Part I

Developments in Land, Infrastructure, Transport and Tourism Administration that Underpin Japan's Economic Growth

~ Strategic infrastructure management that brings about productivity revolution ~

Chapter 1 Relationships between Japanese Economy and Land, Infrastructure, Transport and Tourism Administration

Chapter 1, Relationships between Japanese Economy and Land, Infrastructure, Transport and Tourism Administration, on the assumption of discussions described in chapter 2 and following sections, looks at the significance of the effects infrastructure development has on economic growth with awareness of severe circumstances surrounding the Japanese economy from the perspective of history and statistical data.

Section 1, Japanese Economy and Its Surrounding Conditions, provides an overview of an increasingly declining population, especially that of a productive-age population, to become a super aging society with an estimated aging rate of close to 40% in 2050, and a severe fiscal position due to rapidly growing, long-term outstanding debts and other circumstances.

Section 2, Economic Trends and Infrastructure Development, looks at how infrastructure has supported peoples' lives and the economy of the time by exploring economic growth and the history of infrastructure development (Edo period and post-war economic growth period). In international comparisons of the level of public investment, we describe the need to consider Japan's poor land and severe natural environment, provide an overview of the stock effect of the infrastructure, and examine its impact on the infrastructure, productivity, and economic growth.

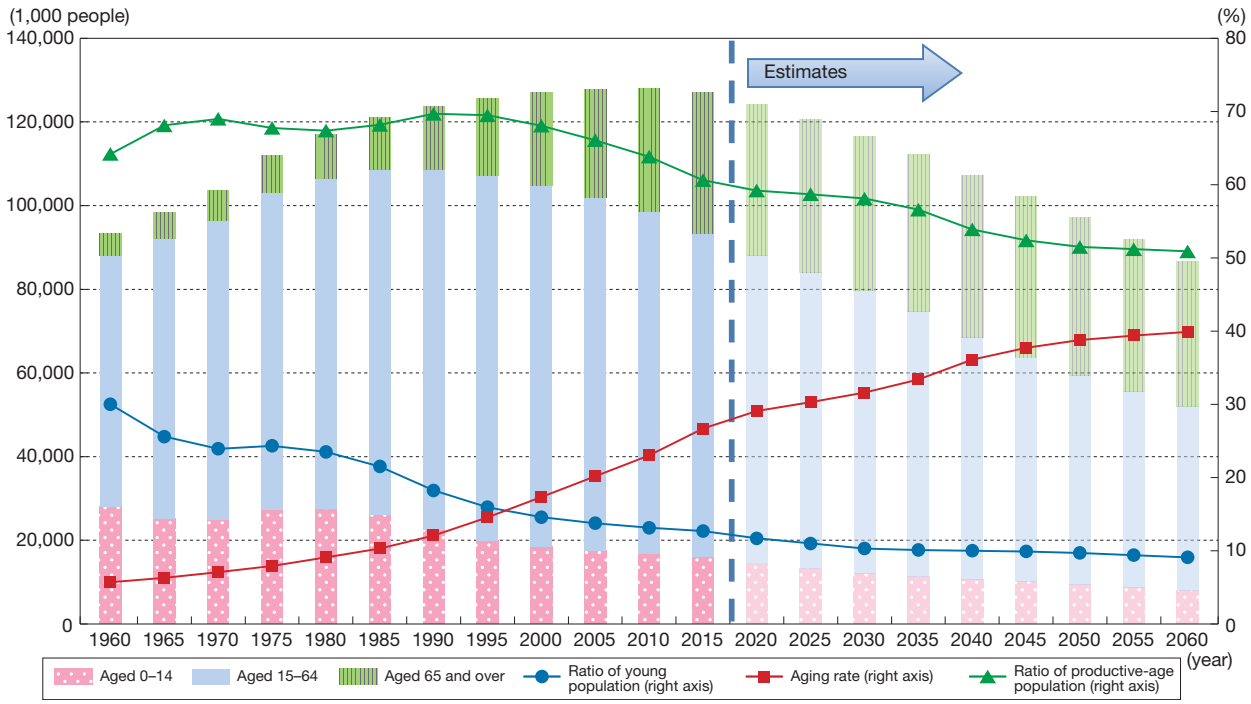
Section 1 Japanese Economy and Its Surrounding Conditions

1 Japan's Population Conditions and Future Estimates

(1) Changes in population and productive-age population

Because of the progression of declining birthrate and aging population, the total population of Japan is falling after peaking in 2008, with the productive-age population also decreasing after the peak in 1995. The preliminary figure from the National Census in 2015 showed that the total population of Japan declined for the first time since the quinquennial Census, falling to 127,110,000. According to the projection of the National Institute of Population and Social Security Research (median projection for birth/death), the total population is projected to decline to 116,620,000 in 2030 and 86,740,000 in 2060 (down 32.3% when compared to 2010), with the productive-age population projected to decline to 67,730,000 in 2030 and 44,180,000 in 2060 (down 45.9% when compared to 2010) (Figure 1-1-1).

Figure 1-1-1 Changes in Population Structure in Japan

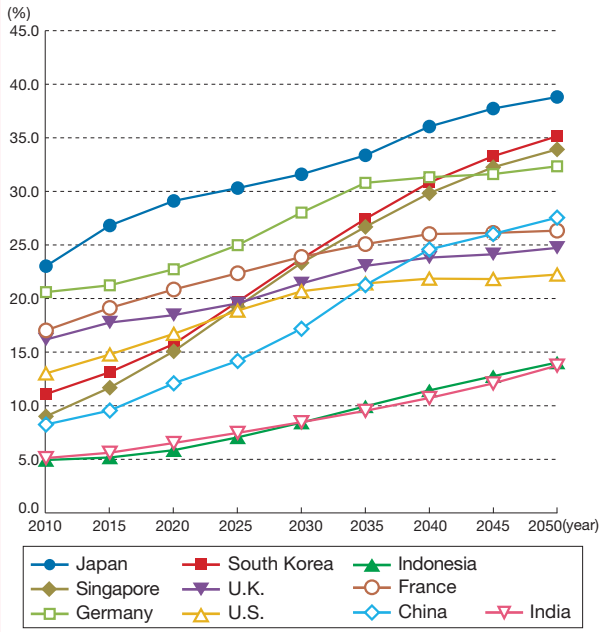


Source) "National Census" and "Population Estimates" by the Ministry of Internal Affairs and Communications for dates up to 2010, "Population Estimates" by the MIC for 2015 data (as of October 1, 2015); estimates are calculated by the MLIT from the median estimates of "Japan's future population estimates" (estimates from January 2012) by IPSS.

(2) Severely aging population

In addition, Japan's aging rate [Note 1], which reached the record high of 26.7% in 2015 [Note 2], is not only at the highest level but also exceptionally high when compared to that of other nations (Figure 1-1-2). Furthermore, Japan is projected to become a super aging society, with its aging rate topping 30% in 2025 and reaching close to 40% in 2050.

Figure 1-1-2 Changes in Population Aging Rate of Japan and Other Countries



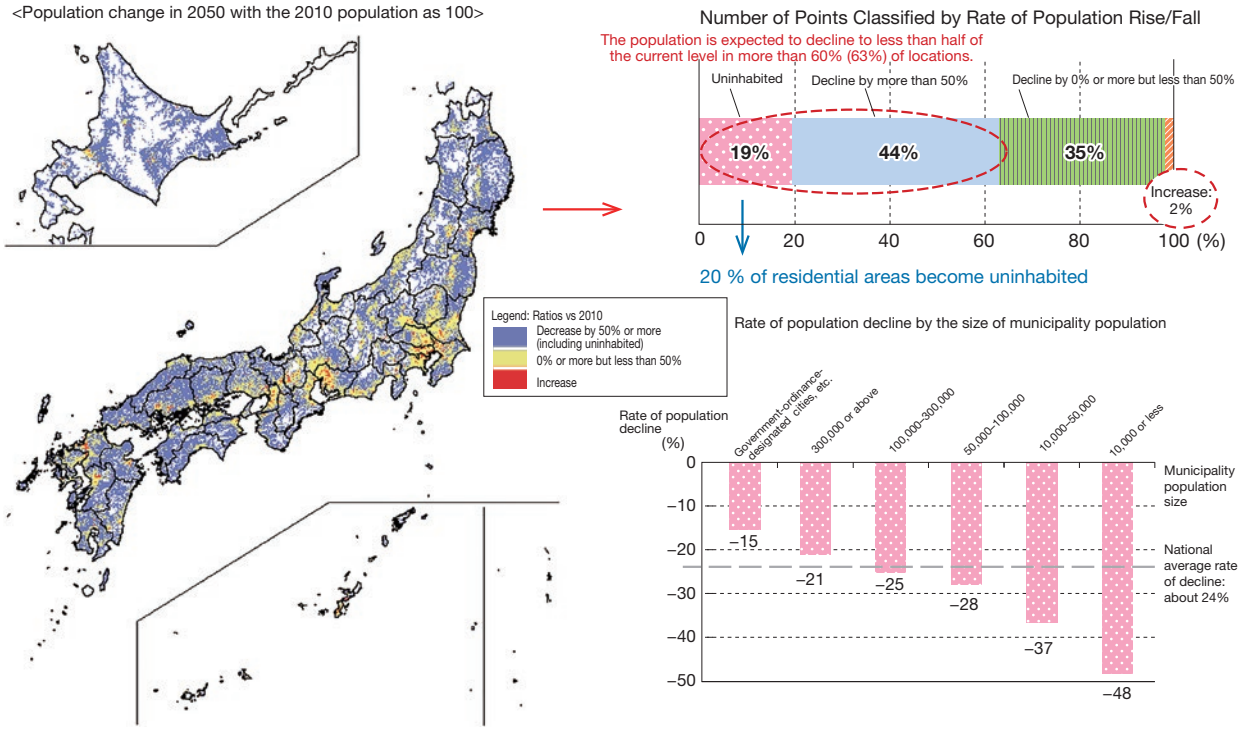
(Note) The populations of Japan and countries other than Japan in 2010 are actual figures and after 2010 figures are median estimates.
Source) For Japan: "Population Projections for Japan" (Estimated in January 2012) by IPSS. For countries other than Japan: Developed by MLIT from United Nations" World Population Prospects: The 2015 Revision"

Note 1 The ratio of elderly (65 years old and over) population to total population.
Note 2 "Population Estimates" (as of October 1, 2015) by the MIC

(3) Difference in demographic shift by region

According to projections of population distribution by region, over 60% of residential areas are projected to see their population decline by half and about 20% will become nonresidential areas during the period from 2010 to 2050 (Figure 1-1-3). Also, projected changes in population by smaller municipality units show that the smaller the size of municipality is, the higher the rate of population decline will be; municipalities with populations less than 10,000 are projected to see their population decrease by about half during the period from 2010 to 2050. Population increases are projected only in limited regions including the Tokyo and Nagoya areas, and depopulation is expected to become more severe across Japan. In depopulated areas, not only the younger population but also the elderly population is about to start declining.

Figure 1-1-3 Population Distribution Forecasts



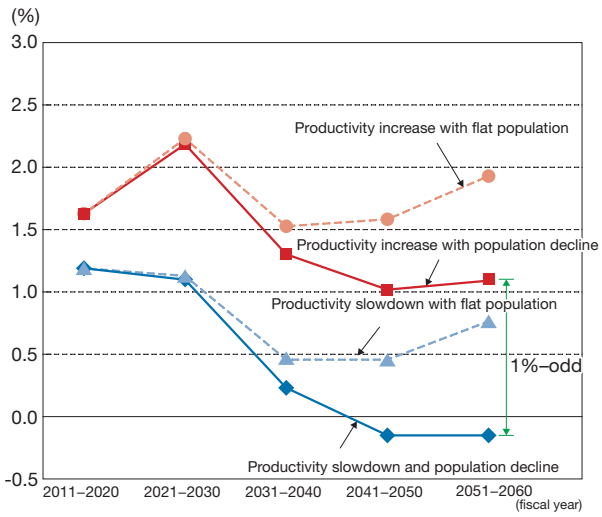
Source) Developed from "National Census Report" by the MIC and estimates of the MLIT

(4) Depopulating society and Japan's economic growth with higher productivity

While it was pointed out that population declines will lead to a smaller size in the overall economy of Japan, the report by the Council on Economic and Fiscal Policy, Expert Panel, Committee for Japan's Future expects that downward pressure is expected to be put on economy in the 2030s and 2040s, as population of working generations will start declining at a faster pace. A decreasing population, and consequent stagnation of the economy, would send it into negative growth in the 2040s, a situation we might find difficult to get out of once falling into it [Note 3].

On the other hand, even with population declines, there will be a 1%-odd difference in real GDP growth rates between the production increase scenario and the flat productivity scenario (Figure 1-1-4). If increased productivity can compensate for the negative factor of a declining workforce, economic growth is considered achievable even with a declining population going forward.

Figure 1-1-4 Estimates of Future Population and real GDP growth rate



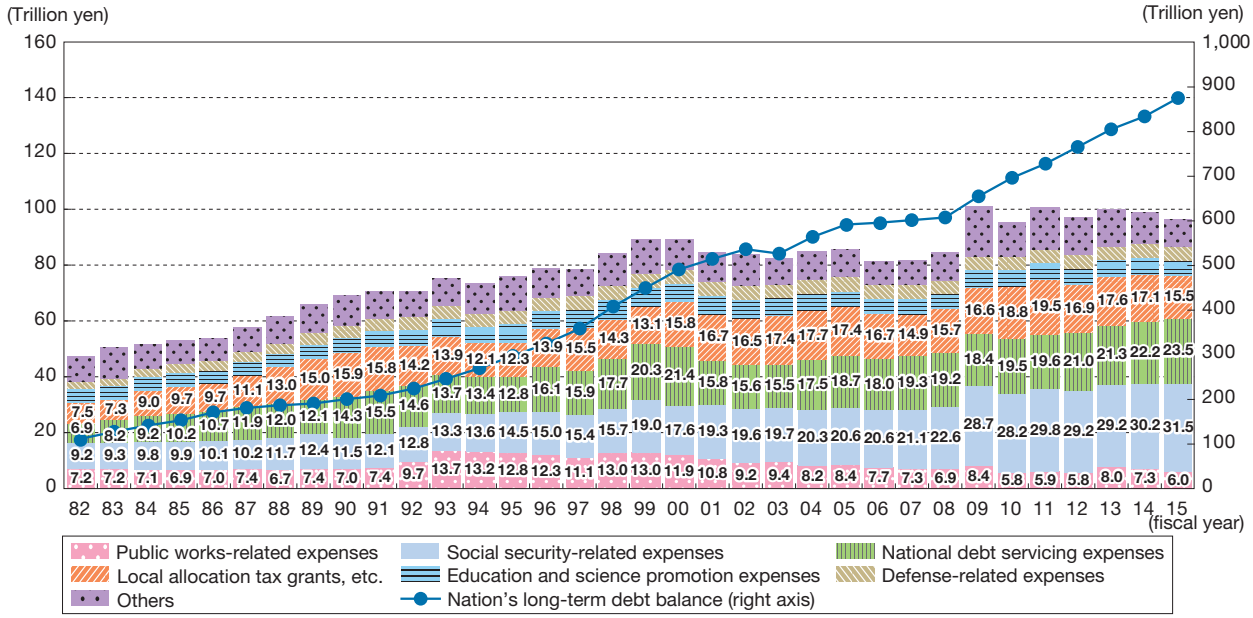
(Note) Scenario assumptions
Flat population: (i) Total Fertility Rate increases to 2.07; (ii) population in 50 years' time is maintained at 100 million
Population decline: (i) Total Fertility Rate declines to 1.33; (ii) population in 50 years' time decreases to 85 million
Productivity increase: TFP increases to around 1.8% by the beginning of the 2020s
Productivity slowdown: TFP increases only around 1.0% at the beginning of the 2020s (the average level of 2000–2005)
Source) Developed by the MLIT from the report by the Council on Economic and Fiscal Policy, Expert Panel, Committee for Japan's Future <reference materials>

Note 3 According to the report by the Committee for Japan's Future, it supposed two population scenarios, the case of population becoming flat at around 100 million and the case of population continuing to decrease, as well as two scenarios for productivity, on in the case of increased productivity through improvements and one in the case of a slowdown in productivity.

2 Japan's Fiscal Situation

In terms of outstanding debt, Japan's fiscal position is deteriorating further due to increases in social security-related expenses, national debt servicing expenses, and local allocation tax grants. At of the end of FY 2015, the nation's long-term debt balance reached 874 trillion yen (Figure 1-1-5).

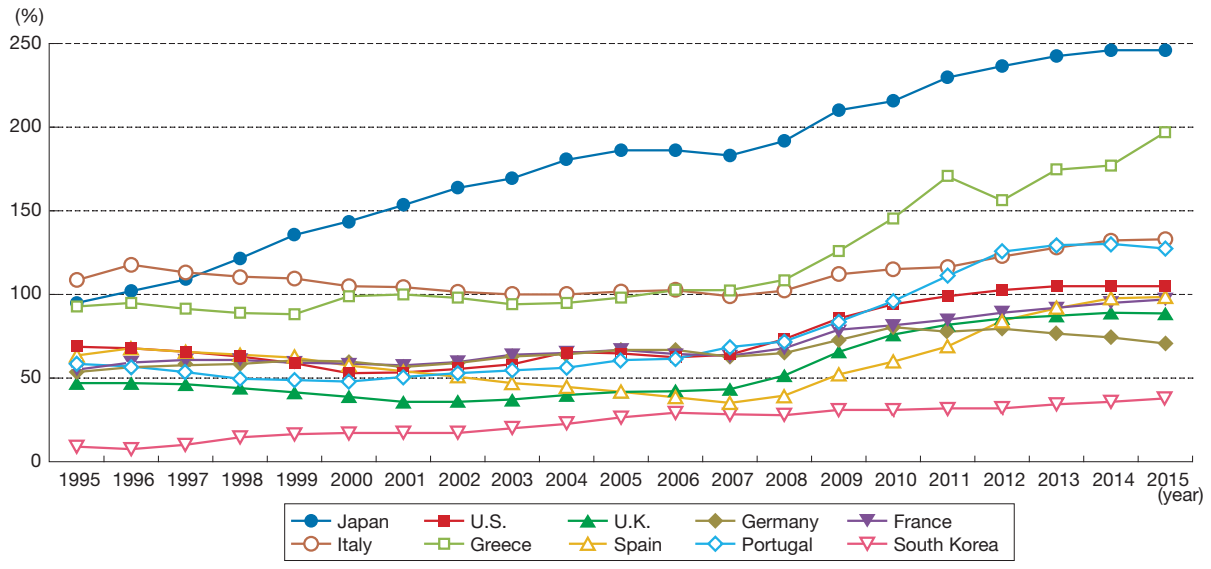
Figure 1-1-5 Changes in Nation's Expenditures and Long-Term Debt Balance



(Note) Expenditures for years up to 2014 are settled amounts and are initial budgets for 2015.
Source) Developed by the MLIT from "Basic Fiscal Data" (April 2016), "Fiscal Statistics" of the Ministry of Finance (MOF)

The debt to GDP ratio provides a measure of debt against economic size, which is a key indicator of fiscal soundness. Japan faces the most severe situation in comparison with other nations (Figure 1-1-6).

