundly altering the global competitive landscape.

In addition, we can estimate that the soaring of such raw materials as energy and grain, and the adverse effect of the commoditization[fn.1] of technology on the balance of payments for processing trade, may result in substantial damage to the dominant position of our country in the global economy.

In the great competitive era in which international competition is becoming increasingly severe, and in order to handle the loss of international competitiveness as a result of an aging society with a declining birthrate, which became obvious since the so-called lost decade, the creation of innovation, especially the creation of innovation by S&T, is essential. We hereafter introduce the current situation concerning science and technology.

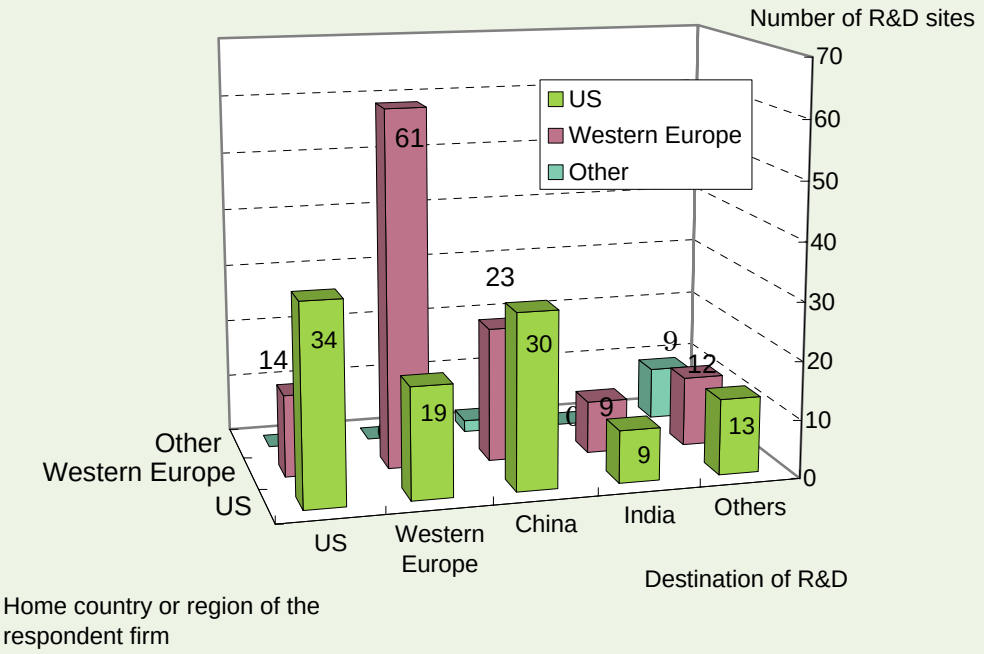
1 Progress in Advancing Information Technology and Globalization

Today, with fiber optic and other networks around the world, it is possible to communicate instantaneously across great geographical distances at very low cost. Basically, computerized online tasks can be accomplished anywhere on the Earth. The Internet is used everywhere in all aspects of society. The financial, media, and other industries disseminate information globally. Concerning this situation, the report *Rising Above the Gathering Storm* published by the US National Academies to be introduced in Part 1, Chapter 2 states that "workers in virtually every sector must now face competitors who live just a mouse-click away in Ireland, Finland, China, India, or dozens of other nations whose economies are growing."

These phenomena mean that utilization of overseas regions and human resources in intelligent production activities is now routine as typically shown by the fact that the IT industries in the US are outsourcing and constructing a research and development establishment in India. (Figure 1-1-1 and Column 1)

fn. 1 Commoditization: Refers to the process of technology-based products becoming readily available and accessible to anyone through generalization and price reduction (See Part 1, Chapter 1, 3).

Figure 1-1-1 The Number of R&D Sites Established Inside the Home County or in China by the US, Western European, and Others' Firms in 2005



Source: All American Academies *Here and There?* (2006)

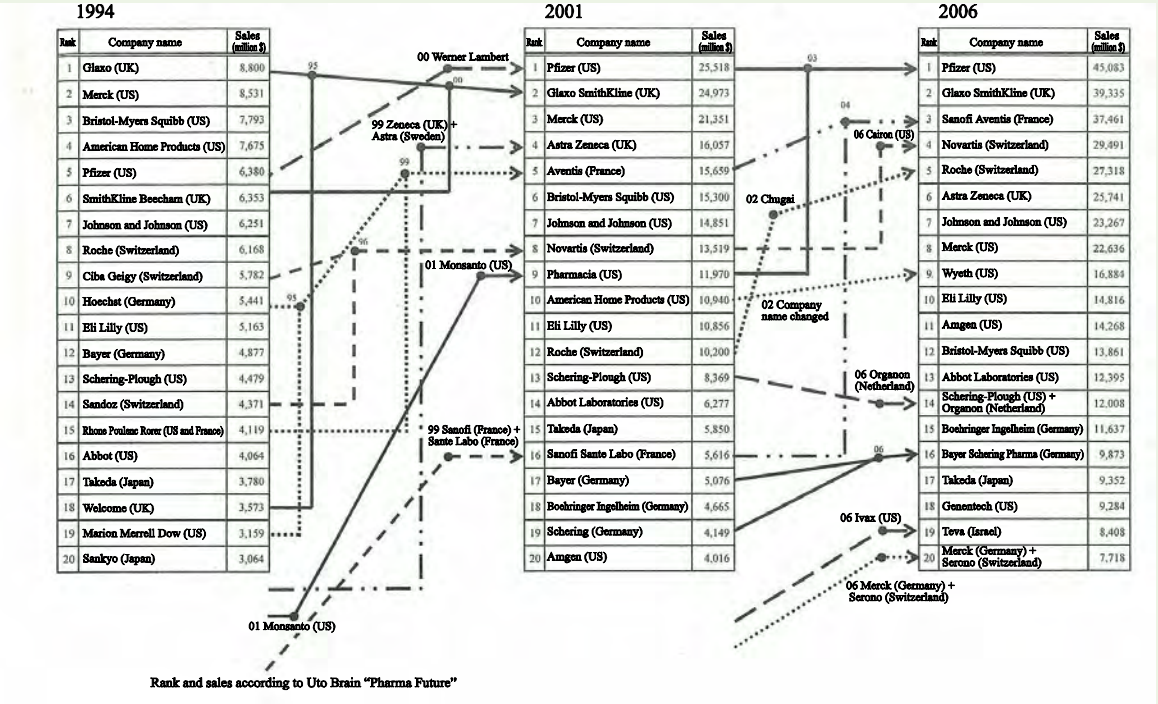
As exemplified by the inflow of highly qualified intellectual human resources from China, India, and other parts of the world to the US for highly knowledge-intensive jobs in R&D and medical fields, a continuing mass transborder migration of intellectual human resources constitutes the driving force behind innovation.

Progress in advancing information technology and globalization has contributed to global business reorganization, as typically shown in the pharmaceutical industry, which resulted in the emergence of corporate giants comparable to or far larger than leading Japanese companies in different fields. Thus, a new situation has emerged where jobs can easily move across national borders, not only in existing globalized industries, such as product manufacturing and sales, but also in R&D, medicine, and other knowledge-intensive industries that traditionally have remained domestic (Figure. 1-1-2).

While globalization facilitates the cross-border mobility of human resources, enterprises, goods, and services, the entities making the transfers tend to flock to hubs with better access to useful information and good business opportunities (localization). This tendency can typically be seen in the convergence of corporate headquarter functions or financial and media center functions in New York, London, or Tokyo. Another example is provided by the R&D hubs in Silicon Valley in the US. As for the BRICs countries mentioned later, R&D hubs have been established in Zhongguancun (Beijing City) in China and in Bangalore in India. Xinzhu City in Taiwan and Dubai in the United Arab Emirates also attract attention as global hubs. The co-occurrence of globalization and localization, sometimes called "glocalization,"[fn.2] has become more prevalent in recent years. The domestic presence of global hubs with good availability of competent human resources and with good access to transportation and other social infrastructures is also viewed as one of the major factors that determine the international competitiveness of a country.

fn. 2 Roland Robertson Globlization: Time-Space and Homogeneity-Heterogeneity in M. Featherstone, S. Lash and R. Robertson (eds) Global Modernities (Theory, Culture & Society), pp. 25-44. (Sage, 1995)