Figure 1-1-6 International Comparisons of Outstanding Debt Balances (debt–to-GDP ratio)



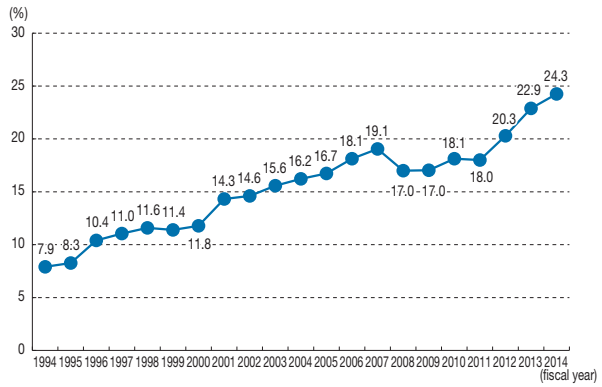
Source) Developed by the MLIT from IMF "World Economic Outlook Database, October 2015"

3 International Conditions

(1) Structuring international division of labor

Since the global economic downturn by the collapse of Lehman Brothes in 2008, the yen has been on a strengthening trend, prompting Japanese companies to build overseas production bases. This created flows of production and sale of products overseas, resulting in decreased exports from Japan [Note 4]. The overseas production ratio of the manufacturing industry [Note 5] is on an increasing trend, exceeding 20% since FY 2012 (Figure 1-1-7).

Figure 1-1-7 Trend in Overseas Production Ratio (Manufacturing industry)



(Note) Overseas Production Ratio = overseas subsidiaries (manufacturing industry) net sales /(overseas subsidiary (manufacturing industry) net sales + domestic subsidiaries (manufacturing industry) net sales)× 100
Source) Developed by the MLIT from MOF's "Financial Statements Statistics of Corporations by Industry" and Ministry of Economy, Trade and Industry (METI)'s "Basic Survey of Overseas Business Activities"

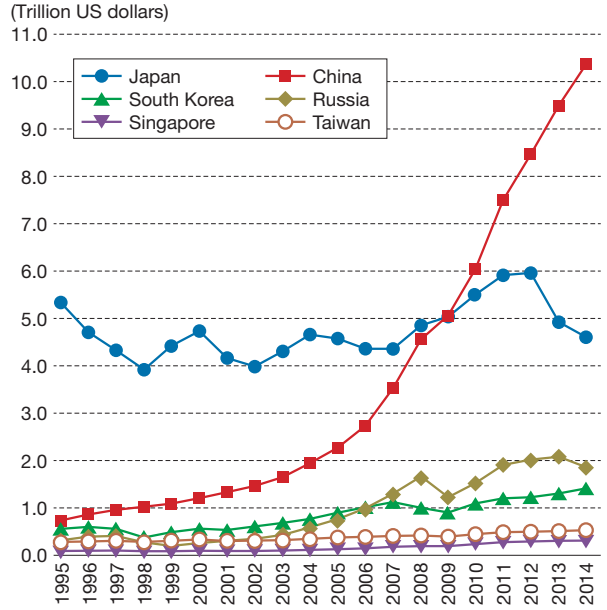
(2) Rise of emerging countries

Emerging economies, especially in Asia, have been growing and China's GDP exceeded that of Japan in 2010 (Figure 1-1-8) [Note 6]. By per-capita GDP, Singapore's GDP topped that of Japan, clearly indicating a growth of Asian nations (Figure 1-1-9).

The Asian area where rapid economic growth is taking place is having a great effect on the development of Japan's industry base and overall economy, as well as being a great factor when we consider the future of regions in Japan.

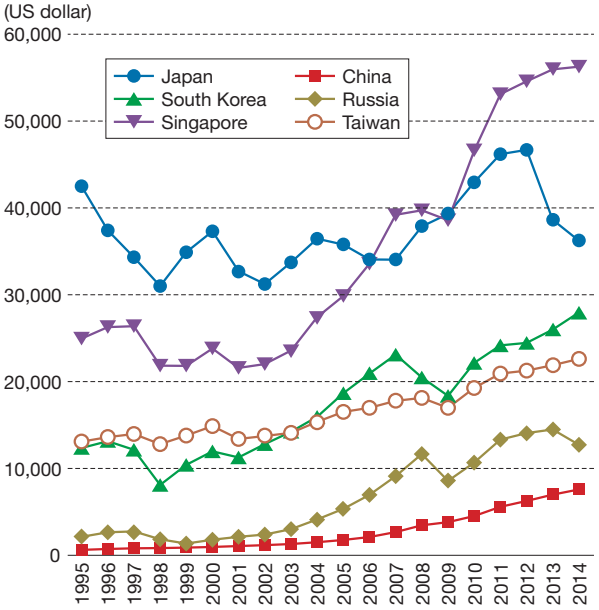
Note 4 Although a move toward reshoring has been seen due to the yen's depreciation in recent years, Japan is in an environment to face fierce competitions with emerging countries mainly in Asia.
Note 5 Net sales of overseas entities divided by the sum of net sales of overseas and domestic entities.
Note 6 Japan's GDP decreased in 2013 due largely to the impact of the yen's depreciation.

Figure 1-1-8 Changes in GDP (nominal) of Asian Nations and Russia



(Note) The decrease in Japan's GDP in 2013 is due mainly to the yen's depreciation (Japan's GDP (nominal) increased in 2013 and onwards on a yen basis).
Source) Developed by the MLIT from IMF "World Economic Outlook Database, October 2015"

Figure 1-1-9 Changes in per capita GDP (nominal) of Asian Nations and Russia



(Note) The decrease in Japan's per-capita GDP in 2013 is due mainly to the yen's depreciation (Japan's per-capita GDP (nominal) increased in 2013 and onwards on a yen basis).
Source) Developed by the MLIT from IMF "World Economic Outlook Database, October 2015"

(3) Infrastructures capable of supporting international competitiveness

In order to strengthen Japan's international competitiveness vis-à-vis intensifying international competition in the global economy, it is necessary to improve industrial locations and working/living environments with the arrangement of industrial/urban infrastructures, as well as to strengthen transportation/logistics services with well-established transport networks.

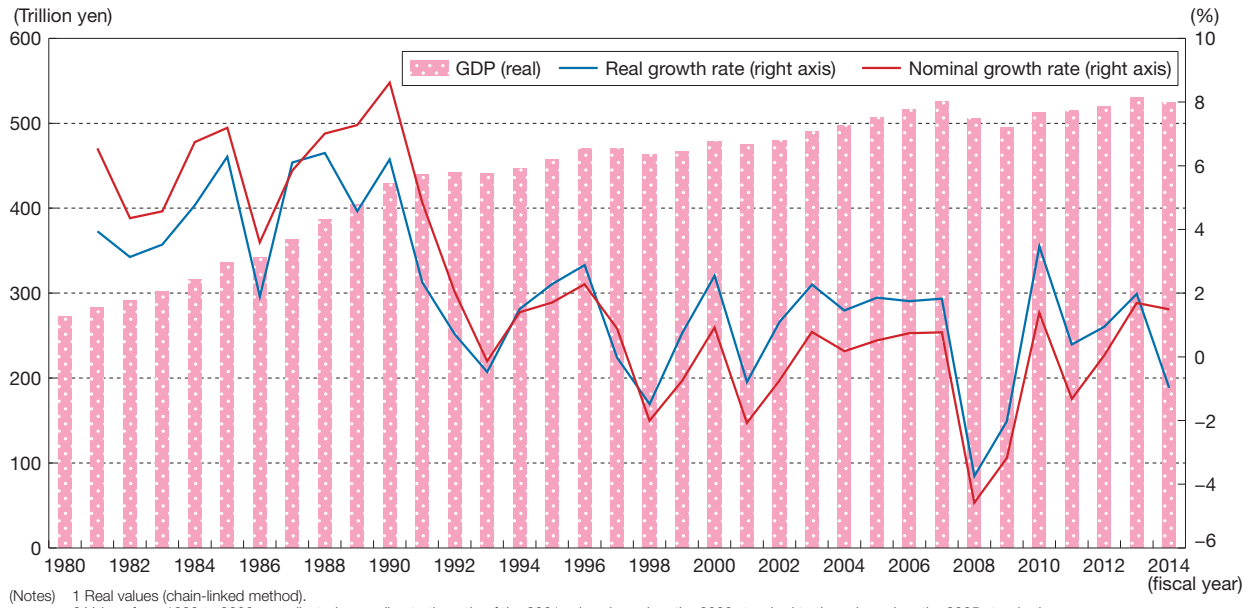
4 Japan's Economic Situation

(1) Current status and growth rate of Japan's economy

The Japanese economy overcame the slowdowns from the effects of the Lehman Shock in the fall of 2008 and the Great East Japan Earthquake in 2011, getting back on a growth track at the end of 2012, but the GDP growth rate has been at low levels in recent years compared to the 1980s' levels (Figure 1-1-10). Despite the impact of a bump in demand before the consumption tax increase in April 2014 and subsequent reaction to it, since late 2014, consumer confidence bottomed out and personal consumption, housing investment, and the like have been robust. Japan's real GDP grew in the January-March quarter of 2015, boosted by increases in private-sector demand like personal consumption, housing investment and capital investment [Note 7].

Note 7 Source "Annual Report on the Japanese Economy and Public Finance 2015-Chapter 1, Section 1. 2 Recent Economic Conditions (August 14, 2015)" by the Cabinet Office

Figure 1-1-10 Changes in Japan's GDP

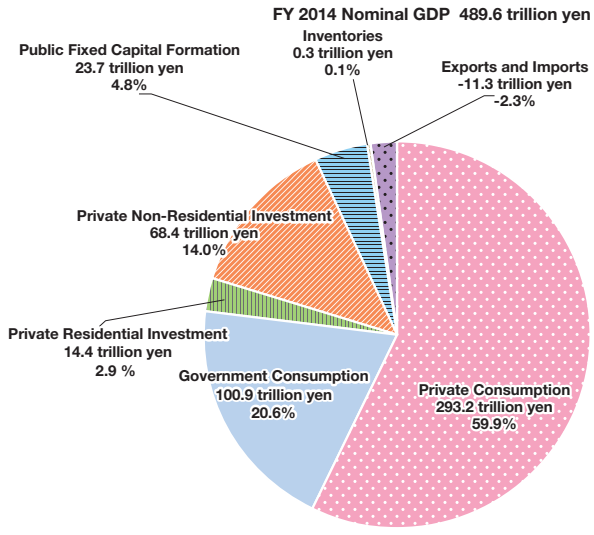


(Notes) 1 Real values (chain-linked method).
2 Values from 1980 to 2000 are adjusted according to the ratio of the 2001 values based on the 2000 standard to those based on the 2005 standard.
Source) Developed by the MLIT from "National Accounts of Japan" by the Cabinet Office

(2) GDP (Expenditure Approach) and Its Components

Gross domestic product (GDP) Note 8 published by the Cabinet Office is the "total value added by goods and services produced during a given period of time in Japan" and quarterly estimates (QE) of GDP are released. QE calculates GDP by adding up estimates of GDP demand items, including Private Consumption Note 9, Gross Fixed Capital Formation Note 10, Change in inventories, Exports and Imports (Net Exports of Goods and Services Note 11), and Private Consumption which account for about 60% of GDP (Figure 1-1-11).

Figure 1-1-11 Composition of nominal GDP (expenditure approach)



*Exports and Imports = 88.4 trillion yen Exports – 99.7 trillion yen Imports

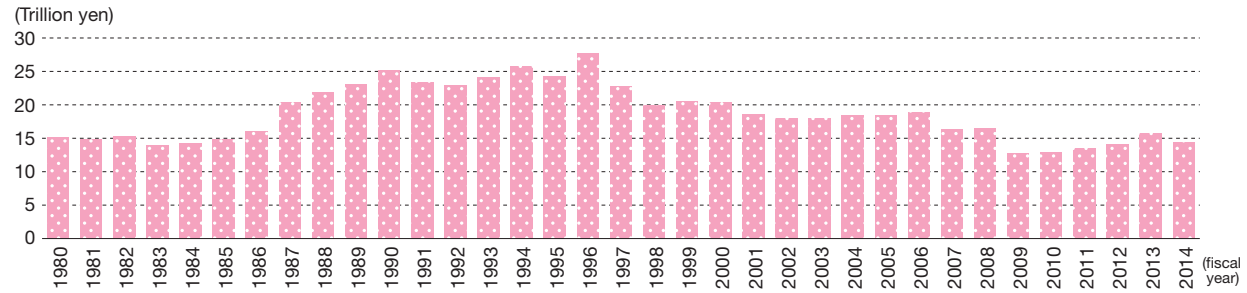
Source) Developed from "National Accounts" by the Cabinet Office

(Private Residential Investment Note 12)

Private Residential Investment in FY 2014 decreased from the previous fiscal year partly due to reaction to a bump in demand in association with the consumption tax increase, although improvements in employment/income environment, reconstruction demand from the Great East Japan Earthquake, and the like were expected (Figure 1-1-12).

Note 8 Since it is "domestic," added values of goods and services produced by Japanese companies at overseas branches and the like are not included.
Note 9 Private Consumption is the sum of Consumption of Households and Final Consumption Expenditure of Private Non-Profit Institutions Serving Households.
Note 10 Gross Fixed Capital Formation consists of Private Residential Investment, Private Non-Residential Investment, and Public Investment.
Note 11 Net Exports of Goods and Services = Exports of Goods and Services - Imports of Goods and Services
Note 12 Private Residential Investment is estimated by the quarterly total of Residential Investment amount after subtracting separately estimated quarterly Public Residential Investment.

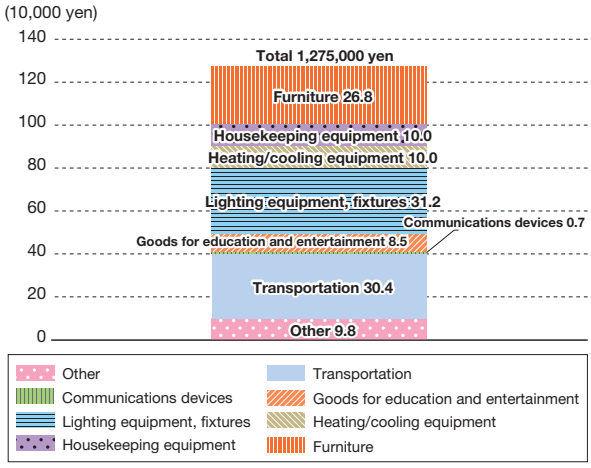
Figure 1-1-12 Changes in Nominal Private Residential Investment



Source) Developed by the MLIT from "National Accounts of Japan" by the Cabinet Office

Private Residential Investment accounts for about 3% of GDP, a ratio not necessarily large compared to other demand items (preceding Figure 1-1-11). However, the production-inducing effect of Residential Investment, which has secondary effects on the overall economy, is big because housing construction related industries are wide-ranging and broad, including construction, real estate, steel, and non-ferrous metal industries. Furthermore, when moving to a new house, demand for home appliances, furniture, and other durable goods are boosted; the purchase amount per household totals to about 1.275 million yen (Figure 1-1-13). Therefore, private residential investment is equally as important as public investment among MLIT related GDP items.

Figure 1-1-13 Breakdown of Durable Goods Purchased upon Home Purchase



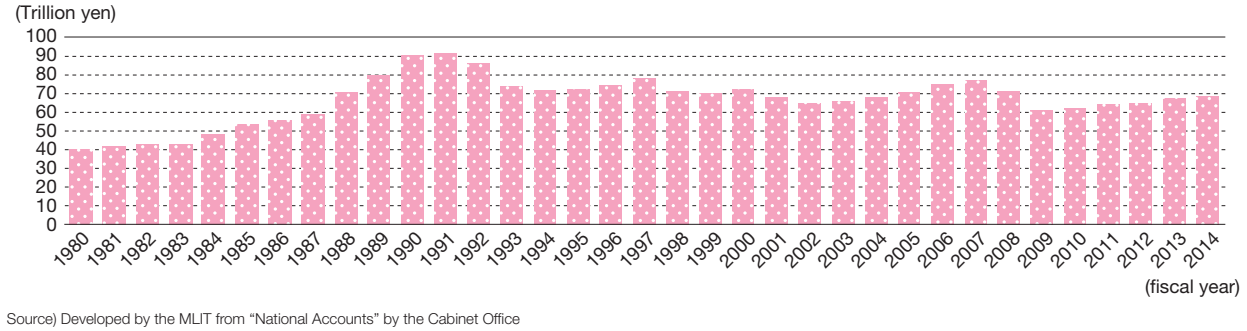
Source) Developed by the MLIT from "Survey on Consumption Relating to Home Purchases (FY 2014)" of Japan Housing Finance Agency

(Private Non-Residential Investment)

Nominal GDP for FY 2014 was 489.6 trillion yen, and Private Non-Residential Investment, which stood at 68.4 trillion yen, accounted for about 14% of the GDP figure. The ratio is not necessarily high compared to that of personal consumption or other items, but the condition of Private Non-Residential investment is closely watched because it is likely to fluctuate and has big impact on overall economic fluctuations.

Capital Investment increased for six consecutive years until FY 2014 on the back of improvements in corporate earnings (Figure 1-1-14). As labor force is expected to decline, the roles played by Capital Investment in improving productivity are increasingly important, in order to prop up Japan's growth potential from the supply side.