Figure 1-1-2 Trends of Reorganization in the World's Pharmaceutical Industry



Rank	Company name	Sales (million $)
1	Glaxo (UK)	8,800
2	Merck (US)	8,531
3	Bristol-Myers Squibb (US)	7,793
4	American Home Products (US)	7,675
5	Pfizer (US)	6,380
6	SmithKline Beecham (UK)	6,353
7	Johnson and Johnson (US)	6,251
8	Roche (Switzerland)	6,168
9	Ciba Geigy (Switzerland)	5,782
10	Hoechst (Germany)	5,441
11	Eli Lilly (US)	5,163
12	Bayer (Germany)	4,877
13	Schering-Plough (US)	4,479
14	Sandoz (Switzerland)	4,371
15	Rhone Poulenc Rorer (US and France)	4,119
16	Abbot (US)	4,064
17	Takeda (Japan)	3,780
18	Welcome (UK)	3,573
19	Marion Merrell Dow (US)	3,159
20	Sankyo (Japan)	3,064

Rank	Company name	Sales (million $)
1	Pfizer (US)	25,518
2	Glaxo SmithKline (UK)	24,973
3	Merck (US)	21,351
4	Astra Zeneca (UK)	16,057
5	Aventis (France)	15,659
6	Bristol-Myers Squibb (US)	15,300
7	Johnson and Johnson (US)	14,851
8	Novartis (Switzerland)	13,519
9	Pharmacia (US)	11,970
10	American Home Products (US)	10,940
11	Eli Lilly (US)	10,856
12	Roche (Switzerland)	10,200
13	Schering-Plough (US)	8,369
14	Abbot Laboratories (US)	6,277
15	Takeda (Japan)	5,850
16	Sanofi Sante Labo (France)	5,616
17	Bayer (Germany)	5,076
18	Boehringer Ingelheim (Germany)	4,665
19	Schering (Germany)	4,149
20	Amgen (US)	4,016

Rank	Company name	Sales (million $)
1	Pfizer (US)	45,083
2	Glaxo SmithKline (UK)	39,335
3	Sanofi Aventis (France)	37,461
4	Novartis (Switzerland)	29,491
5	Roche (Switzerland)	27,318
6	Astra Zeneca (UK)	25,741
7	Johnson and Johnson (US)	23,267
8	Merck (US)	22,636
9	Wyeth (US)	16,884
10	Eli Lilly (US)	14,816
11	Amgen (US)	14,268
12	Bristol-Myers Squibb (US)	13,861
13	Abbot Laboratories (US)	12,395
14	Schering-Plough (US) + Organon (Netherland)	12,008
15	Boehringer Ingelheim (Germany)	11,637
16	Bayer Schering Pharma (Germany)	9,873
17	Takeda (Japan)	9,352
18	Genentech (US)	9,284
19	Teva (Israel)	8,408
20	Merck (Germany) + Serono (Switzerland)	7,718

Source: Ministry of Health, Labor and Welfare *New Pharmaceutical Industry Vision*

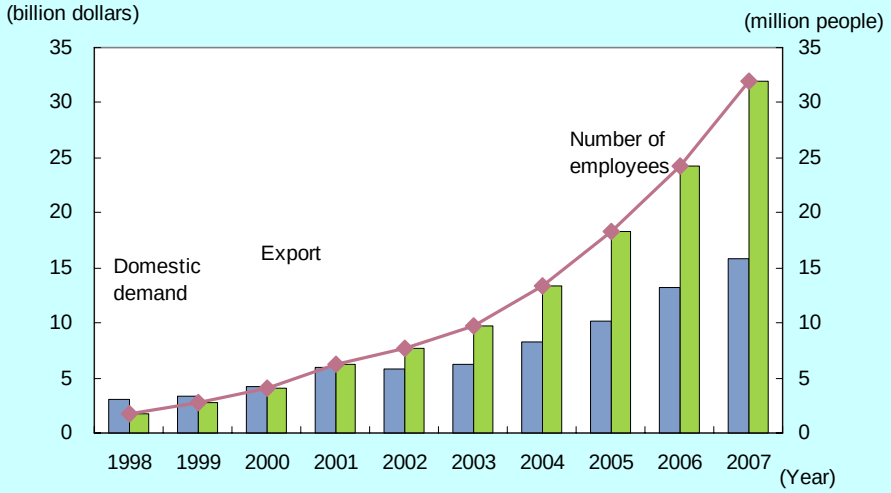
COLUMN 1

Offshore Development of Software

A typical example of using advances in IT technology skillfully is offshore development outsourced from overseas and promoted in hubs located in India. The IT industry in this country is rapidly progressing since political conversion to economic liberalization in 1991. According to NASSCOM, the Indian industrial group, the size of production in the IT industry grew rapidly from 5 billion dollars in 1997 to 19.6 billion dollars in 2003. It is predicted that the size of production will further increase in 2008.

In addition, the export of software from India is increasing each year, and according to NASSCOM, it is predicted that 31.3 billion dollars in 2006 corresponds to a 25% share of all exports from India, and the amount will reach 60 billion dollars by 2010. Moreover, it is estimated that the labor force employed by the Indian IT industry totals 380,000 people, revealing that demand for excellent human resources who have already acquired advanced technology is increasing.

With this background, US enterprises with high level technologies have utilized the excellent local Indian engineers since the latter half of 1980s because the cost of labor is cheaper than in the US. Since then, major enterprises related to IT in the US have constructed hubs in many locations in India, especially Bangalore. Even at present, the destination for most software exports from India is still the US, accounting for 60% or more of all exports from India.



Source: Prepared by MEXT based on India's NASSCOM (National Association of Software and Services Companies) documents.

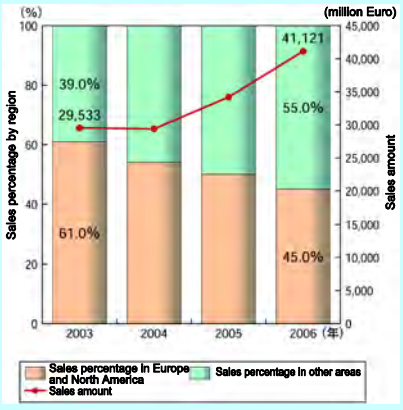
COLUMN 2

Enterprises Active in Global Economy

In the past, worldwide manufacturers that produce products using advanced technologies are in countries with a certain large domestic market such as Japan and the US. Currently, however, manufacturers that acquire a large share of main products not only in the domestic market but worldwide came into existence with the trend toward globalization.

The typical enterprise is Nokia Corporation in Finland, which holds a large share of the mobile phone market. Nokia started as a paper manufacturing enterprise and advanced into other industries, such as personal computers and televisions, by restructuring business fields and taking advantage of a management crisis in the 1990s to restart in the mobile phone related business as the core enterprise. This successful decision allowed them to grow into a manufacture with the largest share in the world of the mobile phone markets. Currently they have about a 36% share (in 2006) of the worldwide mobile phone market and enjoy global sales that are far larger than their domestic one.

Sales percentage of Nokia by region



Source: Ministry of Internal Affairs and Communications *2007 White Paper on Information and Communications*

2 Rise of BRICs Led by China and India

(1) Impact of the rise of BRICs countries

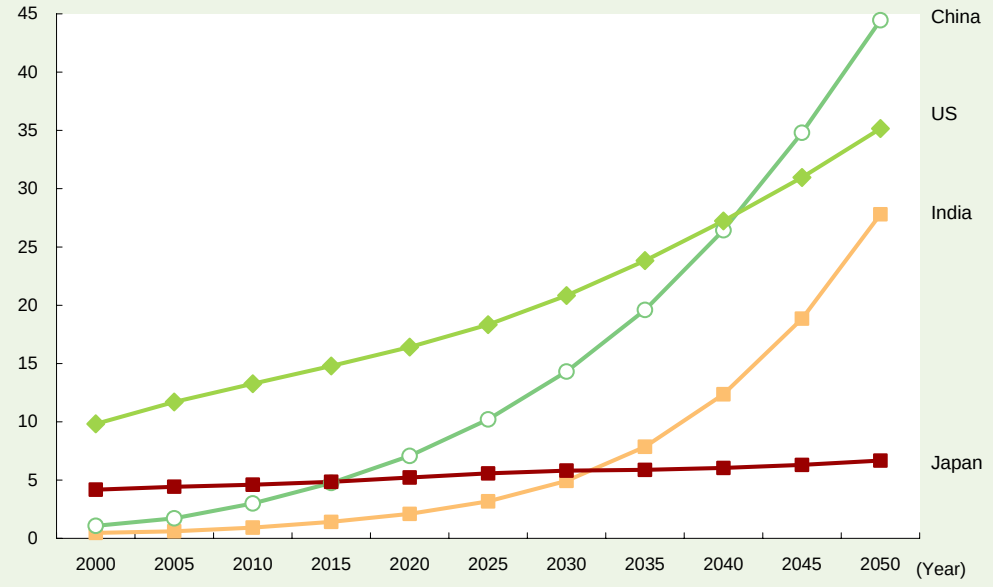
With the opening of the age of highly advanced information technology, Brazil, Russia, India, and China have opened their domestic markets and become more involved in the global economic system, gradually increasing their presence in the world economy. The collective acronym for these countries is BRICs.