Figure 1-1-14 Changes in Nominal Capital Investment



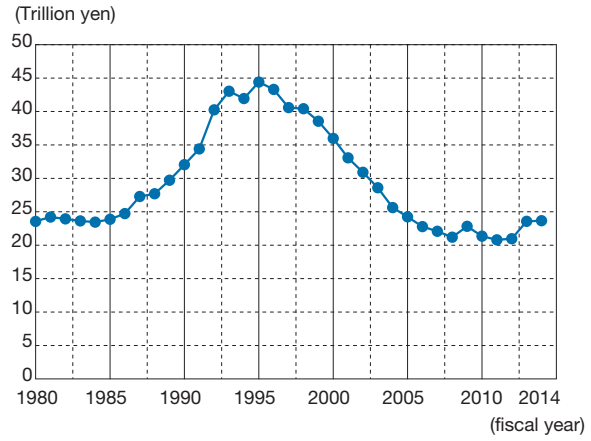
Source) Developed by the MLIT from "National Accounts" by the Cabinet Office

(Public Investment)

Public Investment published in QE is generally used to capture public investment trends. Public Investment indicates investment by the government and public corporations in increases in fixed capital stock and consists of the following three: (i) investment in public housing, (ii) investment in mechanical equipment and buildings used for operation of public corporations, and (iii) investment in public works and construction of facilities conducted by general government (national and local governments) Note 13.

Public Investment, which was on a declining trend after the peak of 44.4 trillion yen in 1995, is increasing after mid-2013, partly due to expenditures relating to the Great East Japan Earthquake (Figure 1-1-15).

Figure 1-1-15 Changes in Public Investment

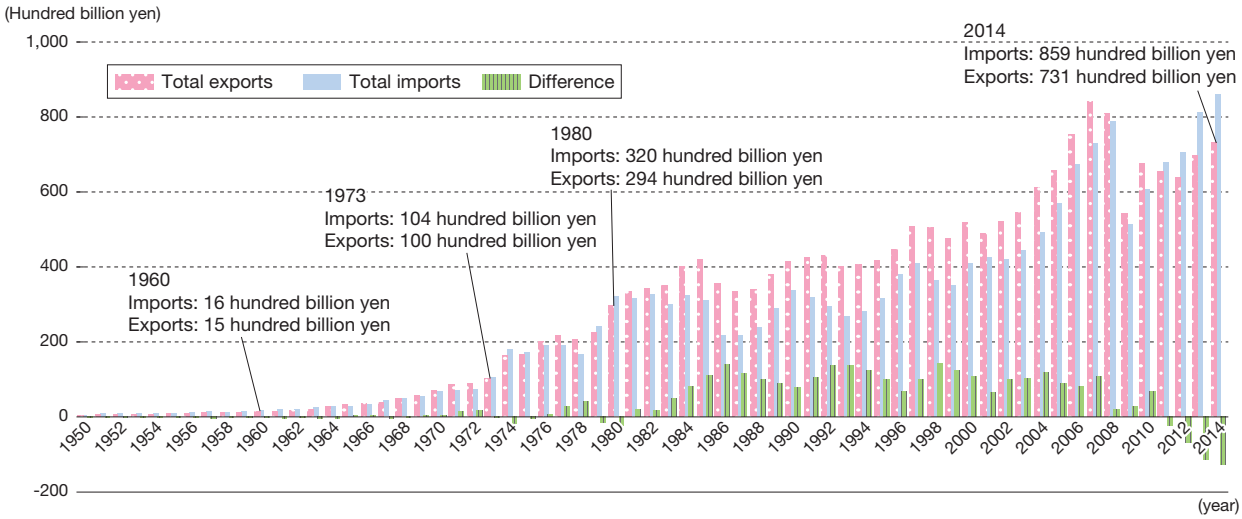


Source) Developed by the MLIT from "National Accounts" by the Cabinet Office

(Total exports and imports)

For trade with foreign countries, Japan's exports in 1960 were approximately 1.5 trillion yen, and imports were around 1.6 trillion yen. However, from 1973, both imports and exports climbed to the 10 trillion level, and by 1980 both had expanded into the 30 trillion yen range. Japan's trade balance was in surplus from 1981 to 2010 but has fallen into deficit since 2011, posting exports of about 73 trillion yen and imports of about 86 trillion yen in 2014 (Figure 1-1-16). In terms of trade partners, the U.S. had been the biggest trade partner for a long time, but China surpassed the U.S. in 2003 and since then has been Japan's number one trade partner (Figure 1-1-17).

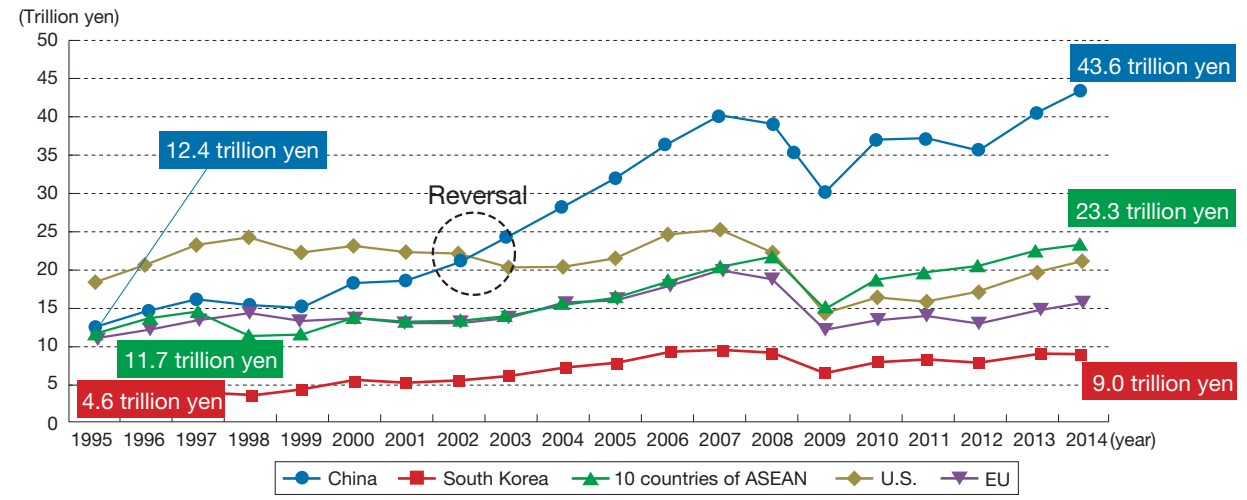
Figure 1-1-16 Trend in Import and Export Totals of Japan



Source) Developed by the MLIT from MOF's "Trade Statistics".

Note 13 Public Investment is recorded in QE according to the progress of construction projects similar to the "Estimate of Construction Investment". On the other hand, finalized Public Investment is estimated based on the government's financial statements and expenditures paid for public works at the financial closing of local governments.

Figure 1-1-17 Changes in Trade Amounts by Trade Partner Countries for 1995–2014



Source) Developed by the MLIT from MOF's "Trade Statistics"

According to the national accounts of Japan, exports of goods and services accounted for about 18% of GDP in FY 2014, indicating that the significance of external demand's contribution to economic growth is relatively important as the pace of increase in domestic demand is on a declining trend.

For example, overseas development of infrastructure systems is expected to boost Japan's economic growth by tapping huge infrastructure demand in emerging countries and other nations [Note 14]. A report by the Organization for Economic Co-operation and Development (OECD) [Note 15] estimates annual global infrastructure demand in 2030 at 2.326 trillion dollars, which is huge. If Japanese companies win such overseas infrastructure markets in addition to the domestic one, it would not only contribute to increased earnings of Japanese companies, but also lead to enhanced cost competitiveness and productivity by leveraging scale advantage, return to domestic businesses by acquiring global standards, and economic revitalization of the Japanese economy.

(The Growing number of inbound foreign tourists)

On the back of affordability created by the yen's depreciation and eased visa requirements for travels to Japan, the number of foreign visitors to Japan is rapidly increasing. According to the Tourism Agency, the number of foreign tourists visiting Japan was the largest ever at about 19.74 million in 2015 (Figure 1-1-18). Also, the consumption amount of foreign visitors to Japan in the same year increased 71% from the previous year, to the record high of 3,477.1 billion yen (Figure 1-1-19).

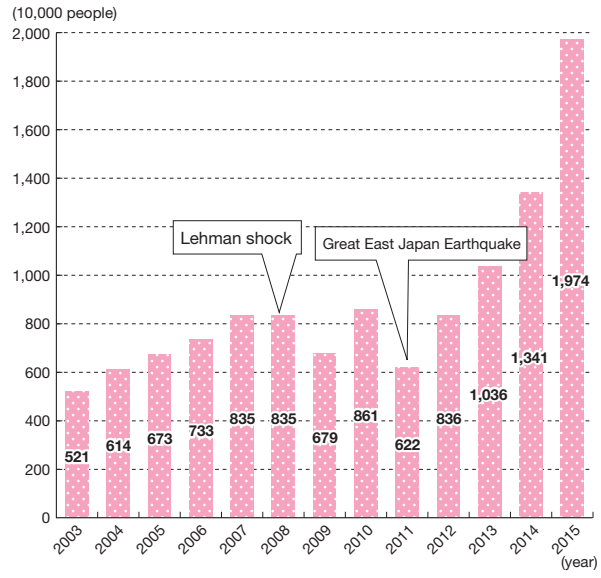
The consumption amount of foreign visitors in Japan is counted toward exports, not personal consumptions, for GDP statistics purposes [Note 16].

Note 14 Overseas development of infrastructure systems also has the aspect of pushing up GDP and GNI. In the case of selling out railway vehicles produced in Japan, the value is recorded in "exports" of GDP components. On the other hand, stock dividends, in the case of establishing a local SPC and being involved in operation, are not included in GDP but included in GNI, which is the gross income the public receives and includes wealth gained from overseas.

Note 15 Computed by the MLIT from OECD (2006/2007) "Infrastructure to 2030" and OECD (2012) "Strategic Transport Infrastructure Needs to 2030"

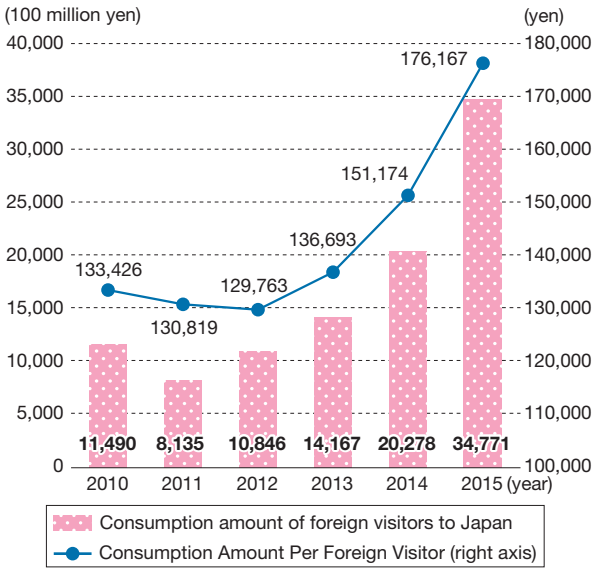
Note 16 Personal consumption conceptually covers consumption by citizens in Japan. On the other hand, consumption by inbound foreign visitors in Japan (easy-to-understand example is the purchase of souvenirs) is positioned as exports in a broad sense even if they are consumed in Japan.

Figure 1-1-18 Changes in the Number of Inbound Foreign Tourists



(Note) Provisional figures for 2015
Source) Developed by the MLIT from materials of the Japan National Tourist Organization (JNTO)

Figure 1-1-19 Changes in Annual Travel Consumption and Per Capita Travel Expenditures



Source) "Consumption Trend Survey for Foreigners Visiting Japan" by Japan Tourism Agency

(3) Changes in industrial structure

Amid changing population structure due to a declining and aging population, improvements to productivity, including technological innovations [Note 17] play important roles in order for the Japanese economy to grow.

Chapter 3, Section 1 of the Annual Report on the Japanese Economy and Public Finance 2015 of the Cabinet Office describes that the prolonged economic downturn is on the back of slow productivity increases, pointing to Japan's service industry [Note 18] where productivity gain is slow compared to other developed countries.

The ratio of the labor-intensive service industry to economic activity is increasing as the economy becomes service-based and society ages.

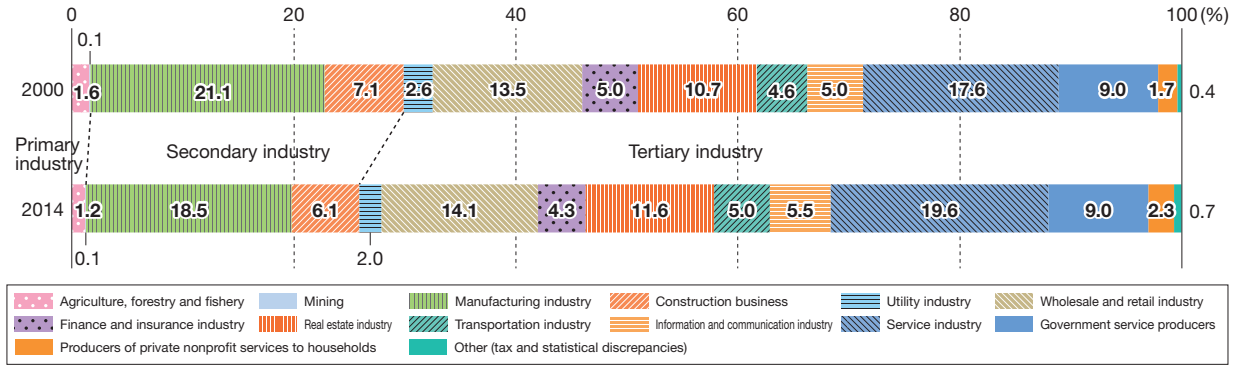
Advanced countries, including Japan, have shifted to service-based economies on the back of raises in demand for services in accordance with changes in social structure, such as higher income levels and a declining and an aging population. This has led to an expansion of demand for labor in non-manufacturing industries. In terms of the shares of GDP contribution and the number of employees to the overall economy, shift from the manufacturing industry to the service industry is happening.

The shift of economic structure from the manufacturing industry to the service industry is common across advanced economies. For Japan, the ratio of nominal value added by the service industry to the overall economy, which was 70% in 2000, rose to 74% in 2014 (Figure 1-1-20). Similarly, the ratio of workers engaged in the service industry increased from 65% in 2000 to 72% in 2013.

Note 17 Productivity is defined as "the ratio of output produced through production activities to inputs used in the production process" and the higher the ratio of output to input is, the higher the efficiency of production is.

Note 18 The service industry means the tertiary industry excluding the agriculture, forestry and fishery, mining, manufacturing industry, and construction business industries, and indicates utilities, wholesale and retail, finance and insurance, real estate, transportation, information and communication industry and other broad services in addition to services in the narrow sense, including services provided to individuals and business offices.

Figure 1-1-20 GDP (nominal) Ratio by Economic Activity

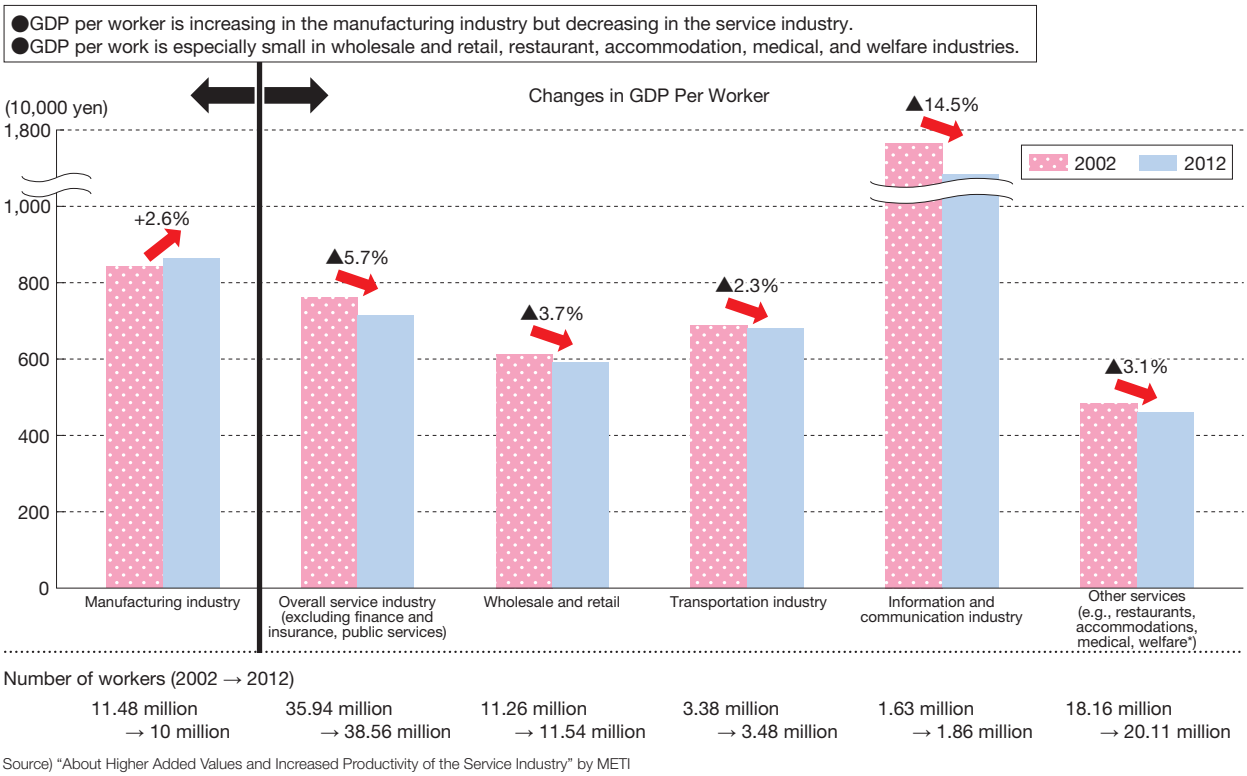


(Note) Government service producers: central and local governments
Producers of private nonprofit services to households: private schools, NGOs, labor unions, political parties, religious organizations, etc.
Source) Developed by the MLIT from "National Accounts" by the Cabinet Office

The productivity per worker in the service industry that accounts for about 70% of GDP and working-age population, however, is declining while that of the manufacturing industry is increasing. The GDP per worker is especially low in such services as wholesale and retail, restaurant, accommodation, medical, and welfare industries (Figure 1-1-21).

Amid these circumstances, it is especially important in the service industry to increase labor productivity by improving production efficiency, technological innovation, and the like.

Figure 1-1-21 GDP Per Worker



Source) "About Higher Added Values and Increased Productivity of the Service Industry" by METI

Section 2 Economic Trend and Infrastructure Development

1 Histry of economic growth and infrastructure development

This Section looks at the history of how infrastructure development supported economic activity and peoples' lives since the early modern period, focusing on infrastructure development in the Edo period and after World War II.

In an international comparison of the level of public investment, we explain the need to take into account Japan's poor land and the severe natural environment, provide overview of the infrastructure stock, and examine its impact on infrastructure productivity and economic growth.