These countries have achieved significant economic growth thanks to the introduction of foreign investment and the appreciation in energy prices to become major world players not only as sellers in the market of finance and services but as major suppliers of natural resources, financing, and services. The US-based securities firm Goldman Sachs Group, Inc. predicted, in its 2003 publication *Dreaming with BRICs: The Path to 2050*, that China will rank at the top of the world in terms of GDP[fn.3] for 2050 (USD basis), followed by the US, India, Japan, Brazil, and Russia in that order (Figure 1-1-3). This prediction gave a great impact to the world.

The size of a national economy depends largely on that of the global economy, the availability of food and other resources, and various negative factors such as environmental burdens; the aforementioned report is no more than one of many predictions. Still, it should be noted that predictions that BRICs countries will grow into major economic powers are far from exceptional (Table 1-1-4).

Figure 1-1-3 Trends in Estimated GDP Growth of Major Countries

US$ trillion (Currency exchange rates based on estimated market exchange rates)



Source: Goldman Sachs Group, Inc.

fn. 3 Gross Domestic Product

Table 1-1-4 Trends in GDP Growth of Major Countries (Estimated Figure)

(Prices in 2005, US$ billion)

Year	Brazil	China	India	Russia	Canada	France	Germany	Italy	Japan	UK	US	BRICs	G7	BRICs/ G7
2000	728	1,354	521	293	819	1,506	2,154	1,244	5,276	1,643	11,093	2,897	23,735	12.20%
2005	882	2,244	781	764	1,132	2,138	2,796	1,773	4,561	2,246	12,434	4,670	27,080	17.20%
2010	1,227	4,461	1,385	1,424	1,206	2,199	2,851	1,953	4,240	2,427	13,837	8,498	28,713	29.60%
2015	1,505	7,616	2,117	1,839	1,385	2,405	3,011	2,101	4,658	2,711	15,893	13,077	32,165	40.70%
2020	1,875	11,716	2,970	2,272	1,559	2,646	3,239	2,248	4,978	3,005	18,269	18,832	35,944	52.40%
2025	2,292	16,636	3,790	2,728	1,740	2,892	3,455	2,400	5,260	3,309	20,900	25,446	39,955	63.70%
2030	2,746	22,061	4,663	3,193	1,933	3,145	3,665	2,553	5,504	3,614	23,807	32,662	44,222	73.90%
2035	3,252	27,434	5,654	3,682	2,128	3,407	3,870	2,709	5,711	3,919	26,892	40,023	48,637	82.30%
2040	3,793	31,888	6,797	4,196	2,333	3,680	4,079	2,871	5,878	4,242	30,282	46,675	53,365	87.50%
2045	4,379	35,237	8,054	4,628	2,540	3,943	4,272	3,020	6,010	4,574	33,841	52,298	58,202	89.90%
2050	4,979	38,010	9,407	4,967	2,764	4,216	4,474	3,170	6,105	4,918	37,748	57,362	63,395	90.50%

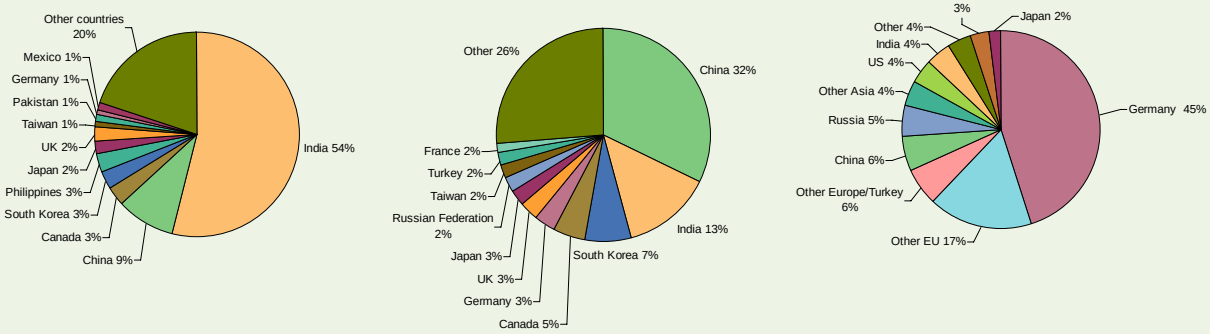
Source: Marubeni Economy Institute

It is noted that economical development in BRICs countries, especially in China, India, and Russia, has a very large impact on the world's competitive landscape. In particular, these three countries have large populations and are not only great political and military powers but have intelligent workers, such as excellent researchers, flourishing throughout the world with a high level of education (Figure 1-1-5). It is highly possible that these countries will grow into major ones of the next generation comparable to the US and EU in the future (Figure 1-1-6). In addition, Russia and Brazil cannot be ignored as economic players nor as suppliers of food and energy. (Table 1-1-7).

Mapping the Global Future: Report of the National Intelligence Council's 2020 Project focuses on the magnitude of the impact by stating, "The likely emergence of China and India, as well as others, as new major global players—similar to the advent of a united Germany in the 19th century and a powerful US in the early 20th century—will transform the geopolitical landscape, with impacts potentially as dramatic as those in the previous two centuries."

In these countries, global giant companies already exist, including Lenovo Group Limited, one of the original companies spun-off from the Chinese Academy of Sciences, the largest national research institution in China, and now the world's eighth largest personal computer manufacturer with IBM's former PC operations under its control; India-based Tata Motors Limited, the world's fifth largest commercial vehicle manufacturer; and Infosys Technologies Limited (IT company specialized in offshore development among other things), which became the first NASDAQ-listed Indian company in 2006.

Figure 1-1-5 Employment Status of Foreign Nationals in the US and Germany



(1) Country of citizenship for new recipients of US H-1B non-immigrant work visas

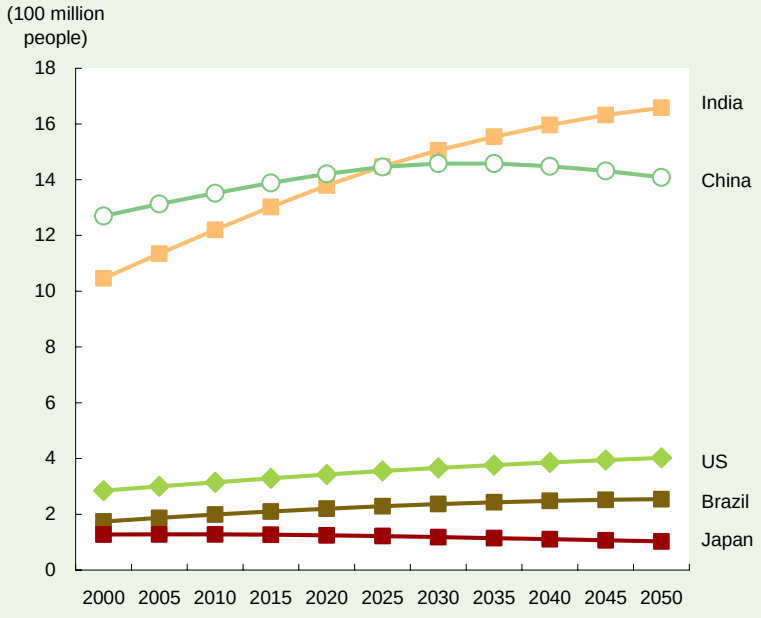
(2) Country of citizenship for new recipients of US H-1B non-immigrant work visas holding doctorates

(3) Citizenship of junior and guest scientists at Max Planck Institutes

Note) The H-1B Non-Immigrant Work Visa may be issued to individuals who are to work in the US in a specialty occupation requiring at least a job-relevant bachelor's degree or higher.

Source: National Science Foundation *Science and Engineering Indicators 2008*

Figure 1-1-6 Trends in Estimated Population in Major Countries



Source: The Goldman Sachs

Table 1-1-7 Comparison of Mining and Manufacturing Production in BRICs Countries

Energy resources	Coal (million ton)	Crude oil (million ton)	Natural gas (1000 trillion Joule)	Uranium ore (ton)
Brazil				339
Russia	164	377	22,308	2,850
India	340			
China	1,398	167		
Japan	3		113	

Mineral resources	Iron ore (million ton)	Nickel ore (thousand ton)	Manganese ore (thousand ton)	Gold ore (ton)
Brazil	140	45	1,554	48
Russia	49	310		168
India	62		672	
China	117	55	2,268	192
Japan				9

Source：United Nations *Monthly Bulletin of Statistics*, August 2006

Currently, the economic growth of these countries has been identified as mostly dependent on cheap labor and resources. However, as described in Part 1, Chapter 2, Section 1, China and other emerging countries are strongly promoting an increase in governmental R&D investment and significant reforms of the R&D system. Thus, they will become strong competitors of advanced countries in innovation creation.

In its 2004 report *Mapping the Global Future*, NIC concluded: "China and India are well positioned to become technology leaders. The expected next revolution in high technology involving the convergence of nano-, bio-, information, and materials technology could further bolster China and India's prospects. Both countries are investing in basic research in these fields and are well placed to be leaders in a number of key fields."

There is a possibility that the growth of the countries called the "Next Eleven"[fn.4] that made their appearance on the world market following the BRICs countries may greatly affect the world economy. It could be noted that they will enhance the both economy and S&T in addition to the BRICs countries

fn. 4 NEXT 11: Eleven countries that are assumed in Economy Prediction Report in 2005 by Goldman Sachs that their economic growth can be expected following BRICs. Specifically, Iran, Indonesia, Egypt, Korea, Turkey, Nigeria, Pakistan, Bangladesh, The Philippines, Vietnam, and Mexico

COLUMN 3

Mapping the Global Future: National Intelligence Council 2020 Project Report

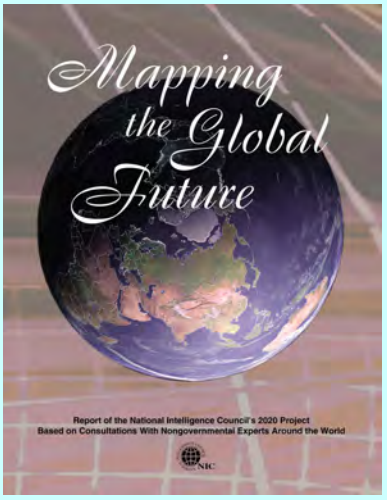
National Intelligence Council (NIC) as a US information agent center prepared a report called *Mapping the Global Future* containing a macroscopic analysis of the global situation in 2020 (hereafter referred to as the "2020 Project") in December 2004.

The 2020 Project provides policymakers from the US with world middle- and long-term trends and positive and negative impacts predicted from those trends. In the past, NIC publicized the Global Trends 2010 and Global Trends 2015.

How does the 2020 Project predict the world in 2020? Summary of relevant descriptions is as follows:

1. Emergence of new global players

Most forecasts indicate that by 2020 China's gross national product (GNP) could exceed that of individual Western economic powers except for the US. The likely emergence of China and India would transform the geopolitical landscape. In the same way that commentators refer to the 1900s as the "American Century," the 21st century might be seen as the time when Asia, led by China and India, comes into its own. A combination of sustained high economic growth, expanding military capabilities, and large populations could be at the root of the expected rapid rise in economic and political power for both countries, causing drastic changes in international relations by 2020.



2. Impact of globalization

- The world GNP in 2020 is projected to be about 80% larger than it was in 2000, and average per capita income would be roughly 50% higher. By having the fastest-growing consumer markets, more firms becoming world-class multinationals, and greater S&T stature, Asia could look set to displace Western countries as the focus for international economic dynamism.
- The benefits of globalization would not be global. Since the growing sectors of China and India in the world market would develop more remarkably, the gap between other developing countries would widen.
- The greatest benefits of globalization would accrue to countries that could access and adopt new technologies. Indeed, a nation's level of technological achievement generally would be defined in terms of its investment in *integrating and applying* the new, globally available technologies—whether the technologies are acquired through a country's own basic research or from technology leaders. But the gap between the "haves" and "have-nots" would widen unless the "have-not" countries pursue policies that support application of new technologies—such as good governance, universal education, and market reforms.
- China and India could be well positioned to become technology leaders. The expected next revolution in high technology involving the convergence of nano-, bio-, information and materials technology could further bolster China and India's prospects. Both countries are investing in basic research in these fields and would be well placed to be leaders in a number of key fields. Europe risks slipping behind Asia in some of these technologies. The US could be still in a position to retain its overall lead, although it should increasingly compete with Asia to retain its edge and might lose significant ground in some sectors.
- An expanding global economy would increase demand for many raw materials, such as crude oil. Total energy consumed probably could rise by about 50% in the next two decades. Russia, Venezuela, and Africa are being counted on to provide increased output involve 0political risk. Traditional suppliers in the Middle East would be also increasingly unstable. Thus sharper demand-driven competition for resources, perhaps accompanied by a major disruption of oil supplies, could be among the key uncertainties. China, India, and other developing countries' growing energy needs suggest a growing preoccupation with energy, shaping their foreign policies.

3. About Japan

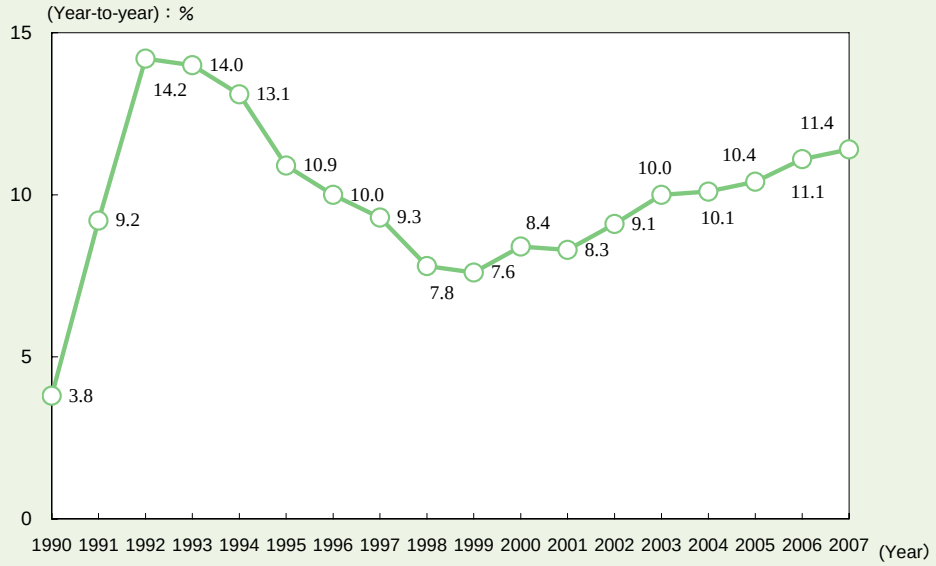
Japan faces an aging crisis that could crimp its longer run economic recovery. In international relations, Japan also could be challenged to evaluate its regional status and role.

(2) China's advances

Among the BRICs countries, China has been the focus of attention. China has made the most remarkable advances among the emerging BRICs economies. Driven by investment and exports, the Chinese economy has achieved a growth at more than 10% for five consecutive years up to 2007 (Figure 1-1-8). According to the World Bank, the nominal GDP of China accounted for approximately 5% of the world total GDP in 2005, placing China as the world's fourth largest economy. China's GDP in terms of purchasing power parity (PPP) has already surpassed that of Japan, pushing China up to the second largest in the world. In addition, China now accounts for 6.7% of the total world trade value. The fact that the both Chinese shares in GDP and trade value were in the level of 1% shows the drastic growth.