(1) Infrastructure development that supported the life and economy in the Edo period

In the Edo period, large-scale town and social infrastructure development centered around Edo Castle were carried out which dramatically changed the towns of Edo.

The coastline that extended near the current Imperial Palace was reclaimed, moats were formed, Nihonbashi Bridge was built, and Gokaido Roads, or the five key roads, and other major transportation networks starting from Nihonbashi, were developed in the Edo period. These infrastructures were handed down to the current Heisei period.

Thus, we focus on Edo, the origin of Tokyo, and explore the infrastructure development and economic activity, peoples' lives, maintenance awareness, disaster prevention awareness, and the like in the period.

(Public works in the Edo period)

Who did public works and how?

In the Edo period, master-servant relationships between the Edo Shogunate and each domain were established and civil engineering projects, such as construction of Edo Castle, creation of ports, river improvement, and road development, were assigned to domain daimyo (feudal lords) as "tenka bushin" (a type of public works projects which the Edo Shogunate ordered), forcing each daimyo to bear economic burden. Also, partly due to large-scale infrastructure development centered around Edo Castle which required labor, Edo's towns became a major metropolitan area with a highly concentrated population.

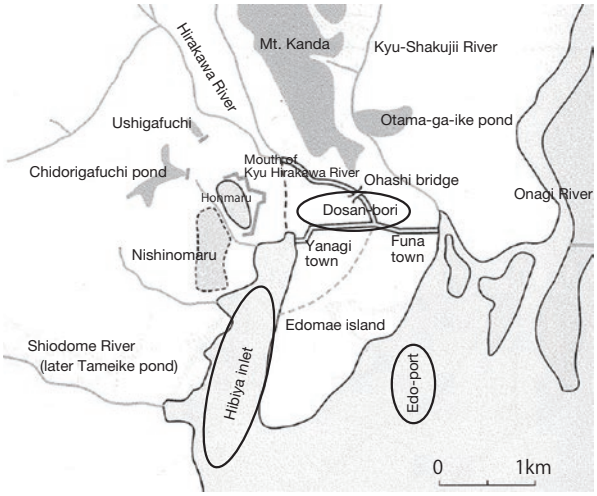
(Reclamation of Hibiya inlet and Development of Edo- Port)

While the Edo Shogunate was founded in 1603 by Ieyasu Tokugawa, who had become shogun, Ieyasu also implemented various infrastructure developments before that.

Edo Castle was originally built by Dokan Ota in 1457 (Muromachi period). When Ieyasu entered Edo Castle in 1590, the castle, which was then over 130 years old, was dilapidated and surrounded by rundown castle towns. Therefore, Ieyasu planned infrastructure development around Edo Castle from an early stage after moving to the castle.

First, Ieyasu focused on the development of water transport networks centered around Edo Castle in order to transport goods in large volume to Edo by ship, and pushed forward the construction of Edo- Port (Figure 1-2-1).

Figure 1-2-1 Edo in 1590-1592



Source) "Super visual version Edo-Tokyo no chiri to chimei: Nippon Jitsugyo Publishing" by Maso Suzuki

In 1592, Dosan-bori that stretches from current Gofuku-bashi Bridge to Ote-mon Gate was constructed, which established a system of ship transportation to just below Edo Castle, thereby enabling transportation of goods, such as stone materials to build the castle.

Also, the coastline at that time extended to the area where the current Imperial Palace is located and Hibiya area was shallow water named Hibiya Inlet. In order to prevent enemy ships from entering the inlet from a military consideration,

a hill named Mt. Kanda (Surugadai) was leveled to reclaim Hibiya Inlet in 1596, and the reclaimed land was utilized for building urban areas and samurai residences.

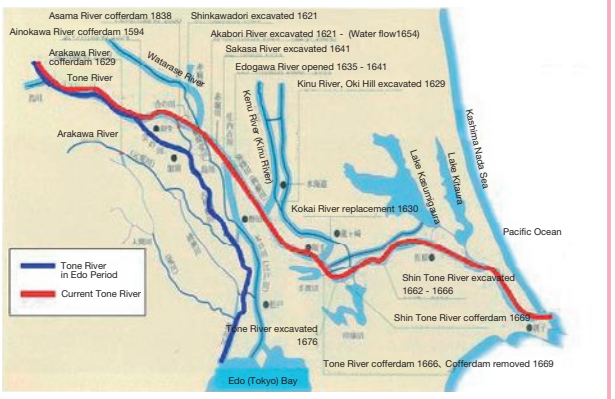
(Eastward Move of Tone River and westward move of Arakawa River)

Tone River, which currently flows into the Pacific Ocean (Choshi-city, Chiba prefecture), flew into Edo Bay (current Tokyo Bay) in the Edo period (Figure 1-2-2).

Towns of Edo suffered frequent water damage due to floods and other disasters. The eastward move of Tone River started in 1594 in order to avoid water damage, develop farmland, and activate logistics by ship transportation.

In the eastward move of Tone River, construction projects for not only changing the flow of the river, but also for building levees and irrigation channels were conducted. These projects took 60 years and were completed in 1654. Also, a construction project to separate the Arakawa River, which joined the Tone River near Koshigaya, from the Tone River was conducted in 1629, resulting in the current path, flowing via the Sumida River into Tokyo Bay.

Figure 1-2-2 Tone River in Edo Period (Blue Line) and Current Tone River (Red Line)



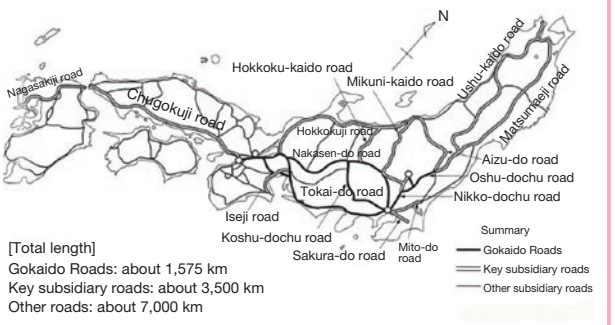
Source) MLIT

These projects contributed to flood prevention, development of new fields and water transportation, and supported the development of Edo.

(Formation of traffic networks centered around Edo by building Gokaido Roads)

Ieyasu planned development of Gokaido Roads (or five key roads, i.e., Tokai-do Road, Nakasen-do Road, Nikko-kaido Road, Koshu-kaido Road and Oshu-kaido Road) based on the radial urban structure starting from Nihonbashi and, as a starter, built Tokai-do Road between Edo and Kyoto in 1601. The width of the Gokaido Roads including the Tokai-do Road was made wide, and they were used for Sankin-kotai (a system that obligated daimyo to reside in Edo periodically, taking turns) and other purposes. Also, roads called *wakikaido* (subsidiary roads) played the roles of supplementing transportation using the Gokaido Roads and serving as main roads that branch off from the Gokaido Roads to local regions, and many such *wakikaido* were built as roads for commoners (Figure 1-2-3).

Figure 1-2-3 Map of Gokaido Roads and Key Roads



Source) MLIT

Thus, the Gokaido Roads and other roads built across Japan by the Edo Shogunate supported the Sankin-kotai system and economies in the areas along the roads used for the system (e.g., prosperity of post towns along the roads). They are still serving as the delicate framework for the traffic networks of Japan, including railways and highways.

■ Economic effect of Sankin-kotai

Sankin-kotai is a system in which daimyo traveling to and from Edo to fulfill their duty for alternate year-attendance at the Tokugawa shogunate government.

Although the size of the daimyo's procession varied depending on their stipend and class, many processions were conducted with 150 to 300 persons, and large domains carried out the procession in the size of a few thousand persons, moving in flocks and taking an even longer period (Figure 1-2-4).

The Sankin-kotai system had a significant effect on the economy through, for example, large-scale consumer activity that took place in towns across Japan and Edo (Figure 1-2-5).

In addition to the economic effect, various traditions and food cultures were developed and exchanged mainly in Edo, which served as the foundation for creating the flow of transportation to local regions across Japan.

Figure 1-2-4 Folding Screen of Kaga Domain Daimyo Procession

Source) Ishikawa Prefectural Museum Of History

Figure 1-2-5 Post Towns of Gokaido Roads (accommodations)

Name of Roads	Number of staging posts	Number of accommodation facilities		
		Honjin	Sub-Honjin	Hatagoya
Tokai-do road	57	116	70	3,103
Koshu-kaido road	45	41	44	525
Nakasen-do road	67	72	99	1,812
Nikko-kaido road	23	25	27	820
Oshu-kaido road	10	11	11	267

Source) Developed by the MLIT from the "Kinsei kotsu shiryoshu" (collection of historical early modern transportation)

In his diary of accompanying a visit to Edo "Edo Sanpu Zuiko Ki", Carl Peter Thunberg, a doctor and botanist at the Dutch trading house (who visited Edo in 1775), praised Japan's roads: "Roads of this country are kept in good conditions throughout the year, wide and have trenches for drainage." In the Edo period, commoners cleaned and maintained roads, and the description indicates that the maintenance conditions were at high levels compared to those of Western nations.

Among ukiyo-e paintings that are emblematic of the Edo period, *Fifty-three Stations on the Tokaido: Morning Scene at Nihonbashi Bridge* by Hiroshige Utagawa, which depicts artisans and merchants of bustling Nihonbashi, is especially famous. Also, Hokusai Katsushika painted energetic people on a bridge, having Mr. Fuji and Edo Castle on the background, in *36 views of Mount Fuji: Edo Nihonbashi* (Figure 1-2-6).

Nihonbashi, the starting point of roads in the Edo period, still serves this role because distances to Tokyo indicated in current road signs show those to Nihonbashi.

Figure 1-2-6 Nihonbashi in the Edo Period Painted in Ukiyo-E

Fifty-three Stations on the Tokaido:
Morning Scene at Nihonbashi Bridge by Hiroshige Utagawa

36 views of Mount Fuji: Edo Nihonbashi by Hokusai Katsushika

Source) National Diet Library

Column

Daily life and infrastructure in the Edo period as portrayed by Hiroshige Utagawa

Figure 1-2-7 Hiroshige Utagawa

Source) National Diet Library

Because cameras were not commonly used in the Edo period, we cannot actually see the pictures to suppose the daily life at the time. However, everybody would know the landscapes of areas in Japan as portrayed in ukiyo-e prints (woodblock prints depicting the ways of the world) by Hiroshige Utagawa (1797–1858), who passed on the scenery of Japan in the latter part of the Edo period to us (Figure 1-2-7).

Around the late Edo period, ordinary people in the Edo area preferred to travel the nation, and ukiyo-e prints, such as the *Fifty-Three Stations on the Tokai-do Road*, depicting noted places of post towns and sightseeing spots, were widely popular as souvenirs. Hiroshige mainly portrayed the lives of Edo citizens as the background for the seas, mountains, rivers, and ponds. These ukiyo-e prints depict the beautiful scenery using indigo blue as the keynote color and had a great influence on the French Impressionists such as van Gogh, creating the term “Hiroshige Blue” outside Japan.

He painted the infrastructures of the time—roads, bridges, rivers, and ports—everywhere in his paintings, along with a variety of nature landscapes, so we can suppose that the infrastructure had been developed in ancient times and were closely related to everyday life and the economic activities of Edo citizens (Figure 1-2-8).

Figure 1-2-8 Various Infrastructures Painted by Hiroshige Utagawa in *Fifty-three Stations on the Tokaido*

A mountain road was developed by cutting through a mountain *Nissaka-shuku* (Kakegawa-city, Shizuoka prefecture)

Okazaki-shuku with a large-scale bridge (Okazaki-city, Aichi prefecture)

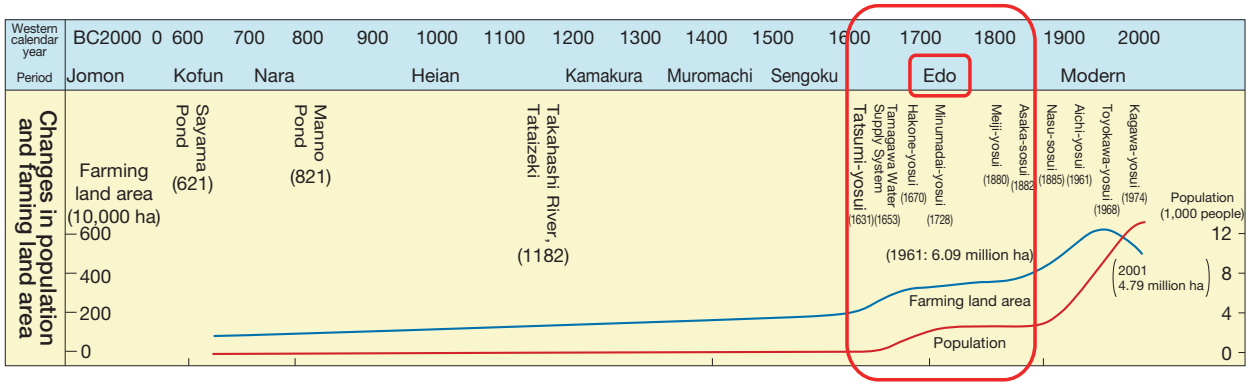
Source) National Diet Library

(Agricultural production increased by development of farming water)

In the Edo period, about 80% of population lived in rural areas [Note 19], thus increases in agricultural production directly led to economic growth. In association with progress in the development of new fields and irrigation since 17th century, production volume (in koku unit) increased by about 30% (Figure 1-2-9, Figure 1-2-10).

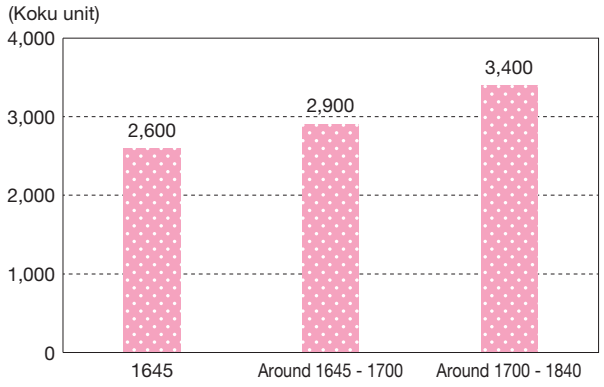
Note 19 See “History of Japan read from its population” by Hiroshi Kito (2007).

Figure 1-2-9 Changes in Farming Land Area and Irrigation System Development



Source) Developed by the MLIT from "Variety of Irrigation Systems in the World" by Ministry of Agriculture, Forestry and Fisheries

Figure 1-2-10 Changes in Koku-Unit Yield in Edo Period



Source) Developed by the MLIT from "Volume 1of New Field Development" by Toshio Kikuchi (1958)

(Water supply system development)

Partly due to the location close to the coastline, the salt concentration of well water of Edo towns was high and not suitable for drinking. Therefore, Ieyasu sent his vassal Okubo Togoro Tadayuki and ordered him to develop water supply systems.

Around 1629, the Kanda Water Supply System that has spring water sourced from Inokashira Pond, Zenfukuji and Myoshoji Ponds, and the like was completed. At that time, water pipes were made of stones, woods, bamboo, and the like (Figure 1-2-11).

As the population of Edo increased, drinking water became scarce and the development of the Tamagawa Water Supply System was planned by order of the fourth shogun Ietsuna Tokugawa, and Shouemon Tamagawa and Seiemon Tamagawa, known as Tamagawa brothers, started construction of a water supply system.

The brothers started excavation works in April 1653 and planned to connect stone and wooden pipes from Yotsuya Okido to Toranomon but they ran out of money for construction expenses near Takaido. Therefore, the brothers requested the Shogunate to allocate additional expenses but the request was not approved and they invested their own money to continue the construction projects. As a result, they completed the pipe from Hamura to

Figure 1-2-11 Wooden Water Pipes of Edo Period Excavated in Chiyoda Ward, Tokyo

Water pipes from Marunouchi 3-chome remains

Mark of seams on wooden water pipes

Source) Tokyo Waterworks Historical Museum

Yotsuya Okido about seven months later in November of the same year, and from Yotsuya Okido to Toranomon in November 1654, completing the whole Tamagawa Water Supply System in the short period of about one and half years.

Because of the success of the Tamagawa brothers, water from the Tamagawa Water Supply System was used for irrigation and drinking water by Edo citizens and it is still used as current Tokyo people's drinking water more than 360 years later.

(Sewerage systems in Edo)

In the Edo period, oil, chemical detergents, and the like were not used in large volumes as we do now, and human excrement was traded as a valuable resources to be used asfertilizer. Therefore, sewerage in the Edo period was mainly for rain and spring water, and its contamination level was said to be relatively low compared to current levels.

In the case of the Taiko Gesui (Sewerage System) (Osaka-city), built in the Azuchi-Momoyama period before the Edo period, town people jointly conducted water cleaning activity in accordance with the official notice of Machi-bugyo (town magistrate), and they are also said to have borne maintenance, repair and other expenses (Figure 1-2-12).

The Taiko Sewerage System has been used up until now after an elapse of 400 years since its construction, which indicates that appropriate maintenance enables such a system to serve as infrastructure that supports people's lives for a long time.

Figure1-2-12 Taiko Gesui (Sewerage System) still being used (Osaka-shi)

Source) Construction Bureau, Osaka City

(808 Bridges of Naniwa)

Many towns were packed in Edo to the extent it was called "Edo 808 Towns of Edo." On the other hand, towns of Osaka with numerous bridges were referred to as the "808 Bridges of Naniwa" (Figure 1-2-13).

About half of the 350 bridges in Edo were public works bridges built by Shogunate.