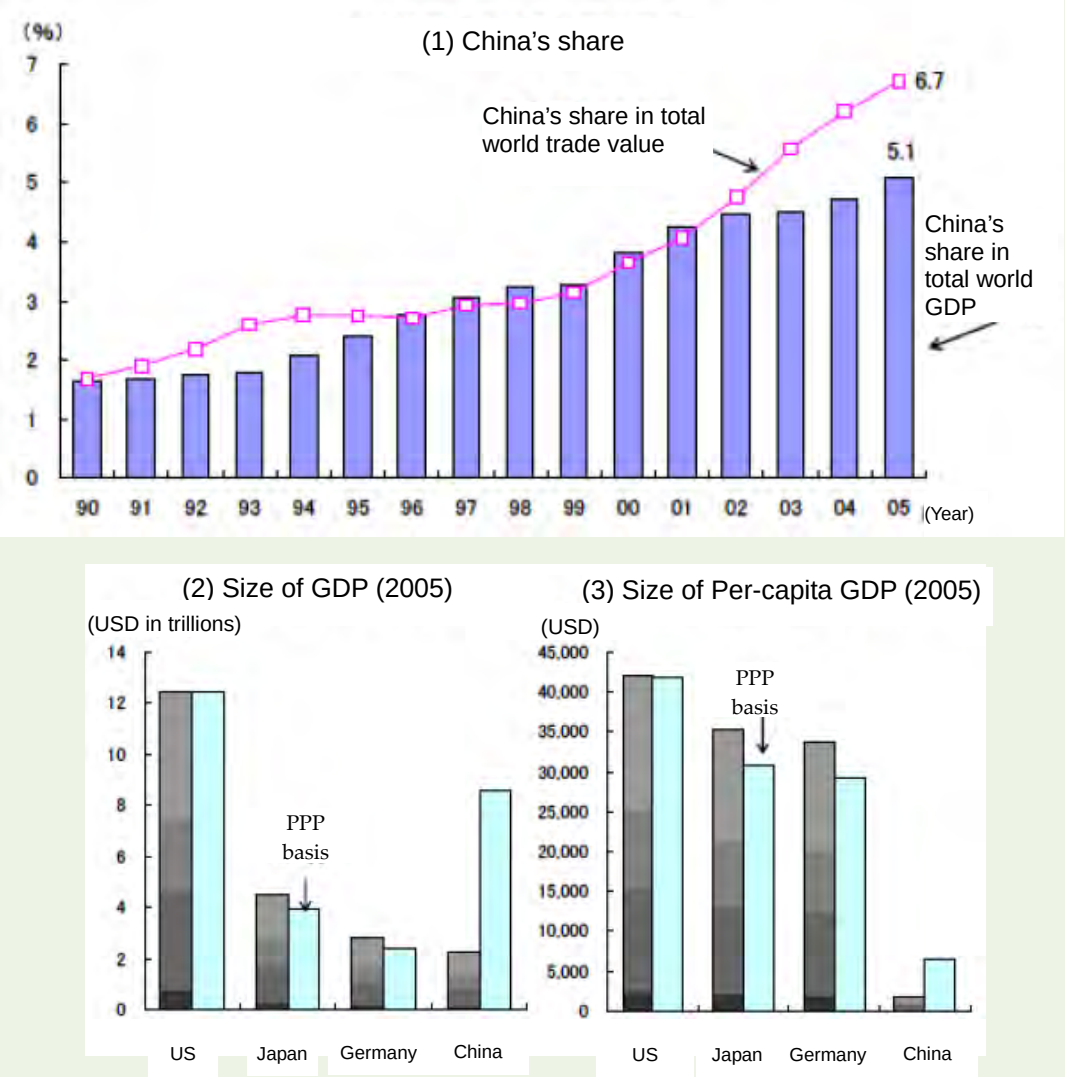
In China, the manufacturing industries, in particular, are developing abruptly thanks to the introduction of foreign investment and exports contributed by excellent human resources. China is now in the situation of acquiring a large share in home electric appliances, of which Japan boasted in the past, especially final products for consumers in the world markets (Figures 1-1-9 and 1-1-10).

Figure 1-1-8 Trends in Growth Rate of Real GDP in China



Source: National Bureau Statistics of China

Figure 1-1-9 China's Share in Total World GDP and Total World Trade Value

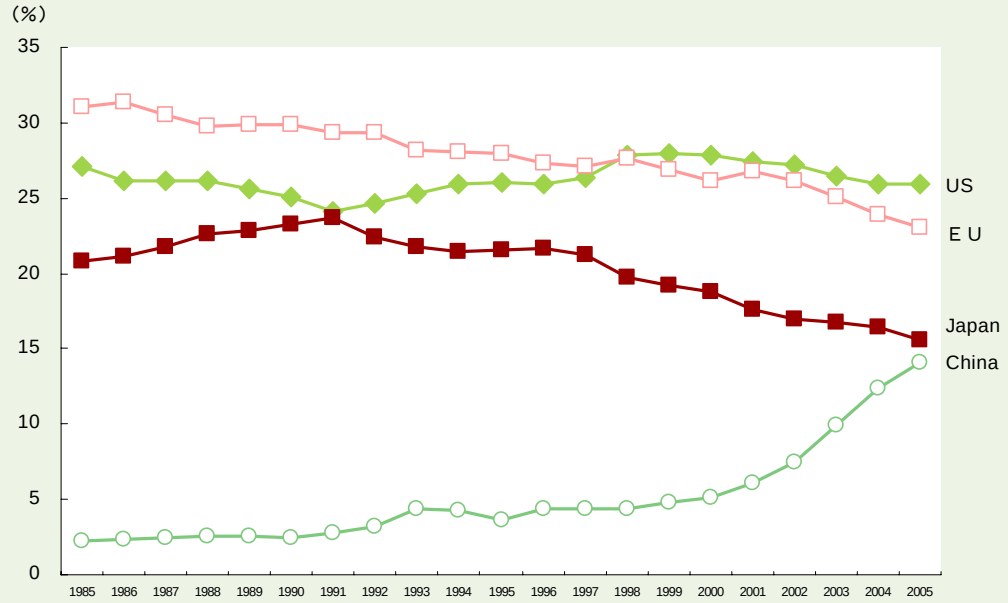


■: Foreign exchange rate basis

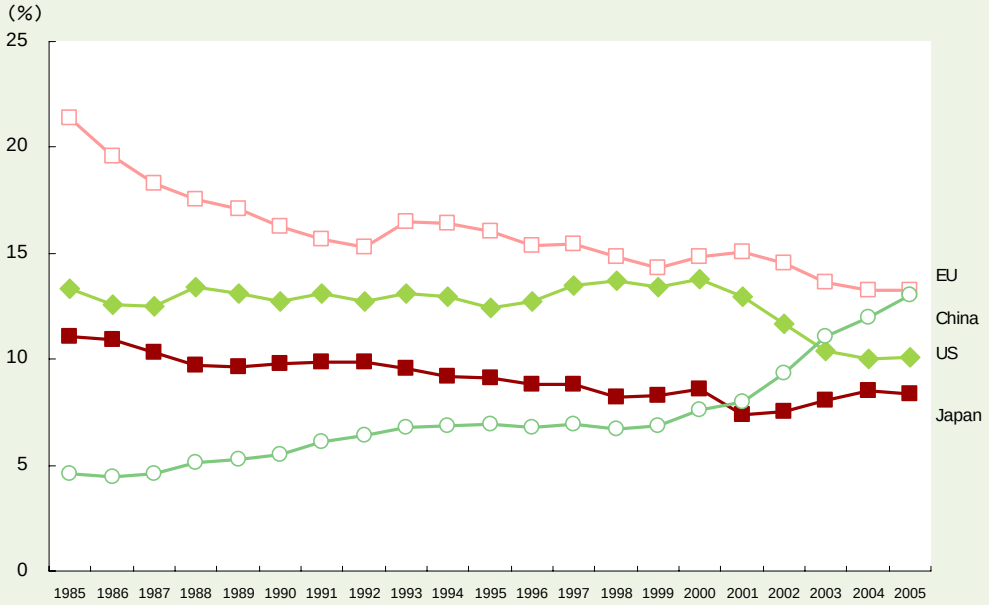
Source: Cabinet Office *World Economic Trend, Autumn 2006, No. 10*

Figure 1-1-10 Progress of Manufacturing Industry in China

(1) World share of sales in manufacturing industry



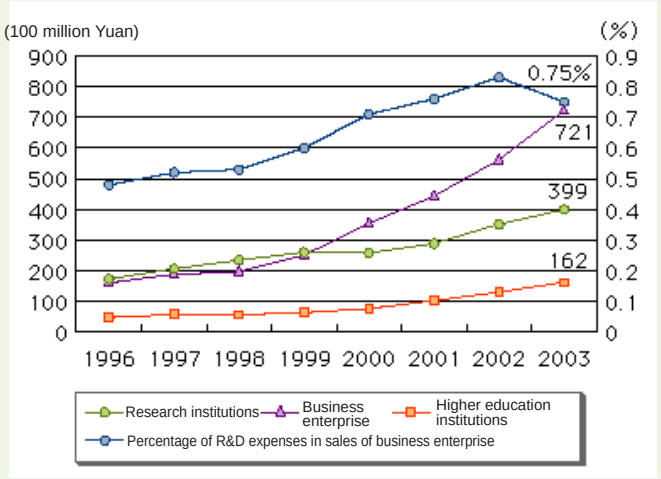
(2) World share of revenue and exports in manufacturing industry



Source: National Science Foundation *Science and Engineering Indicators 2008*

As described in Part 1, Chapter 2, China now increases its R&D investment rapidly, and private enterprises are also recognized to increase R&D expenditures (Figure 1-1-11). Furthermore, Chinese enterprises are recognized to buy foreign enterprises etc. having technological capability to enhance their own brand and technological powers in addition to enhancing R&D within the country, thus approaching to economic growth focusing on innovation based on S&T (Table 1-1-12).