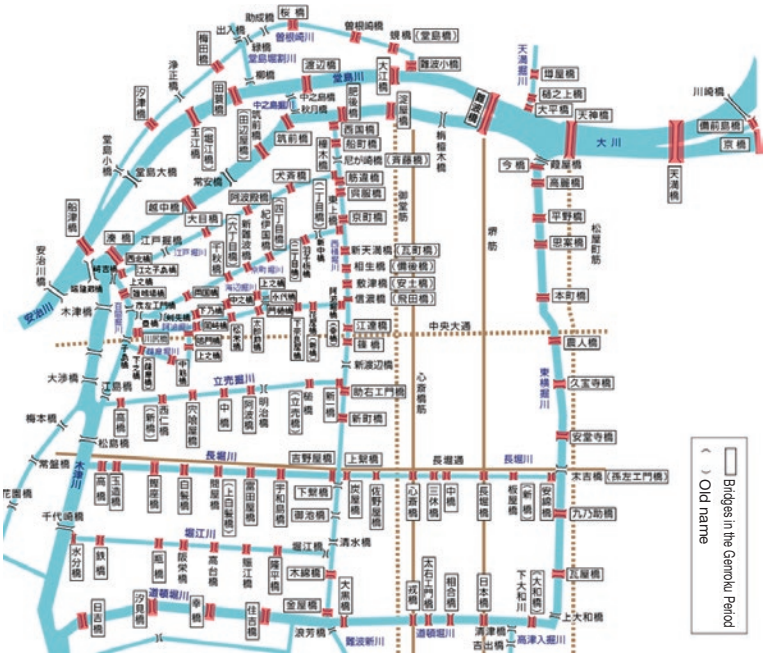
Of Osaka's remaining bridges, only 12 were built through public works projects, such as Tenjin-bashi Bridge and Korai-bashi Bridge, and the rest of about 190 bridges were built by town people at their own expense for their living and business (Figure 1-2-14). Noninbashi Bridge (Osaka-shi) was one of the public works bridges, but duties of daily maintenance were imposed on town people around the bridge, including cleaning of the bridge, reporting of any crashing of a ship into the bridge and detention of the boatman, and reporting of any damage to the bridge.

Figure 1-2-13 Scenery of *808 Bridges of Naniwa*

Source) National Diet Library

Of four bridges on the Sumida River in the Edo period, Ryogokubashi Bridge, Eitaibashi Bridge, Azumabashi Bridge, and Shin'ohashi Bridge, the Azumabashi Bridge was built in 1774 by six town persons at their own expense by obtaining the approval of the Edo Shogunate, and the other three bridges were constructed by the Shogunate. This indicates that bridges were so indispensable for living and economic activity of town people in Edo that they constructed bridges even by using their own money.

Figure 1-2-14 Bridges in Osaka Constructed in Genroku Period (1688-1704)



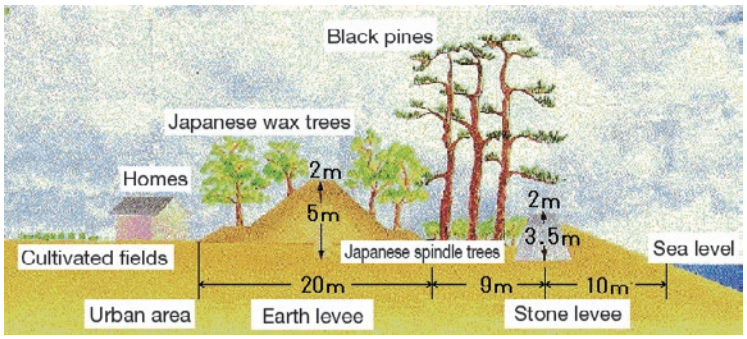
Source) MLIT

(Infrastructure development and nurturing of disaster prevention awareness by wealthy merchants)

Goryo Hamaguchi, the seventh head of the Hamaguchi family that ran a *shoyu* (soy) sauce production business, predicted the coming of a tsunami to Hiromura (current Hirogawa-cho, Wakayama) right after the Ansei Nankai Earthquake in November 5, 1854, and set a fire on just harvested precious rice to evacuate village people to a hill, which rescued many of them. This is the anecdote known as the Fire of Rice Sheaves.

Just three months after the earthquake, Goryo implemented reconstruction measures aimed at two purposes by investing his own money and filing a petition to Kishu domain.

Figure 1-2-15 Bronze Statue of Goryo Hamaguchi and Cross-Sectional Drawing of Hiro Village Breakwater (Hirogawa-cho, Wakayama)



Source) Inamura-no-Hi no Yakata museum

In addition to levee development to prevent future tsunami disasters, measures were also aimed at countering unemployment for villagers who had lost jobs due to the tsunami. The four year construction project resulted in a large-scale breakwater, Hiromura Breakwater, with dimensions 600 m long, 20 m wide and 5 m high, in 1858 (Figure 1-2-15).

The public works project conducted with investment of money by Goryo himself promoted self-support and disaster awareness among villagers, as well as the sense that the breakwater was their asset.

Subsequently, the Hiromura Breakwater was designated as a historic site in 1938, and the breakwater protected many villagers from a tsunami caused by the Showa Nankai Earthquake in 1946, about 100 years after the construction of the

breakwater.

The Hiromura Breakwater still exists in Hirogawa-cho. In 1994, the Hiromura Breakwater Preservation Committee was established, with cleaning activity taking place a few times a year on a regular basis, in which not only the committee members but also children in the neighborhood participate to learn disaster prevention. This represents praises for Goryo's accomplishments as well as continued fostering of disaster prevention awareness among local residents.

Inamura-no-Hi no Yakata museum, which consists of the Goryo Hamaguchi Archives and the Tsunami Educational Center, was opened in 2007 and the facilities communicate the importance of disaster prevention awareness to visitors. In December 2015, the UN General Assembly adopted a resolution to designate November 5, the date when the Ansei Nankai Earthquake hit, as World Tsunami Day, contributing to the fostering of disaster prevention awareness, not only in Japan, but also on a global scale.

(Infrastructure maintenance awareness handed to present time)

The awareness that infrastructure is an asset and it should be maintained by people as in the Edo period is handed down to the present day in some areas, case examples of which are as follows.

Example (i): In Chuo Ward, Osaka-city, conducts the annual event of cleaning bridges in the ward "Bridge Cleaning Brash Up Project" led by the ward office in public and private sector collaboration with local residents, companies, various organizations, and others (Figure 1-2-16).

Figure 1-2-16 Cleaning of Bridges in Chuo-ku by Citizens, Corporations and Various Organizations

Source) Chuo Ward Office, Osaka City

Example (ii): Nihonbashi Bridge, Chuo Ward, Tokyo Metropolis, Nihonbashi Bridge cleaning has been conducted since 1971, hosted by the Nihonbashi-Meikyou (Nihonbashi preservation association), with participation of people from companies, elementary schools, and other organizations in the neighborhood (Figure 1-2-17).

Figure 1-2-17 People Washing Nihonbashi Bridge

Source) Nihonbashi-Meikyou

Example (iii): In Chuo Ward, Niigata-city, Niigata prefecture, a festival to celebrate the birth of Bandaibashi Bridge, a symbol of Niigata-city, is held annually (Figure 1-2-18).

Figure 1-2-18 Bandaibashi Bridge Birth Festival Leaflet and Picture of the Festival

Source) Chuo Ward Office, Niigata-city

Example (iv): The activity of the committee to think about environmental beautification established in 1999 in Saikai-city, Nagasaki prefecture [Note 20], is conducting planting and road weeding projects in and out of the region (Figure 1-2-19).

Figure 1-2-19 Road Beautification Activity in Saikai city

Cleaning activity around Oshima-Ohashi Bridge

General education in coordination with elementary schools

Source) MLIT

Column Development of attractive communities where local activities and infrastructure are combined

Many of the measures implemented by local districts that have received Handmade Hometown Prizes are to revitalize the regions utilizing familiar infrastructures.

Semboku-city, Akita prefecture, is working on Vitalization of the Local District utilizing sediment control facilities, mainly driven by NPO Iyashi-No Keiryu, Sato, Machi Net (healing mountain streams, villages, and town net) (Figure 1-2-20 and 1-2-21). The sediment control dam with large culverts on the Obanaigawa River, completed in 2005, had been planned as a facility, not only to have disaster prevention functions, but also to be friendly to the environment and landscape, and to allow the participation of residents. The universal design of the facility makes it easy for every person to visit and use. The NPO corporation has hosted an event called the Iyashi-De Walk (Walk in Healing) every year since 2005, through which more than 100 people who enjoy walking at the waterside and in the forest, including wheelchair users and kindergarteners, have deepened exchanges among them. In addition, various activities are carried out in the facility to encourage contacts with nature and raise awareness of regional disaster prevention, while the facility serves as the playground for many schools and organizations, and as the place to hold citizens' forums focusing on the environment and disaster.

Figure 1-2-20 Exchanges of Broader People after Introduction of Universal Design for Sediment Control Dam

Source) MLIT

Figure 1-2-21 Kindergarteners Viewing From Above Sediment Control Dam (Playing and Leaning Ground)

Source) MLIT

In Kashima-city, Saga prefecture, since around 1989 when local residents came into action to revitalize the exhausted towns, residents have been making efforts to develop towns utilizing the townscape of Hizenhamashuku [Note] dating back to the Edo period (Figure 1-2-22 and 1-2-23). Nowadays, with the NPO

Note In 2006, designated as an important preservation district of historic building in Japan.

Note 20 Won 2015 MLIT Mister Award "Handmade Hometown Prizes." This Award is given by the MLIT Minister to social capital that creates attractions and distinct characteristics of a region and brilliant local activity that utilize it.

Hizenhamashuku Mizu To Machinami No Kai (Society of Water and Townscape in Hizenhamashuku) consisting of volunteers playing a major role, the city is working to promote the tourism industry by hosting concerts or exhibitions, and spreading Sake Brewery Tourism with use of the time-honored sake breweries. As shown by the 70,000 attendants crowding the Kashima Sake Brewery Tourism & Hizenhamashuku Flower and Sake Festival in FY 2015, the city is attracting nationwide attention as an advanced example. The more the city's name is recognized, the more people are relocating to the city, so the NPO corporation is engaged in further Vitalization of the Local District by responding to would-be residents and grappling with the problem of vacant townhouses, one of the issues of the district.

Figure 1-2-22 Hizenhamashuku Flower and Sake Festival (Kashima Sake Brewery Tourism)

Source) MLIT

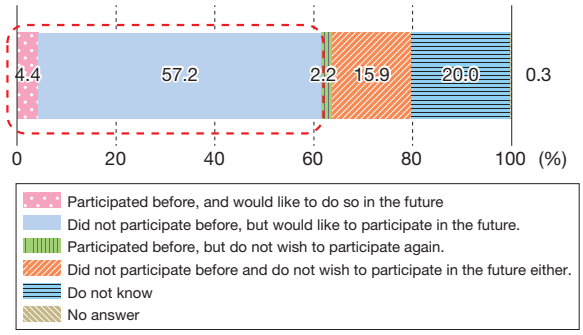
Figure 1-2-23 Events Utilizing Sake Brewery (fashion show by local high school students)

Source) MLIT

(Survey on resident awareness of infrastructure management)

The MLIT conducts Monitor Surveys [Note 21], and a Monitor Survey conducted in February 2016 [Note 22] included the following question: "Expansion of cooperation by residents is being examined and tried as an effort to appropriately maintain infrastructures amid declining population and severe fiscal condition. What do you think of such an effort?" A majority of respondents answered, "I have not participated in such activity before, but I would like to do so going forward." This shows willingness of residents to participate in infrastructure maintenance (Figure 1-2-24).

Figure 1-2-24 Survey Results on "Resident Participation Awareness on Infrastructure Maintenance"



Source) MLIT "Monitor Survey"

As explained above, a few hundred years after the Edo period, we can still see that bridges, roads, rivers, running water, levees, and other infrastructures that serve as the foundation of people's activity are closely connected with the lives and economic activity of local residents.

It is important that each of us lives affectionately with infrastructures and maintain them, not only for now but also for the future to hand them over to the next generation.

In preparing for natural disasters, it is also important for local residents to have disaster prevention awareness (non-

Note 21 A system in place since 2004 of surveying the general public on issues concerning MLIT administration through the Internet to collect high quality opinions, requests, and the like for the purpose of using the results as reference in planning, developing, and implementing land, infrastructure, transport and tourism administration.

Note 22 During a period form Monday, February 8, 2016 to Monday, February 22, 2016, 1098 Men and women aged 20 or over were surveyed on the awareness of resident participation in infrastructure management. The number of respondents was 914 (484 men and 430 women).

structural measures) in addition to infrastructure development (structural measures) as indicated by the example of the Hiromura Breakwater.

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(2) Infrastructure development that supported economic growth after World War II

After the end of the Pacific War in 1945, Japan restored and reconstructed from war damage and showed dramatic economic growth after just 10 years of post-war reconstruction period.

During the high economic growth period, when various infrastructure developments were a pressing task due to rapid population increase mainly in Tokyo, expansion of cities, motorization and the like, the hosting of 1964 Tokyo Olympics was decided. This event required all-out efforts of the nation and large-scale infrastructure development mainly in Tokyo was conducted. This started the enhancement of Japan's rich livelihood infrastructure, from the period of high economic growth until now.

As more than 70 years have passed since the war, we look at the post-war infrastructure development, which is deeply connected to Japan's economic development, as follows.

(Flood control projects)

A series of large-scale typhoons, including Kathleen, hit Japan from the late 1940s to 1950s, causing frequent and significant damage (Figure 1-2-25). After Ise Bay Typhoon in 1959, long-term plans and legislation for flood control projects (10-year plan or five-year plan) were developed for the first time. To counter repeated flood damage, the significance of flood prevention and sediment-related disasters together with flood control became recognized. Also, water resource development, by way of multi-purpose dams for flood control and water utilization, was pushed forward in order to meet rapidly increasing demand for industrial water and municipal water in association with economic development.

Figure 1-2-25 Damage by 1947 Typhoon Kathleen (Kuki City, Saitama prefecture (former Kurihashi Town))

Source) MLIT

At the same time, sudden urbanization caused various river related problems, such as surges in serious water shortages and sediment-related disasters during the high economic growth period. Because of the construction of dams to counter severe water shortages, water supply restrictions were largely decreased in recent years. Furthermore, comprehensive flood control measures including permeation and retention of rainwater together with river improvement and warning and evacuation systems together with countermeasures against debris flows have been conducted.

(Development of main roads)

Because of the task of driving road policies in association with social and economic reconstruction after World War II, the Act on Special Measures concerning Road Construction and Improvement was established in 1952 and the system of toll roads in Japan started. The Act on Temporary Measures concerning Funding of Road Development Expenses was established in 1953, which provided for use of gasoline tax as special revenues for road construction as well as systematic promotion of road development by setting road development goals and project volumes in Five-Year Road Development Programs. The first Five-Year Road Development Program was formulated in 1954.

Figure 1-2-26 Deteriorated Roads Conditions in 1950s "Watkins Commission Report"

Source) MLIT

Roads in Japan after the end of World War II were so severely dilapidated and insufficient that the report of the Watkins Commission published in 1956 warned, "The roads of Japan are incredibly bad. No other industrial nation has so completely neglected its highway system" (Figure 1-2-26).

Five-Year Road Development Programs were formulated until the 11th Five-Year Road Development Program in 1997, contributing to rapid improvement of Japan's levels of road development.

(Comprehensive National Development Plan)

The Comprehensive National Development Plan presents medium to long-term land plans in order to establish desirable national land while responding to issues faced by local regions and changing times.

The Plan was reviewed every seven to 10 years since the formulation of the First Comprehensive National Development Plan in 1962, establishing the New Comprehensive National Development Plan in 1969, Third Comprehensive National Development Plan in 1977, the Fourth Comprehensive National Development Plan in 1987, and the Grand Design for the 21st Century in 1998. Under these medium to long-term plans, infrastructure has been developed in line with the needs of the times (Figure 1-2-27).

Figure 1-2-27 First Comprehensive National Development Plan

	First Comprehensive National Development Plan	New Comprehensive National Development Plan	Third Comprehensive National Development Plan	Fourth Comprehensive National Development Plan	Grand Design for the 21st Century
Cabinet decision	October 5, 1962	May 30, 1969	November 4, 1977	June 30, 1987	March 31, 1998
Background	1 Transition to rapidly growing economy 2 Overpopulated city issues and widening income gaps 3 Income doubling plan (Pacific Belt Zone Initiative)	1 Rapidly growing economy 2 Concentration of population and industries in major metropolitan cities 3 Progress in informatization, internationalization, technological innovation	1 Consistently growing economy 2 Signs of decentralization of population and industries 3 Finiteness of land resources, energy and the like that became visible	1 Overconcentration of population and various functions in Tokyo 2 Serious employment problems in regions outside metropolitan areas due to rapid changes in industrial structures 3 Progress of full-scale internationalization	1 Global era (global environmental issues, fierce competition, exchanges with Asian nations) 2 Era of depopulation and aging 3 Era of advanced computerization
Target year	1970	1985	About 10 years from 1977	Around 2000	From 2010 to 2015
Basic goal	Balanced development between regions	Rich environment creation	Development of an integrated human living environment	Multipolar distributed national land building	Laying of groundwork for multiaxial national land structure formation
Development method, etc.	Site-based development method It is necessary to diversify industries to achieve the goal of realizing balanced development between regions. To this end, we facilitate deployment of development bases that relate to the existing concentration areas such as Tokyo and cause them to communicate organically through transportation and communication facilities to influence each other and, at the same time, push forward chain reaction development, leveraging the characteristics of the surrounding areas.	Large-scale development project initiative By establishing transportation networks such as Shinkansen and expressways to drive forward large-scale projects, correct the eccentric use of land and resolve overpopulation/depopulation and regional gaps.	Settlement initiative While restraining the concentration of population and industries in major metropolitan areas, revive other regions to counter overpopulation/depopulation problems, aiming to facilitate balanced use of land in Japan and create a total environment for human inhabitation.	Exchange network initiative Build a multipolar and diversified national land by (i) pushing forward regional development with ingenuity and devices, leveraging regional characteristics, (ii) developing main transportation, information and communications systems by the hand of government or promoting the development across Japan based on the government's leading guidelines, (iii) creating various opportunities for exchanges in coordination among national and local governments and private sector organizations.	Participation and coordination -Land development with participation by various entities and regional coordination- (Four strategies) 1 Create nature rich residential areas (e.g., small cities, regions of farming and fishing villages, hilly and mountainous areas) 2 Renovate metropolitan areas (Fix, renew and utilize urban spaces) 3 Form regional cooperation corridors (groups of regional coordination on the axis) 4 international spheres of interactim on a large scale (formation of areas with international exchange functions)

Source) MLIT

(Major port and harbor development)

Around the time when the First Comprehensive National Development Plan was formulated, seaside industrial zone, centering on the development of Kashima Port and other industrial ports, was constructed including formation of industrial complex, mainly for the heavy industry, in the Pacific belt zone.

Subsequently, in order to cope with closer international exchanges, international ports including Tokyo Bay, Osaka Bay, and Ise Bay were developed. Also, container transportation appeared in Japan in the late 1960s and developed rapidly to form the current international marine container transportation networks.

(Infrastructure development with hosting of Tokyo Olympic)

The hosting of the 18th Olympics Games in Tokyo was decided by the 56th International Olympic Committee (IOC) General Session held in Munich, West Germany on May 26, 1959.