Figure 1-1-11 Trends in R&D Investments by Sector in China



Source: Ministry of Economy, Trade and Industry *White Paper on International Economy and Trade* (2005)

Table 1-1-12 China's Foreign Direct Investments

Industry type	Investor	Investment destination	Invested company	Summary
Electrical and Electronics	Haier	Thailand	Distar Electric Corporation Public Co., Ltd.	Acquires home appliance joint venture plant of Distar and Daewoo Electronics Co., Ltd. and begins consignment production of refrigerators at aforementioned plant; sells refrigerators in Thailand using Distar's sales channel and begins exporting them after 2003
		Japan	Sanyo Electric Co., Ltd.	Begins joint product development with Sanyo; establishes joint venture Sanyo Haier with Sanyo through which it begins selling refrigerators and washing machines from May 2002
	TCL International Holdings Ltd.	Germany	Schneider Electronics GmbH	Acquires production facilities, inventory goods, brand, etc. of bankrupt German TV maker Schneider in September 2002 for approximately 8.2 million euros
		France	Thomson SA	Establishes new joint venture with Thomson, TCL-Thomson Electronics Corporation (TTE), in July 2004; both companies consolidate their TV and DVD manufacturing divisions
	Boe Technology Group Co., Ltd.	Korea	Hydis	Acquires the TFT-LCD business of Hydis, which is affiliated with Korea's major semiconductor maker Hynix Semiconductor Inc., for US$380 million in January 2003
	Lenovo Group Ltd.	US	IBM	Acquires IBM's personal computer business for US$1.75 billion in November 2004
Automotive	Chery Automobile Co., Ltd.	Iran	SKT	Signs contract to jointly produce passenger vehicles in Iran; production begins in the end of 2003
	Shanghai Automotive Co. Ltd.	Korea	Daewoo Motor Sales Corp.	Acquires 10% of Daewoo's shares, a carmaker affiliated with GM, in October 2002
		Korea	SsangYong Motor Company	Acquires SsangYong, the fourth largest carmaker in Korea, for 590 billion won in October 2004
	Wanxiang Group Corporation	US	Rockford Powertrain Inc.	Acquires 33.5% of Rockford Powertrain's shares, a well-established US automobile parts maker, in September 2003 and becomes its largest shareholder

Source: Ministry of Economy, Trade and Industry *White Paper on International Economy and Trade* (2005)

COLUMN 4

Historical View of Sizes of BRICs Economy

This is not the first time for BRICs countries to play important roles in the world economy. It is pointed out that China and India acquired a 20 to 30% share in the world economy from the 16th century to the early 19th century, and the total of both countries occupied nearly a half of the world economy. Russia once occupied around 10% of the world GDP share in the 20th century, and Brazil also had 7.5% of world GDP share for a period of time after the second World War.

When opening history books, it is rather natural that countries with large populations and abundant resources rise even in the world today where globalization is rapidly progressing.

Share of major countries in world GDP (1500 – 2005)

(%)

		1500	1600	1700	1820	1870	1913	1950	1973	1998	2005
BRICs	Brazil	–	–	0.8	1.0	1.7	3.3	7.5	4.6	2.8	2.6
	China	25	29.2	22.3	32.9	17.2	8.9	4.5	4.6	11.3	15.4
	India	24.5	22.6	24.4	16.0	12.2	7.6	4.2	3.1	5.1	5.9
	Russia*	3.4	3.5	4.4	5.4	7.6	8.6	9.6	9.4	2.2	2.6
G6	France	4.4	4.7	5.7	5.5	6.5	5.3	4.1	4.3	3.3	3.0
	Germany	3.3	3.8	3.6	3.8	6.5	8.8	5.0	5.9	4.9	4.1
	Italy	4.7	4.4	3.9	3.2	3.8	3.5	3.1	3.6	3.3	2.7
	Japan	3.1	2.9	4.1	3.0	2.3	2.6	3.0	7.7	7.7	6.4
	England	1.1	1.8	2.9	5.2	9.1	8.3	6.5	4.2	3.2	3.0
	US	0.3	0.2	0.1	1.8	8.9	19.1	27.3	22.0	21.5	20.1

Note) 1. GDP based on purchasing power parity 2. Russian before 1991 means old USSR
Source: Marubeni Research Institute

3 Soaring Raw Material Prices and Commoditization[fn.5] of Technology

Economy of our country has been greatly dependent on processing trade; importing raw materials and exporting manufactured products after processing with the imported materials, and further importing raw materials with the foreign currency acquired from the previous trade. Therefore, there is a possibility that soaring prices of raw materials, especially crude oil, and the so-called commoditization phenomena in recent years may destabilize preconditions of international competitiveness that our country has conventionally maintained.

(1) Rising raw material prices

Crude oil prices have continuously renewed the past highest level in 2007 and have been rising even since the beginning of 2008 (Figures 1-1-13 and 1-1-14). Moreover, the soaring Chicago grain futures prices, which serves as an international index, has led to global grain price hikes and begun to be reflected in products (Figure 1-1-14). Sustainable growth in the world economy in countries, including BRICs, is as a great factor in the background of the appreciation of raw materials, and these

fn. 5 Commoditization: Refers to the process of technology-based products becoming readily available and accessible to anyone through generalization and price reduction.

trends may have a significant impact on the Japanese economy, which is heavily reliant on imported raw materials.

Figure 1-1-13 Trends in Crude Oil Prices in Recent Years

The diagram shows US produced West Texas Intermediate (WTI) prices traded in NYMEX (New York Mercantile Exchange)
Source: Japan Oil, Gas and Metals National Corporation

Figure 1-1-14 Trends in Soybean Prices at the Chicago Board of Trade

Source: The Food and Agriculture Organization of the United Nations *Food Outlook*

(2) Commoditization of technology

In recent years, many technology-based products have undergone commoditization, or rapid generalization of technologies. This phenomenon clearly indicates the fact that information equipment and home electrical appliances, which have been the traditional forte of Japanese manufacturers, are priced down and made obsolete rapidly due to the entry of Asian manufacturers into the market (Figure 1-1-15).

In the LCD TV market, once dominated by Japanese manufacturers, for example, VIZIO, Inc., a US-based venture firm that joined the market following South Korea-based Samsung C&T Corporation, has rapidly increased its market share and grown into a world-class company in a matter of several years from 2002. It is estimated that these phenomena will give a significant impact on profits on enterprises in our country.

COLUMN 5

VIZIO—Rapidly Growing LCD Television Manufacturer in the US

VIZIO acquired a 12% share of liquid crystal display (LCD) and plasma televisions in the US in 2007 and achieved the top share, moving ahead of Samsung Electronics despite being an emerging company with about 100 employees established by William Wang (current Chairman of VISIO) in 2002.

The reason the company dominates the market with not only cheap prices but high quality and satisfactory after-sale services is considered based on the following business strategy:

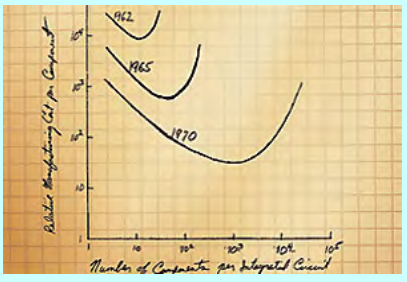
VIZIO only plans and designs LCD TVs; they do not own any plants themselves. They procure LCDs from South Korea and Taiwan and outsource the assembly to Chinese manufacturers. VISIO is so-called a "fabless" company and adopts the drastic horizontal specialization system. The policy where most of the 100 employees are in charge of customer service enables the company to quickly respond to problems.

COLUMN 6

Moore's Law

Typical example of the situation that technological progress is accelerated in recent years can be seen in semiconductor industry. The prediction that transistor count for semiconductor doubles roughly every two years (Moore's Law) coined by Gordon E. Moore (current honorary chairman) of Intel Corporation in 1965 accurately stated the aspect of further technological progress in the industry.

Moreover, memory density doubles every year (Hwang's Law) was coined by Hwang Chang-gyu, CEO of Samsung Electronics' semiconductor business, and represents the situation where technological progress is further accelerated.