Large-scale infrastructure development was conducted mainly in Tokyo over a five-year preparation period leading up to the 1964 Tokyo Olympic Games (the 1964 Games), which provided many high quality infrastructure developments.

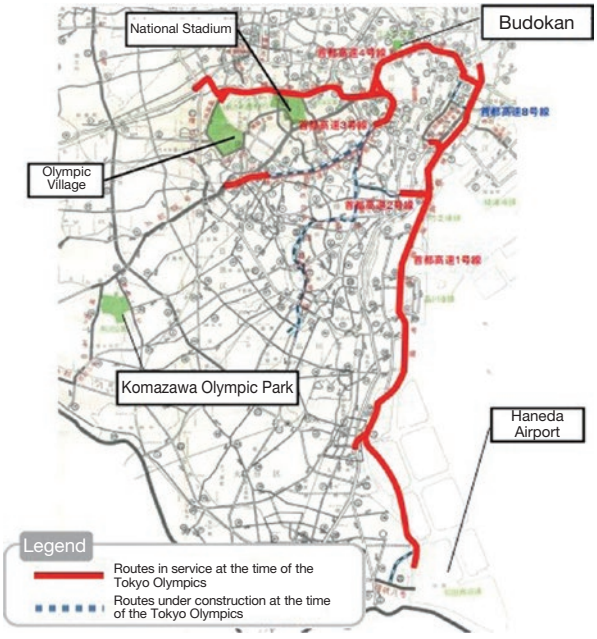
In order to receive Olympians, officials and visitors from in and out of Japan for the Olympic games in which 93 countries and approximately 5,000 players participated during the 15-day period from October 10 to 24, 1964, transportation networks including the Metropolitan Expressway and Tokaido Shinkansen were developed and road networks connecting sports grounds in various locations mainly in Tokyo and Haneda Airport were also established. Also, amid increasingly severe environmental pollution problems at that time, sewage and water supply systems in the Tokyo Area were improved dramatically, and the large-scale infrastructures constructed for the 1964 Olympic are high quality assets of present Japan. The overview of infrastructures constructed is as follows.

■ Olympic related roads and the Metropolitan Expressway

Preparations for the 1964 Games, as infrastructure development to secure transportation between sports grounds in the city center and neighboring prefectures and the Olympic Village became a pressing task; Olympic related roads of 22 lines and to lengths of 54.6 km were developed [Note 23].

With regards to the plan and vision of the Metropolitan Expressway, preliminary investigations by Tokyo government started in 1951 and the basic plan was decided and instructed in 1959. However, in order to meet demand for transport between sports grounds in the city center and the Olympic Village, the development of the Metropolitan Expressway was considered indispensable and the construction of five routes (32.9 km) that needed to be built urgently was decided on by the Metropolitan Expressway development committee in December 1960.

Figure 1-2-28 Metropolitan Expressway at the Time of the 1964 Games



Source) MLIT

Note 23 Radial route No. 4 (Aoyama-dori Avenue, Tamagawa-dori Avenue), radial route No. 7 (Mejiro-dori Avenue), circular route No. 3 (Gaien Higashi-dori Avenue), circular route No. 4 (Gaien Nishi-dori Avenue), circular route No. 7 (Kannana-dori Avenue) were newly established/widened and existing Showa-dori Avenue (radial route No. 12, No. 19) was turned into a multi-level crossing.

Since completion in a short period of time was required, spaces above existing roads, rivers, moats, and water channels were used as much as possible to minimize land purchases. Starting with the opening of route No. 1 (about 4.5 km between Kyobashi and Shibaura) in December 1962, four routes (32.8 km) Note 24 were opened to traffic by the 1964 Games in just five years from the start of planning (Figure 1-2-28).

■ Tokaido Shinkansen (Bullet Train)

Because of economic growth, Tokai-do Line at that time was in a tight supply situation for transportation of both passengers and cargos. Therefore, the study committee on main national railways was established in 1957, which started examining measures to enhance transportation capacity, focusing on Tokaido Line.

The study committee compiled a report in July 1958 and decided that construction of a separate line by AC electric power to enhance transportation capacity of Tokaido Line was necessary, and the Japan National Railways was to manage the new line together with the existing railways.

The dream super express Tokaido Shinkansen, which connected Tokyo and Shin-Osaka (515 km) in about four hours Note 25, started operation in October 1, 1964, in time for the 1964 Games, taking just five and a half years from the construction start in 1959 with construction expenses of 380 billion yen.

The growth of Tokaido Shinkansen has influenced the subsequent development of other New Shinkansen lines. In the wake of Tokaido Shinkansen, the Sanyo, Tohoku, Joetsu, Hokuriku, Kyushu, and Hokkaido Shinkansen lines have been developed in sequence. Shinkansen development has led to further economic growth of Japan.

■ Development of subway

Subway were developed before the war and the line between Asakusa and Ueno Note 27 (about 2.2 km), which was the base of the Ginza Line Note 26, was opened in 1927 as the first subway in the East.

Although Tokyo was hit by air strikes during World War II, the subway suffered relatively small damage compared to other means of transportation.

As post-war reconstruction progressed, population concentrated in Tokyo and securing a means of transportation for commuting to work and schools was an issue. However, Toden streetcars, which were the main means of transportation at that time, were always congested and hopes were put on the development of subway. In 1954, the Marunouchi Line opened between Ikebukuro and Ochanomizu (6.4 km), and Hibiya Line, part of which started operation in 1961, opened the whole line between Nakameguro and Kitasenju (20.3 km) to traffic (Figure 1-2-29) in August 1964, just in time for the 1964 Games.

Figure 1-2-29 Opening of Hibiya Line

Source) Adachi Museum

Note 24 Route 8 (100 m) was not in service at the time of the 1964 Games.
Note 25 Time required when it was opened (about 2 hours and 30 minutes as of March 2016)
Note 26 Ginza Line became the official name in December 1953.
Note 27 The whole Ginza Line was opened in 1939.

■ Tokyo International Airport (Haneda Airport) and Tokyo Monorail

Tokyo International Airport (Haneda Airport [Note 28]) was opened as "Tokyo Airport" in 1931 as Japan's first civil aviation airport. In October 1945 after the end of World War II, however, the Allied Forces banned Japan's production and operation of aircraft.

The Allied Forces returned most of the facilities in 1952, extension of runways and construction of aircraft parking aprons were conducted in sequence, and the airport was renamed as Tokyo International Airport.

In 1964, overseas travel by Japanese was liberalized and Haneda Airport started such services as an arrival terminal dedicated for domestic flights and former Runway C.

Since the congestion in the area between Haneda Airport and the city center had been a problem and introduction of railway access to the airport was hoped for, the construction of Tokyo Monorail was decided in order to prepare for the 1964 Games successfully.

Figure 1-2-30 Opening Ceremony of Tokyo Monorail

Source) Tokyo Monorail Co., Ltd.

The construction works started in May 1963 and in just one year and four months, Tokyo Monorail that connects Monorail Hamamatsucho Station, located adjacent to JR Hamamatsucho Station, and Haneda Airport Station, located right under the former Haneda Terminal Building (13.1 km), was opened to traffic on September 17, 1964, just before the opening of the 1964 Games (Figure 1-2-30).

■ Water supply system development

In the 1960s, water-purification facilities were built across Japan, but water demand increased as convenient and comfortable living spread and as the economy grew rapidly. Therefore, water shortages occurred year after year since 1958. An especially severe time of water shortage happened at the time of the 1964 games, called the "Tokyo Olympic Water Shortage" in which water supply in Tokyo was restricted by as much as 50%, severely affecting daily activities of the public, including laundry and cooking at shops and homes, queues waiting for water trucks, and the spread of food poisoning due to deteriorating sanitary conditions (Figure 1-2-31).

Figure 1-2-31 Emergency Water Supply at the Time of Tokyo Olympic Water Shortage

Source) Tokyo Waterworks Historical Museum

After the Tokyo Olympic Water Shortage, a plan to transmit water from Tone River was pushed forward, resulting in water resource development facilities like channels and dams, such as Musashi Channel between Tone River and Arakawa River in 1965, and an extension of water supply pipes was implemented in earnest. On the other hand, water demand continued to increase.

Note 28 The official name is Tokyo International Airport and Haneda Airport is a common name.

■ Sewerage system development

In association with population concentration and industrial development, water pollution of public water areas, such as rivers and lakes became severe from around 1955 due to discharged water from homes and factories.

In accordance with the so-called "36 report" submitted in 1961 by the Tokyo city planning special sewerage system investigation committee, medium and small-sized rivers severely polluted by discharged water from factories and homes were covered and Shibuya River was covered in 1964 located near the 1964 games fields (Figure 1-2-32).

Subsequently, with the revision of the Sewerage Service Act in 1970, sewerage systems served important roles of preserving water quality of public water areas in addition to making cities clean.

Figure 1-2-32 Shibuya River under Covering Construction

Source) Shibuya Folk and Literary Shirane Memorial Museum *Regional history told by Shibuya River Haru-no-Ogawa*

(Succession of Olympic legacy)

As described above, large-scale infrastructure development took place leading up to the 1964 Games. For the 2020 Tokyo Olympics and Paralympic Games, games will be conducted in the Heritage Zone, which includes venues constructed for the 1964 Games, and the Tokyo Bay Area Zone, to be newly constructed mainly in bay areas.

The construction of the Olympic Village to be established in the Harumi area (Chuo Ward, Tokyo), has already started with participation of private-sector business operators.

The coastal region reclaimed in the Edo period is booming on the back of expectations for improved convenience of life due to infrastructure development for the hosting of the 2020 Games [Note 29].

Edo, which was called a water city, had active water transportation and the revitalization of water transportation, such as touring and restaurant ships from Tokyo Port and rivers, will be promoted for the 2020 Games.

As for road development in consideration of the 2020 Games, National Route 357 Tokyo Bay Tunnel was opened in March 2016, and a walking event was held one week before the opening. Road development will be conducted in sequence by the 2020 Games.

Note 29 For example, residential land of Chuo Ward, Tokyo rose 9.7% in "2016 official land price" from the previous year.

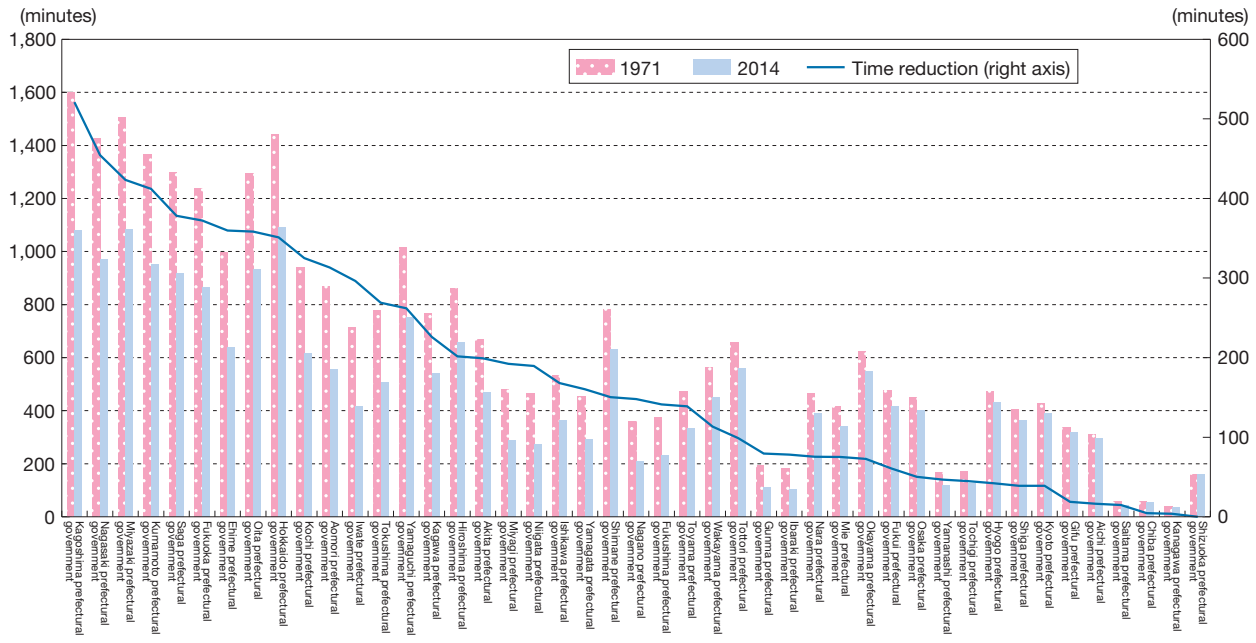
(Upholding economic growth through infrastructure development)

As described above, post-war Japan implemented large-scale construction of social infrastructure, which serves as the foundation of our lives today, and thereby supported not only people's lives but also the economy.

Transit times trimmed by the development of transportation networks offer an easy-to-understand example of the economic effects brought by infrastructure development.

When comparing times needed to transport freight from the MLIT office (Tokyo) to prefectural governments in over the 40 years from 1971 to 2014, the time needed is reduced by up to 500 minutes (Figure 1-2-33).

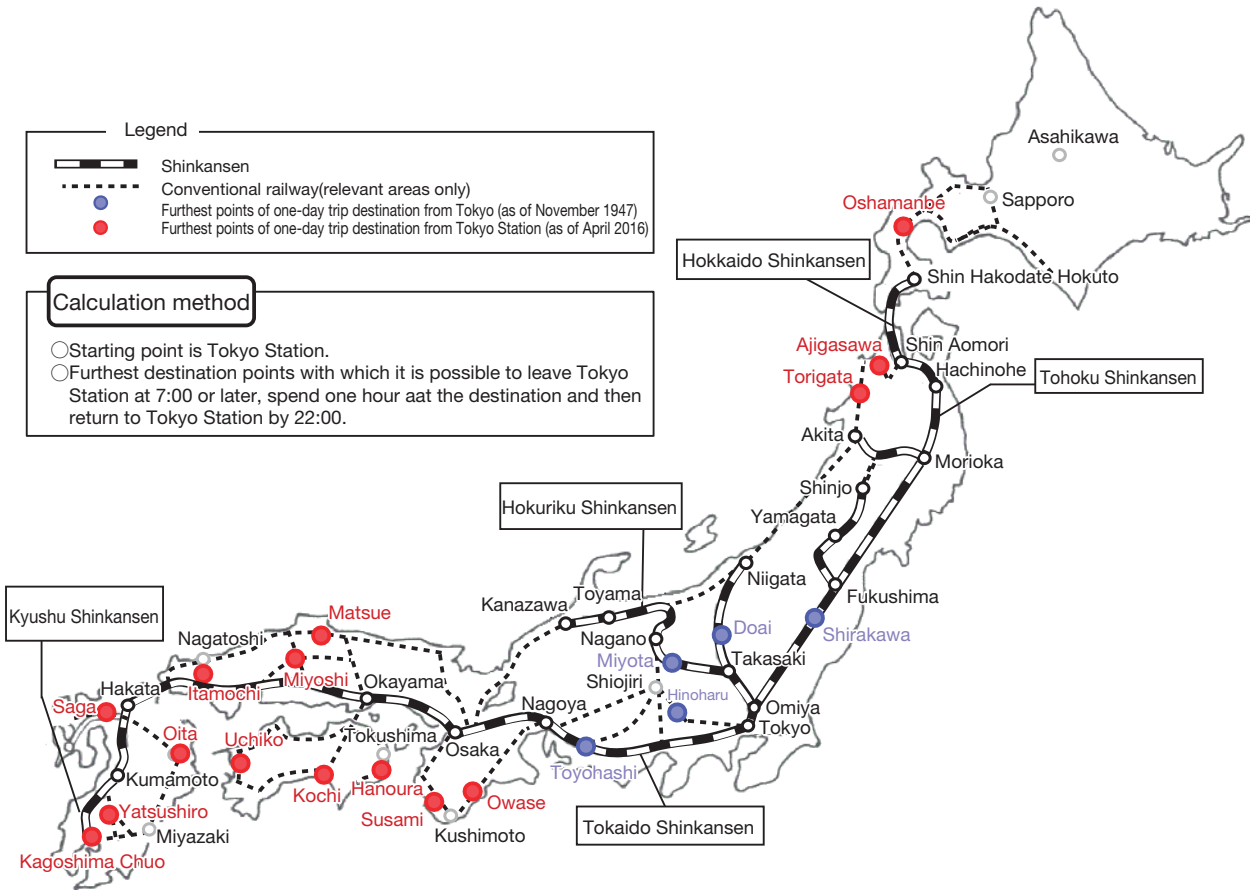
Figure 1-2-33 Time Needed to Transport Feight from Tokyo to Prefectural Governments



(Notes) 1 Measurement of the time needed to transport a 10-ton freight aboard a large truck from the location of the MLIT (Kasumigaseki, Chiyoda City, Tokyo) to a prefectural government office by way of a road network.
2 The difference between 1971 and 2014 lies in road network; the other conditions, such as travel speed, are the same.
3 For transportation time for Hokkaido, Tokushima, Kagawa, Ehime, and Kochi in 1971 and Hokkaido in 2014, the cargo transportation time was calculated based on the time on terries in addition time by roads
4 Tokyo and Okinawa were excluded.
Source) MLIT, "National Integrated Transport Analysis System (NITAS) ver. 2.3."

Also, we can see that the area of one-day round trip from Tokyo by railway expanded dramatically during a period from 1947, right after the World War II, to now (Figure 1-2-34).

Figure 1-2-34 One-Day Trip Zone from Tokyo Station by Railway



Source) Developed by the MLIT from Toshihiko Miyake "Reprint Edition-Train Timetable during and after War, November 1947" for November 1947, and "Yahoo Japan! route search" for April 2016.

Obviously, enhanced transportation networks resulting from the development of express highways, express railways, and the like have cut the transit times drastically. Such infrastructure development supported Japan's economic growth to become one of the world's biggest economies.

As described above, infrastructure development by Ieyasu Tokugawa centered around Edo Castle in the Edo period was the base of current Japan. Also, various infrastructures that support Japan's economic activities nowadays were constructed in the period of war reconstruction and high economic growth period.

Infrastructure constructed in the past exists as legacy assets, and has greatly contributed to the economic growth of Japan.