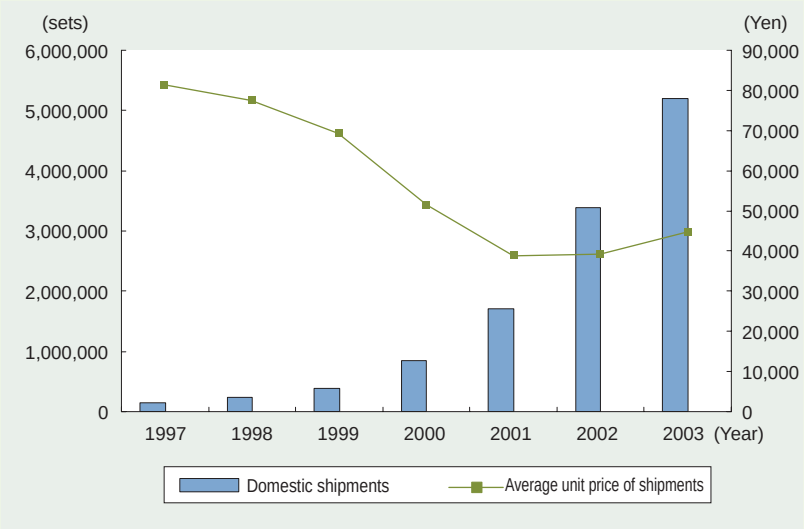
Moore's Law (Graph drawn by Moore)
Source: Intel Corporation

The technological progress represented by Moore's Law or Hwang's Law are realized by microfabrication in nanoscale, thus requiring the industry to make more highly sophisticated and larger size semiconductor manufacturing equipment available. It is essential to continue investment in the development of semiconductor manufacturing equipment capable of dealing with trends in the semiconductor markets where the supply and demand

tendency is unpredictable and fluctuating and where the investment in the renewal of facilities makes the amount of spending on equipment huge.

On the other hand, fast-evolving microfabrication technology in nanoscale is approaching its physical limitation. R&D attempts to break through this limitation are called "More than Moore" and aim for the diversification of functions by integrating semiconductor digital circuits and sensors as a device. Discontinuous and epoch-making innovations that cannot be positioned on the extended line from the conventional semiconductor manufacturing technology is challenged right now.

Figure 1-1-15 Trends in Domestic Shipments and Average Unit Price of Shipments of DVD Players



Note) The reason why a certain rise is seen in 2003 is that statistics of DVD-HD recorders is included.
Source: Ministry of Economy, Trade and Industry *Road Map for Increasing Profitability inInformation Appliances Industry* (October 2004)

(3) Increasing importance of intellectual property rights

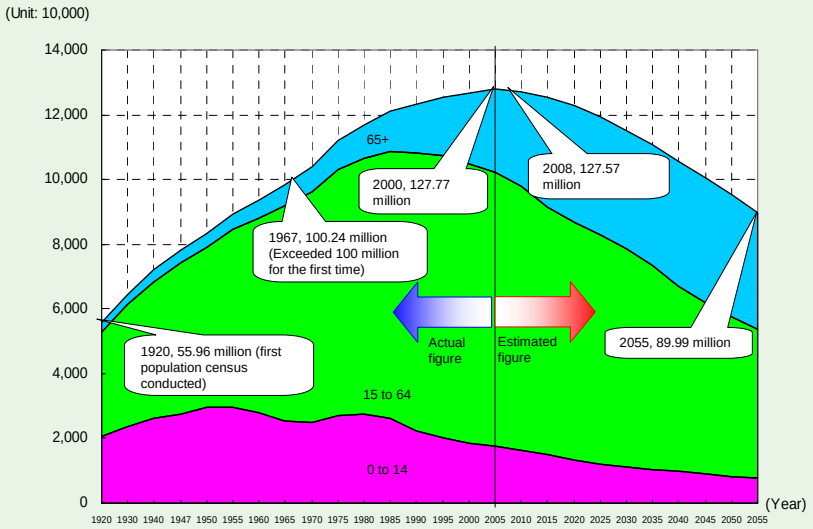
Currently, there are relatively fewer patents constituting products in the IT and biotechnology industries, and hence their productization is relatively easier, than in conventional manufacturing industries such as the automotive industry. Therefore, the success of a business in such new industries depends heavily on intellectual property rights protection. The advent of such new businesses has resulted in new classes of patents, for example, on genetically modified organisms in the biotechnology field or computer software. Furthermore, medical treatment methods and business models can be protected with patents in the US.

Moreover, along with aforementioned globalization of economical activities and intellectual labor, globalization of the protection of intellectual property rights by the application of patents not only by the patent-devised country but also by the other multiple countries is progressing, and system amendments are internationally progressing toward international consistency of patent system. Thus, considering the viewpoint of how to deal with the rise of emerging countries, it has never been more important than now not only to produce new technologies but to take appropriate measures for protecting new technologies.

4 Shifts toward Aging Society with Declining Birthrate

Population is one of the factors on which the international competitiveness of a county depends. It is no exaggeration that Japan is at a critical juncture, facing the coming of an era of an aging and shrinking population, which is exceptional and unprecedented even in developed countries. The Japanese population took a downturn for the first time in 2006. The so-called productive-age population in the 15-to-64 year old age brackets had already started to shrink in the 1980s. Such a shift in the national demographic composition poses a serious threat for the maintenance of international competitiveness (Figure 1-1-16). However, as shown in the after-mentioned Figure 1-1-19, it is considered that innovation based on S&T rather than rise of labor stock plays an important role in the trend of economic growth rate also in foreign countries.

Figure 1-1-16 Year-to-Year Change in Japan Population



Note:
The estimates for the years up to 2006 are as of Oct. 1, calculated based on *Population Census*, *Historical Statistics of Japan*, and *Annual Report on Current Population Estimates* published by the Statistics Bureau of the Ministry of Internal Affairs and Communications (MIC). Okinawa Prefecture is excluded from the statistics above for the years from 1947 to 1970.

Source: Cited by MEXT from *Population Projections for Japan (Estimates as of Dec. 2006)* compiled by the National Institute of Population and Social Security Research.

5 Need for Science and Technology-based Innovation

(1) Sluggish economic growth

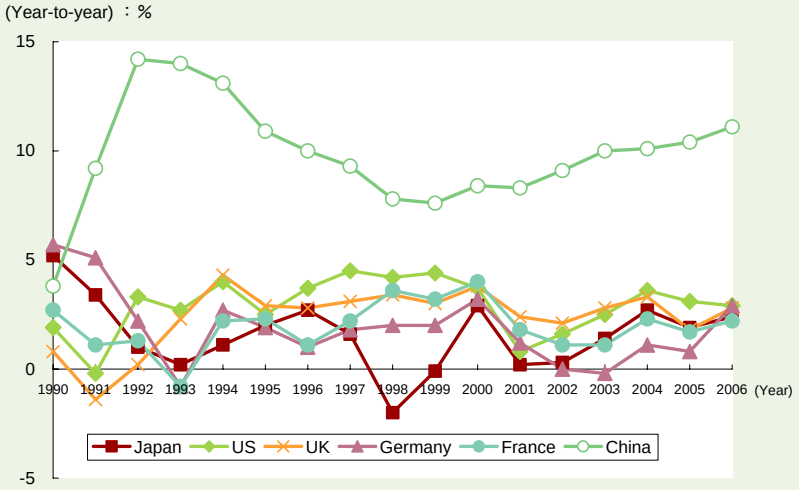
The Japanese economy grew at an annual rate exceeding 10% from the 1960s to the 1970s. Technological capability in the economic system and manufacturing industries enabled Japan to become the second ranked economic power in the world following the US. Japan's position was based on high economic growth in an extremely short period of time and became the object of global admiration, as evidenced by the publication of a book titled *Japan as No.1* written by an overseas researcher on Japanese business system (Ezra F. Vogel, 1979) where the international competitiveness of our country was highly evaluated in 1980s.

Entering the 1990s, however, Japanese economic growth became stagnant, and Japan was stuck in a long recession. As shown by the fact that negative growth was recorded in 1998 when major banking facilities went bankrupt, the average economic growth rate for the ten years since 1990 remained at the lowest level among OECD member countries, resulting in our country remaining in a business

depression for a long period of time (Figure 1-1-17). The low economic growth rate due to this recession pushed down the per-capita GDP of Japan for six consecutive years from the world's third in 2000 to eighteenth in 2006. Thus, Japan now belongs in the lower half group of the 30 OECD member countries in terms of per-capita GDP. Although relative ranks of major countries show no significant change, only the rank of our country continues to drop rapidly (Figure 1-1-18).

In addition, the proportion of Japanese economy in the world economy has gradually been decreasing. Back in 1994, Japan accounted for 17.9% of the world total GDP. Then, Japan went down to 9.1% in 2006[fn.6], hitting a sub-10% level for the first time in the past 24 years, that is to say the proportion of Japan has dropped into a half level in comparison with 10 years ago.