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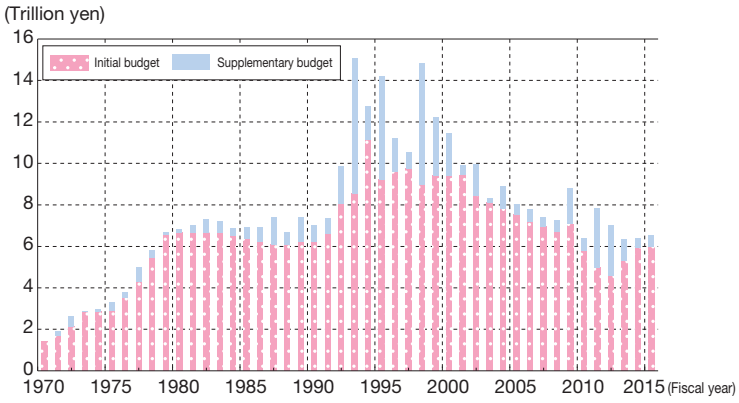
(3) Changes in infrastructure investment

(Changes in public works-related expenses (general account))

After the surge in the 1970s, public works-related expenses stayed flat in 1980s and then got back on a rising trend, peaking in the mid-to-late 1990s before declining, and have been almost flat since around 2013 (Figure 1-2-35).

Figure 1-2-35 Changes in Public Works-Related Expenses (General Account)



(Note) Expenses relating to restoration and reconstruction from the Great East Japan Earthquake are recorded in special account for the Great East Japan Earthquake from 2012 and not included in public works-related expenses.
Source) Developed by the MLIT from MOF "Fiscal Statistics"

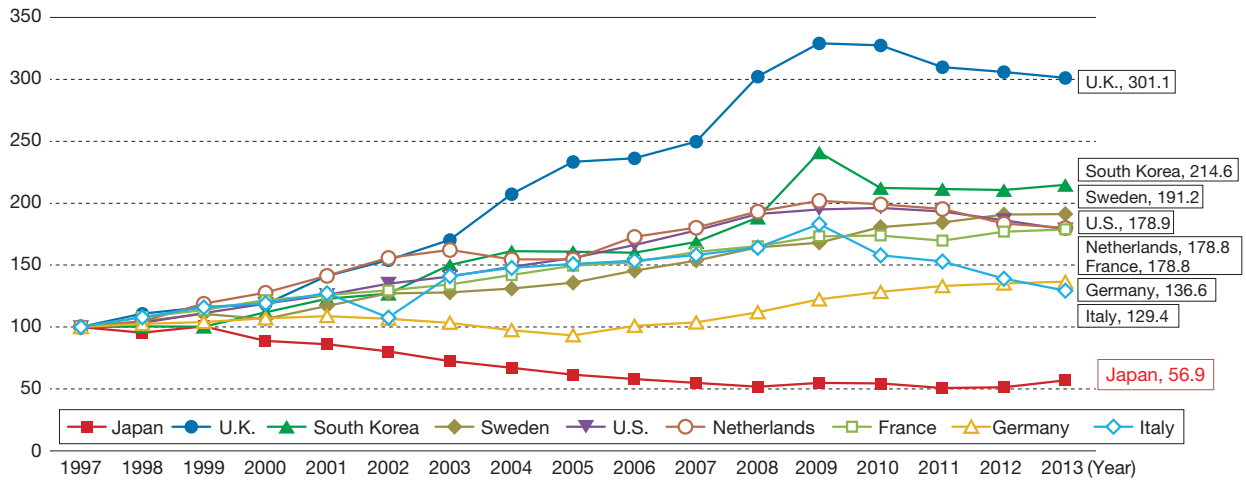
(International comparison of infrastructure standards)

Comparison between Japan's public investment trends with that of other countries is as follows.

Changes in gross general government general fixed capital formation, having 1997 figure as baseline, indicate that while other major OECD countries are on an increasing trend, only Japan shows continued declines and is hovering at around 50 in recent years (Figure 1-2-36).

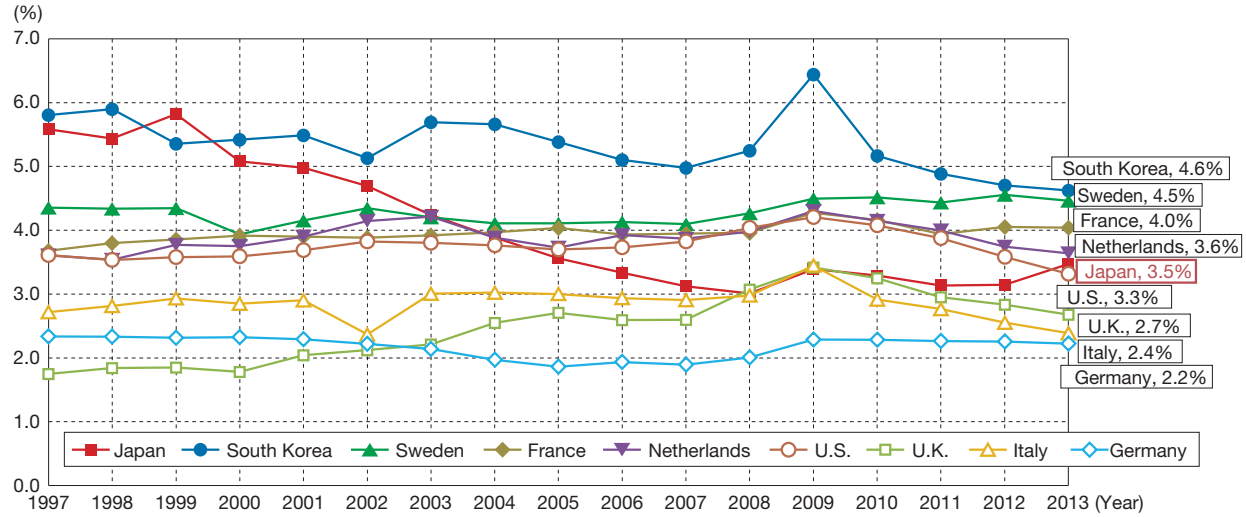
Also, the ratio of gross general government fixed capital formation to GDP for each year shows that Japan's level of investment was high compared to other nations in late 1990s but has been at the same levels as other major developed countries since 2000 (Figure 1-2-37).

Figure 1-2-36 Changes in General Governmental Public Fixed Capital Formation (1997 = 100)



(Notes) 1 All values indicated are normal.
2 For the U.K. in 2005, the effect of the assumption of the assets and debts of British Nuclear Fuels Limited (BNFL) by the central government (approximately 14 trillion pounds) are excluded.
3 Since there is no available data for gross fixed capital formation of Germany and France (from 1997 to 2008), gross capital formation data is used for all years.
4 Data based on 08SNA for Japan and data based on 93SNA for other nations.
Source) Developed by the MLIT from OECD Stat. Extracts "National Accounts" for countries other than Japan and from "Fiscal 2014 National Accounts (2005 basis, 93SNA)" (Authentic Information) compiled by the Cabinet Office for Japan.

Figure 1-2-37 Charges in the Ratio of Public Investment (Ig/GDP) in Major Advanced Nations



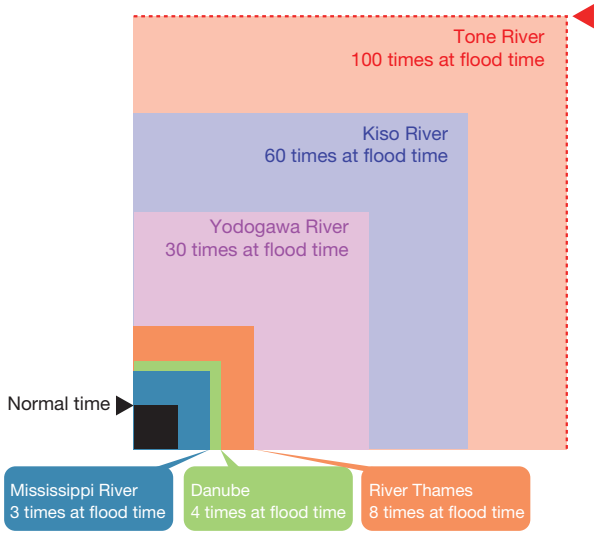
(Notes) 1 All values indicated are normal.
2 For the U.K. in 2005, the effect of the assumption of the assets and debts of British Nuclear Fuels Limited (BNFL) by the central government (approximately 1.4 billion pounds) are excluded.
3 Since there is no available data for gross fixed capital formation of Germany and France (from 1997 to 2008), gross capital formation data is used for all years.
4 Data based on 08SNA for Japan and data based on 93SNA for other nations
Source) Developed by the MLIT from OECD Stat. Extracts "National Accounts" for countries other than Japan and from "Fiscal 2014 National Accounts (2005 basis, 93SNA)" (Authentic Information) compiled by the Cabinet Office for Japan.

(Poor land and severe natural conditions that are expensive)

As described above, when looking at Ig/GDP ratio, Japan's public investment amount is at the same level as those of major OECD member countries; however, it is difficult to determine whether the level is high or low by comparing nations that have different territorial structures and are in different stages of infrastructure development.

As Japanese rivers are precipitous and short, their flow suddenly increases at times of heavy rains. While comparison of normal time flow and flood time flow shows that the increase is eight times for the River Thames, four times for the Danube and three times for the Mississippi River, that of Japanese rivers generally changes significantly—100 times for Tone River, 60 times for Kiso River, and 30 times for Yodogawa River (Figure 1-2-38).

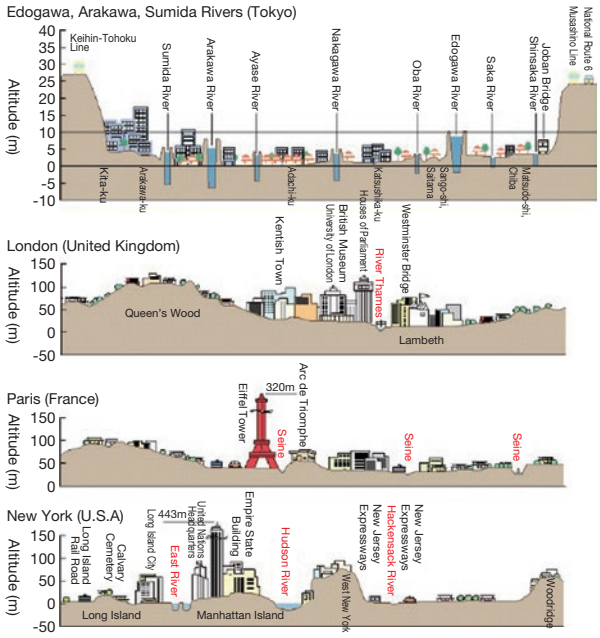
Figure 1-2-38 Flow Comparison Between Flood Time and Normal Time



Source) MLIT

Furthermore, much of the land where people live is lower than the river level at times of flooding (Figure 1-2-39). Therefore, flooding rivers tend to cause severe damage to people's lives.

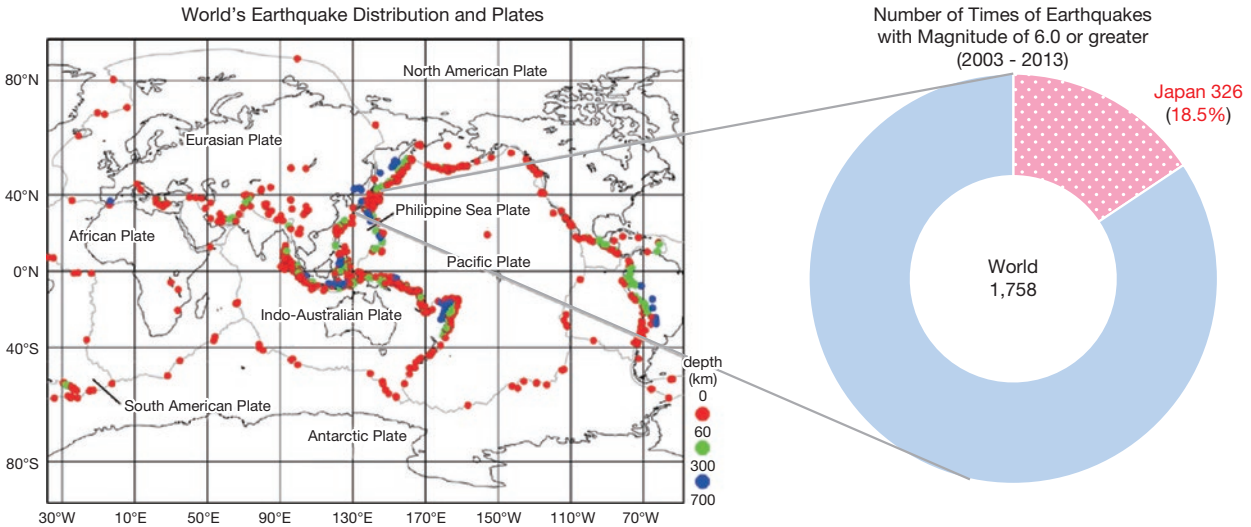
Figure 1-2-39 Cities' River Water Levels



Source) MLIT

As for earthquakes, about 20% of world's earthquakes with magnitude of 6.0 or greater occur around Japan (Figure 1-2-40).

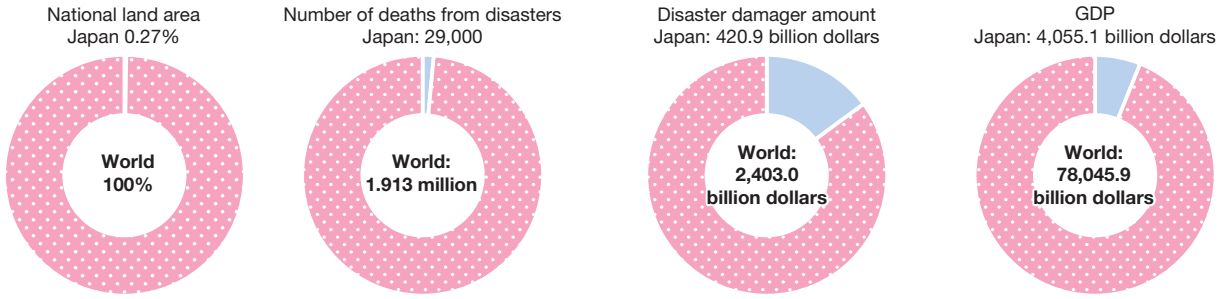
Figure 1-2-40 Worlds Earthquake Distribution



Source) Developed by the MLIT from Cabinet Office "2014 White Paper on Disaster Management"

Besides floods and earthquakes, Japan is prone to such natural disasters as typhoons, rainfall disaster, torrential snows, sediment-related disasters, tsunami, and volcanic disasters, accounting for about 20% of the global total amount of disaster damage, although Japan's land area makes up only 0.27% of world's land area (Figure 1-2-41).

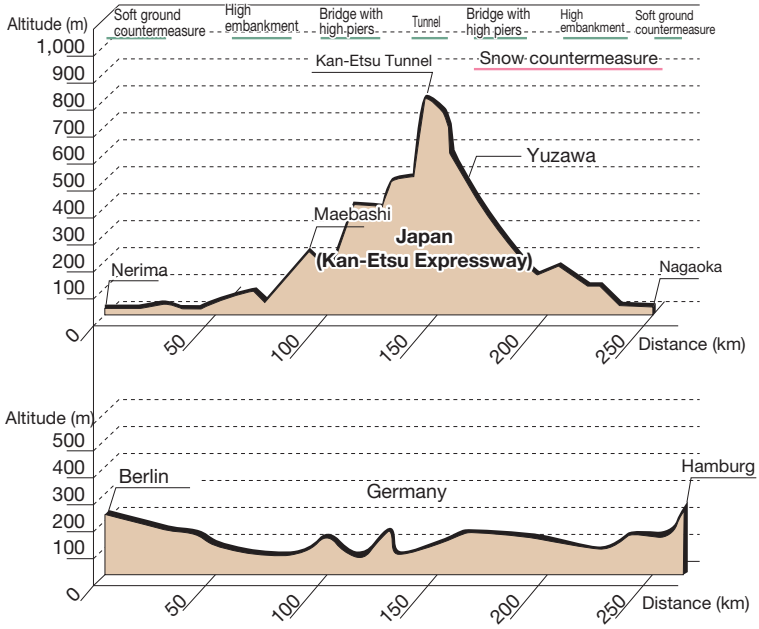
Figure 1-2-41 Japan's National Land Area, Number of Deaths from Disasters, Disaster Damage Cost, and GDP in the World



(Note) Numbers of deaths and disaster damage amounts are 1984-2013 total; land area and GDP figures are of 2014 data.
Source) Developed by the MLIT from Cabinet Office "2014 White Paper on Disaster Management" and MIC "World Statistics 2016"

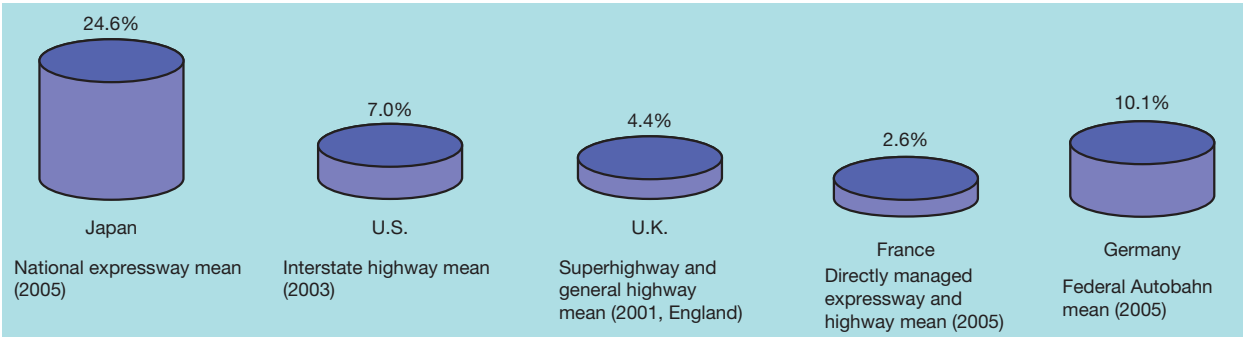
Also, in terms of landform, Japan has a high ratio of structures including bridges and tunnels compared to other nations (Figure 1-2-43) to deal with steep landforms with many mountains and rivers (Figure 1-2-42).

Figure 1-2-42 Difference in Landform between Japan and Germany and Expressways



(Note) As of 1998
Source) Topographical map of the Geospatial Information Authority of Japan, Michelin "Motoring Atlas Europe"

Figure 1-2-43 Comparisons of the Proportion of Structures by Country



(Note) Proportion of structures = (Bridge beam length + Tunnel length)/Total length
Source) Survey by Infrastructure Development Institute

Since Japan needs to adopt construction methods that take into consideration its specificity based on such harsh natural and land conditions, it tends to incur larger costs for infrastructure development compared to other nations. Therefore, caution must be exercised when comparing public investment amounts of Japan with those of other nations.