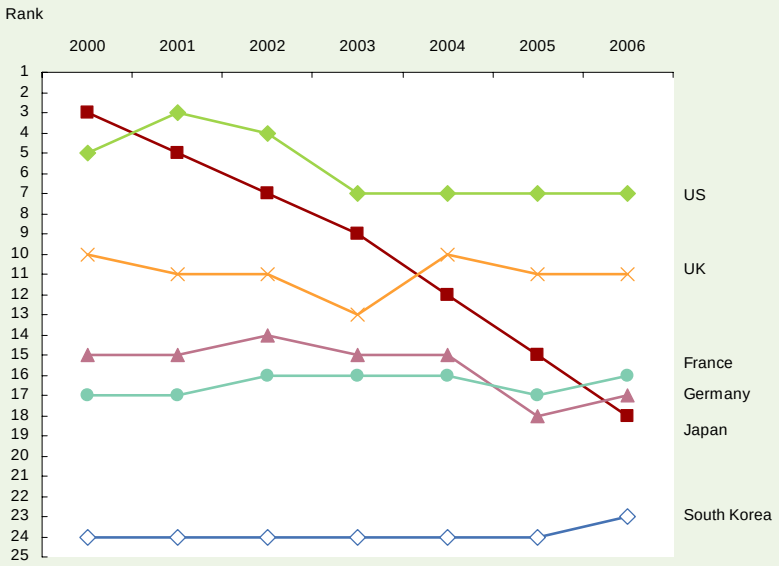
Figure 1-1-17 Trends in Growth Rate of Real GDP in Major Countries in the 1990s and 2000s



Source: Cabinet Office *World Economy Outlook, Fall 2007*.

fn. 6 US: 27.2%, EU: 28.3%, China: 5.5%

Figure 1-1-18 Rank of Nominal GDP per Capita in OECD Countries

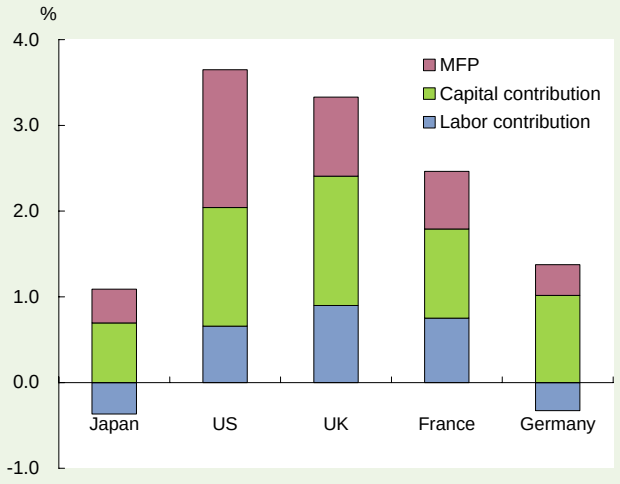


Source: Economic and Social Research Institute Cabinet Office *Annual Report on National Accounts in FY 2006*

Among the indicators for evaluating the contribution of S&T-driven innovation to economic growth is a concept called multi-factor productivity (MFP)[fn.7] contribution to GDP growth. MFP is defined as productivity that takes into account all productive factors other than labor input and capital stock. MFP can improve because of economic cycles or improved labor quality, but it is often used as the indicator of progress in S&T innovation.

As shown in Figure 1-1-19, a look at the trends in the economic growth rate of Japan for the years 1995 to 2004 reveals that MFP made a relatively smaller contribution to economic growth in Japan than in other countries. In contrast, MFP made the largest contribution to economic growth in the US, enabling the estimate that innovation contributed significantly to economic growth.

Figure 1-1-19 Economic Growth Rates of Major Countries (1995-2004)



Source: EU KLEMS[fn.8]

fn. 7 Multi-factor productivity (MFP) or total factor productivity (TFP)

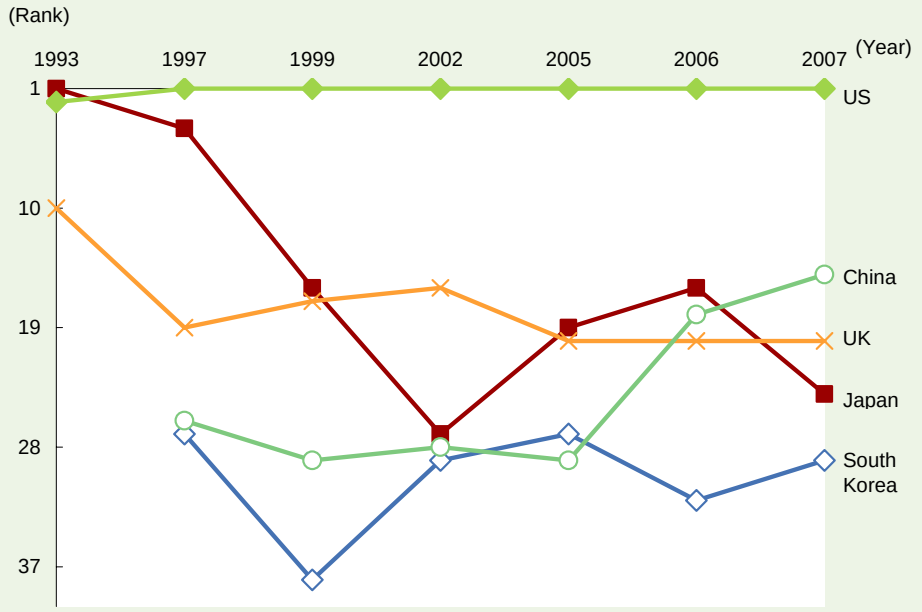
fn. 8 KLEMS: EU-funded program for database construction and statistical analysis research. The acronym KLEMS stands for K(C)apital, Labour, Energy, Material, and Service input.

(2) Japan losing international competitiveness

Being the world's second largest economy on the foreign exchange rate basis, Japan still remains among the world's top economic players. On the other hand, Japan is losing its international competitiveness. Since the concept of international competitiveness has no fixed definition, and the rank is determined by combining various kinds of indicators, it is not appropriate to discuss only rise and fall of the rank. Overseas investigation institutions are attempting to rank international competitiveness by country, and their ranking triggers much attention in the world.

The Swiss-based International Institute for Management Development (IMD), one of the research institutes, investigates and publishes the international competitiveness of countries around the world. According to the IMD ranking, the international competitiveness of Japan was the world's highest in 1993. According to the IMD ranking in 2007, however, Japan slipped to 24th place[fn.9]. On the other hand, the US competed for the top position with our country in 1993 and still maintains its position even today. Further, China, where the rise in the ranking is significant, finally moved ahead of our country and is the third country in Asia following Singapore and Hong Kong in 2007 (Figure 1-1-20).

Figure 1-1-20 Change in IMD International Competitiveness Ranking



Source: Cited by MEXT from the International Institute for Management Development *World Competitiveness Yearbook 2008*
[The rank order places for 2007 are as announced by IMD (May 2007).]

(3) Necessity of innovation by science and technology

The aforementioned *Rising Above the Gathering Storm* report published by the National Academies introduces various situations regarding international competitiveness of the US as competitiveness indicators. Typical ones extracted from the report are shown as below:

(US Economy)

"US scheduled airlines currently outsource portions of their aircraft maintenance to China and El

fn. 9 It should be noted that a straightforward year-on-year comparison of IMD ranking is impossible because IMD often changes from one statistical method to another.

Salvador."
"IBM[fn.10] recently sold its personal computer business to an entity in China."

(Comparative Economics)
"A company can hire nine factory workers in Mexico for the cost of one in America. A company can hire eight young professional engineers in India for the cost of one in America."

(K-12 Education)
"According to a recent survey, 86% of US voters believe that the United States must increase the number of workers with a background in science and mathematics or America's ability to compete in the global economy will be diminished."

(Higher Education)
"In the US science and technology workforce in 2000, 38% of PhDs were foreign-born."

(Perspectives)
"We go where the smart people are. Now our business operations are two-thirds in the U.S. and one-third overseas. But that ratio will flip over the next ten years." —Intel Corporation spokesman Howard High
"If I take the revenue in January and look again in December of that year 90% of my December revenue comes from products which were not there in January." —Craig Barrett, Chairman of Intel Corporation
"When I compare our high schools to what I see when I'm traveling abroad, I am terrified for our workforce of tomorrow." —Bill Gates, Chairman and Chief Software Architect of Microsoft Corporation
"Science and technology have never been more essential to the defense of the nation and the health of our economy." —President George W. Bush

These comments not only draw situations accurately and express the progress of globalization but emphasize the need for fostering scientifically and technologically educated human resources and innovation through S&T, thus providing valuable suggestions for the course we should take while exceeding the difference between Japan and the US.

In our country, innovation is essential to maintain and improve economic growth while solving the problem of an aging society with a declining birthrate and to recognize the difficulty in the significant increase of capital in the fierce competition.

Therefore, powerful and effective promotion of S&T as a strong means for creating innovation is the key to our country in order to maintain economic growth, survive as a major player in the world economy, and realize a plentiful lifestyle of the Japanese people.

fn. 10 International Business Machines Corporation