2 Current Status of Infrastructure Development and Aging

(Comparison of infrastructure development of major countries)

Although harsh natural and land conditions of Japan compared to other nations make it difficult to make appropriate comparisons, in the area of flood control, levee control coverage is low compared to the levels of other nations at about 69% (Figure 1-2-44). Since heavy rains have caused flood damage in recent years, infrastructure development, including robust infrastructures, is considered necessary going forward.

Figure 1-2-44 Infrastructure Development Status of Major Countries

Area	Indicators	Japan Current level	Japan Target in early 21st century	Status of Other Nations U.K.	Germany	France	U.S.
Sewerage	Sewage treatment population dissemination rate Note 1	77.6% Note 2 (End of FY 2014)	—	97% ('10)	96% ('07)	82% ('04)	74% ('07)
	Cities with population of 1 million or more	99.1% Note 2					
	Cities with population of less than 50,000	49.6% Note 2					
City parks	Per capita area covered by urban plans	Japan 10.2 m² Tokyo 4.4 m² (End of FY 2014)	About 20 m²	26.9m² London ('97)	27.9m² Berlin ('07)	11.6m² Paris ('09)	52.3m² Washington D.C. ('07)
Home	Per capita floor area Note 3	39m² ('13)	—	46m² ('13)	46m² ('10)	44m² ('06)	61 m² Note 4 ('13)
	Floor area per home Note 3	94m² ('13)	—	96m² ('13)	101m² ('11)	100m² ('06)	131m² ('13)
	Owner-Occupied houses	122m²	—	103m²	130m²	120m²	157m²
	Rental Housing	46m²	—	68m²	78m²	74m²	114m²
Roads	Arterial High-Standard Highways Extension Note 5	11,050 km (End of FY 2014)	Almost completed 14,000 km network	3,641km ('13)	12,917km ('13)	11,552km ('13)	103,029km ('13)
	National High-Grade Trunk Highways extension per 10,000 units	1.40 km (End of FY 2013)	—	1.08km ('12)	2.69km ('12)	3.01km ('12)	4.15km ('12)
	Total road length (width: 5.5 m or above) Note 6	341,509 km (End of FY 2012)	—	420,346km ('12)	643,517km ('12)	1,062,683km ('12)	6,539,718km ('12)
	Road density Note 6	0.90 km/km² (End of FY 2012)	—	1.73km/km² ('12)	1.80km/km² ('12)	1.94km/km² ('12)	0.67km/km² ('12)
Flood control	Flood Control Safety Goals Note 7	1/200	—	1/1,000	—	1/100	About 1/500
	Levee development coverage Note 8	Arakawa River About 69% (As of March-end 2016)	—	River Thames (Storm surge) Complete ('83)	—	Seine Complete ('88)	Mississippi River Downstream levee Development coverage About 93% ('11)
Railway	Rate of Congestion	165% Tokyo Area (FY 2014)	By 2020 150%	149% London ('91)	—	152% Paris ('91)	71% New York ('91)
Aviation	Airport development status (number of runways) in world's major metropolitan areas Note 9	Tokyo Narita 2 Haneda 4 Total 6 Osaka Kansai 2 Itami 2 Kobe 1 Total 5	Tokyo Narita 3 Note 10 Haneda 4 Total 7 Osaka Kansai 2 Itami 2 Kobe 1 Total 5	London Heathrow 2 Gatwick 2 Stansted 1 Luton 1 City 1 Total 7 ('13)	Berlin Tegel 2 Schönefeld 1 Total 3 ('13)	Paris Charles de Gaulle 4 Orly 3 Total 7 ('13)	New York JFK 4 Newark 3 LaGuardia 2 Total 9 ('13)
Ports and harbors	Quay of 16 m water depth level in service (number of berths) Note 11	12 Note 12 ('15)	—	3 ('15)	23 Note 13 ('15)	6 Note 12 ('15)	20 Note 13 ('15)

(Notes) 1 Status of foreign countries are quoted from OECD ENVIRONMENTAL DATA COMPENDIUM
2 FY 2012-end is excluded because there were municipalities that could not be surveyed in Fukushima due to the effects of the Great East Japan Earthquake. The end of FY 2012 sewage treatment population dissemination rate for Japan is the figure of 46 prefectures after excluding Fukushima.
3 The floor area is adjusted to a calculation from the center of walls where such adjustment is possible (Germany and France × 1.10, U.S. × 0.94).
4 The floor space of the U.S. is median value and detached houses and mobile homes are in the scope.
5 Japan: national high-grade trunk highways, U.K.: motorways, Germany: autobahn, France: auto routes, U.S.: interstate highways, other freeways and expressways.
6 Total road length (width: 5.5 m or more) and road density data are quoted from WORLD ROAD STATISTICS 2012 (IRF).
7 The annual probability of flood overrun targeted for water control facilities. However, the data is the annual probability of tidal wave overrun for the River Thames.
8 The ratio of levees constructed to those required under river improvement plans.
9 According to the latest AIP Aeronautical Information Publication.
10 With respect to crosswind runways, based on the conclusion of a round-table discussion, it will be proposed to regions after investigating environmental impacts and the like upon completion of parallel runways. Until then, it will be developed as surface roads.
11 Values organized by the MLIT from websites of ports, Containerization International Yearbook, and other materials.
12 Some data include the number of berths whose water depth is less than 16 m and provisionally in service.
13 Because of data restrictions, some data include the number of berths whose water depth is less than 16 m.
Source) MLIT

(Aging social infrastructures)

In Japan, those infrastructures that have been built after the period of rapid economic growth, including Tokyo Metropolitan Expressway Route 1 which was laid after the 1964 Tokyo Olympic Games, are forecast to get need replacement simultaneously in the future, with the proportion of facilities that will reach 50 years of age or older in 20

years to increase at an accelerating pace.

As described in Section 1, fiscal condition of Japan is expected to become severer as the population declines and ages, but renewal expenses estimated at about 3.6 trillion yen for FY 2013 are expected to increase by about 30% to 50% to 4.6-5.5 trillion yen in 20 years' time (Figure 1-2-45).

The MLIT developed aging countermeasures, marking 2013 as the Starting Year of Infrastructure Maintenance Activity. In November of the same year, the Basic Plan for Life Extension of Infrastracture by government was formulated, and relevant ministries are developing action plans starting with the MLIT's Action Plans for Life Extension of Infrastructure established in May 2014. Also, municipalities are formulating action plans for a period through FY 2016.

We need to ensure strategic maintenance so that we can balance securing the safety of existing social infrastructure and reduction and leveling of total costs through execution of the plans.

Figure 1-2-45 Maintenance and Renewal Expenses and Aging of Social Infrastructure

Estimated Costs of Maintenance/ management and renewal

Fiscal year	Estimated result
FY 2013	About 3.6 trillion yen
FY 2023 (In 10 years' time)	About 4.3-5.1 trillion yen
FY 2033 (In 20 years' time)	About 4.6-5.5 trillion yen

*1. The number of facilities falling in each of the 10 fields of social infrastructures (roads, flood control, sewer systems, ports and harbors, public housing, parks, coasts, airports, aids to navigation, governmental facilities) over which the MLIT has jurisdiction and that are managed by the state, local public entities Regional Road Public Corporations or Japan Water Agency, an incorporated administrative agency, has been checked by year of initial construction for estimation, with records of their maintenance/management, renewal, etc. taken into account.
*2. New construction and removal are not considered because they are difficult to estimate.
*3. Regarding functional improvements when renewing facilities, the assumption is to renew with similar functions (however, improvements to meet quake-resistance standards and the like are included).
*4. It does not include the land cost and compensation cost, natural disaster relief expenditure
*5. Since maintenance and renewal unit cost and renewal timing vary among social infrastructures for such reasons as differences in the degree of damage stemming from different location conditions of facilities, the estimations are shown as ranges.

Present Status of Aging Social Infrastructures

<<Percentage Ratios of Social Infrastructure over 50 Years Old>>

	March 2013	March 2023	March 2033
Highway bridges [About 400 thousand bridges Note 1)(of 700 thousand bridges at least 2m long)]	About 18%	About 43%	About 67%
Tunnel [About 10 thousand tunnels Note 2)]	About 20%	About 34%	About 50%
River management facilities (such as sluices) [About 10 thousand facilities Note 3)]	About 25%	About 43%	About 64%
Sewerage pipes [Total length: about 450 thousand km Note 4)]	About 2%	About 9%	About 24%
Harbor quays [About 5 thousand facilities Note 5)(at least 4.5 m in water depth)]	About 8%	About 32%	About 58%

Note 1) About 300,000 bridges whose year of construction is unknown have been excluded from the ratio calculations.
Note 2) About 250 tunnels whose year of construction is unknown are excluded from the calculation of ratios.
Note 3) Government-managed facilities only, including about 1,000 facilities whose year of construction is unknown. (Since the facilities developed within the last 30 years generally have a documented history, the facilities whose year of construction is unknown have been sorted as being 50 years or older.)
Note 4) The figure includes approximately 15,000 km whose year of construction is unknown (since pipes laid within the past 30 years generally have records, pipes whose year of construction is unknown are treated as those aged 30 years or over and their length proportionally distributed in the ratio of construction by documented number of years elapsed.)
Note 5) About 100 quay facilities whose year of construction is unknown are excluded from the calculation of ratios.

Source) MLIT

3 Relationships with Infrastructure and Productivity, moving toward a productivity revolution

The MLIT will make all-out efforts on productivity revolution, positioning 2016 as the Starting Year of Productivity Revolution. We examine the effects that land, infrastructure, transport and tourism administration, especially infrastructure, have on productivity and economic growth.

The effect of infrastructure development consists of flow and stock effects. Flow effect is the short-term effect of expanding the overall economy as public investment projects create economic activities including production, employment, and consumption. Stock effect is the medium- to long-term effect that continues as infrastructures are accumulated and function as social overhead capital, which includes various effects, such as productivity improvement. Up until now, the focus when discussing effects of public investment tended to be short-term flow effect; however, it is important to look at the inherent stock effect of infrastructures. Stock effects will be explained in more details in chapter 2.

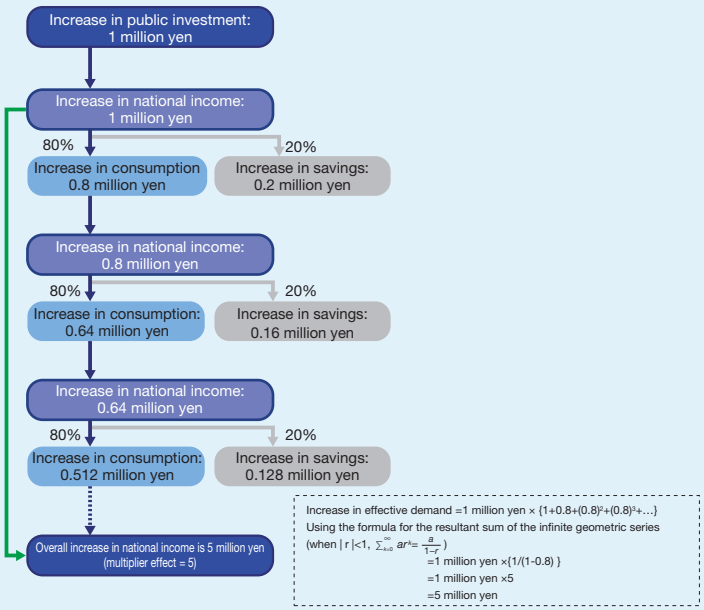
Column

Has the multiplier effect been diminishing?

There is a multiplier effect as one of flow effects of public investment. The multiple effect means that not only the public investment becomes a final demand and expands the economy, but also the increase in public investment influences consumer spending, etc. and boosts GDP in the end (Figure 1-2-46).

It is sometimes said that the multiplier effect is representative of the economic effects of public investment, but the multiplier effect originally refers to merely the things generated in the process in which the amount of public investment increases employee incomes, eventually leading to a rise in consumption. That is, the multiplier effect is different from the production inducement effect Note 1 caused by public investment, and does not include the economic effects gained from the combined use of the infrastructure at all. We need to pay attention to these points.

Figure 1-2-46 Flows o Multiplier Effect (image)



Source) Developed by the MLIT from Tsutomu Miyagawa, Miho Takizawa (2011) "Graphic Macro Economics 2nd Edition"

As for this multiplier effect, it is said that the figure has been falling in recent years, but there are indications that in the macro-econometric model in the early 70s and earlier, the importance of the supply block and financial block was not recognized, so the model was constructed in which multiplier controls by price hikes or financial aspects were not counted at all, and the comparison of the multipliers in the same structure models in the 80s and 90s showed almost no change in the multipliers (theses by persons involved in the development of the models in the former Economic Planning Agency Note 2).

Note 1 The effect refers to when an investment is made in a part of the industry sector, not only production of the relevant industry sector increases, but also through procurement of raw materials and equipment, the effects influence other industry sector directly or indirectly, and cause a rise in their production.

Note 2 Masahiro Hori, Susumu Suzuki, and Osamu Kayasono (1998) "Tanki nihon keizai makuro keiryo moderu no kozo to makuro keizaiseisaku no koka" ["The structure of macro-econometric model in the short-term Japanese economy and the effects of macro economy policies"]. Economic Research Institute, Economic Planning Agency. *Economic Analysis, 157*.

(Productivity is the key to economic growth)

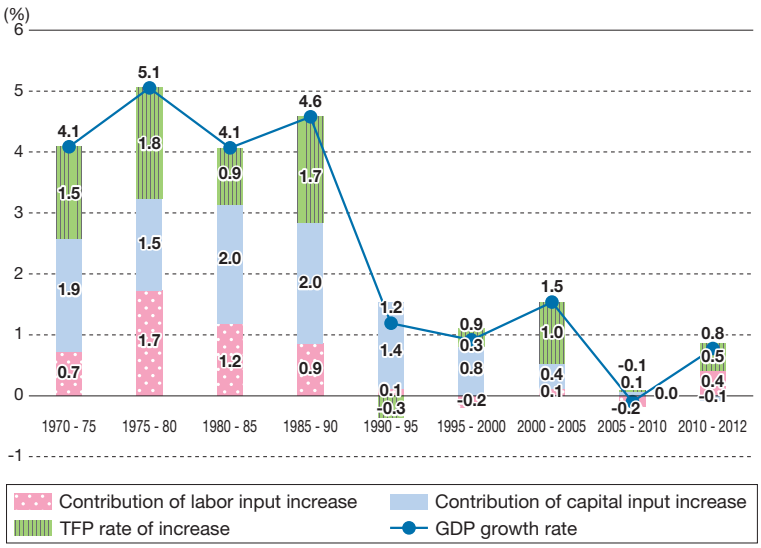
There are three factors that create economic growth: (i) labor, (ii) capital, and (iii) total factor productivity (TFP) Note 30.

Note 30 This is defined as "balance after excluding contribution of labor input and capital input from the growth in total production" and specifically includes changes in technological innovation and resource allocation, as well as qualitative changes in labor or capital (e.g., enhanced ability of laborers through training, capital investment in cutting-edge information technologies).

The analysis of economic growth of Japan by growth accounting [Note 31] shows that contributions of capital and TFP were larger than those of labor (Figure 1-2-47).

Also, comparisons between the GDP growth rate and the rate of increase in labor force during the period from 1956 and 1970, in the high economic growth period, show that the average annual rate of increase in labor force was only about 1.4% compared to the average annual growth rate of about 9.6% for real GDP, and it reveals that the rapid growth did not depend on the increase of labor force only [Note 32]. While productive-age population, which constitutes the labor force, is expected to decrease by close to 1% annually during the 20-year period until 2030, the above data indicates that it is possible to achieve economic growth with the declining population going forward if the decrease in labor force can be compensated by capital accumulation and productivity improvement [Note 33]. Therefore, it is important to be conscious of productivity on the condition of ensuring security and safety in order to support economic growth going forward.

Figure 1-2-47 Changes in Growth Accounting

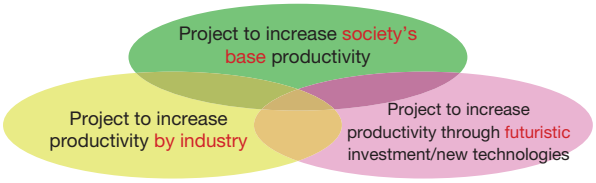


Source) Developed by the MLIT from Research Institute of Economy, Trade and Industry "JIP Database 2015"

(Productivity Revolution Projects)

The MLIT is working on productivity improvement through individual projects from three approaches: (i) projects for increasing society's base productivity, (ii) projects for increasing productivity by industry, and (iii) projects for increasing productivity through futuristic investment/new technologies (Figure 1-2-48).

Figure 1-2-48 Productivity Revolution Project (Three Approaches)



Source) MLIT

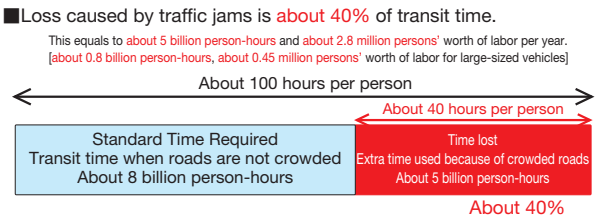
Note 31 Growth accounting is a technique by which the sources of economic growth are broken down into an increased capital stock, increased labor population, and higher TFP to determine quantitatively which of the three sources contributes most to the economic growth. Assuming a Cobb-Douglas production function based on Y: GDP, A: technology level, K: capital stock, L: labor quantity, α: capital share and 1-α: labor share, GDP can be stated in an equation as $Y = AK^{\alpha}L^{(1-\alpha)}$. After taking the log of both sides and differentiating with respect to time, it will be stated as $\frac{\dot{Y}}{Y}=\frac{\dot{A}}{A}+\alpha\frac{\dot{K}}{K}+(1-\alpha)\frac{\dot{L}}{L}$ (Y, A, K, L is respectively differentiated with respect to time) and GDP growth rate can be resolved into three elements: technological advancement, increase in capital stock, and growth in labor force.

Note 32 Calculated based on "Japanese Economy 2014-2016" by the Cabinet Office, and "2005 Trade White Paper" by the Ministry of Economy, Trade and Industry.

Note 33 According to the estimates by the selective future committee (Figure 1-1-4), even with population declines, there will be about a 1% difference in real GDP growth rates between the production increase scenario and the flat productivity scenario.

For example, if we look at the projects for increasing society's base productivity, Japan's economic society has many inefficiencies and wastes. Specifically, as shown in Figure 1-2-49, about 40% of road transit time is spent in traffic jams, which equals to annual labor force of about 2.8 million persons.

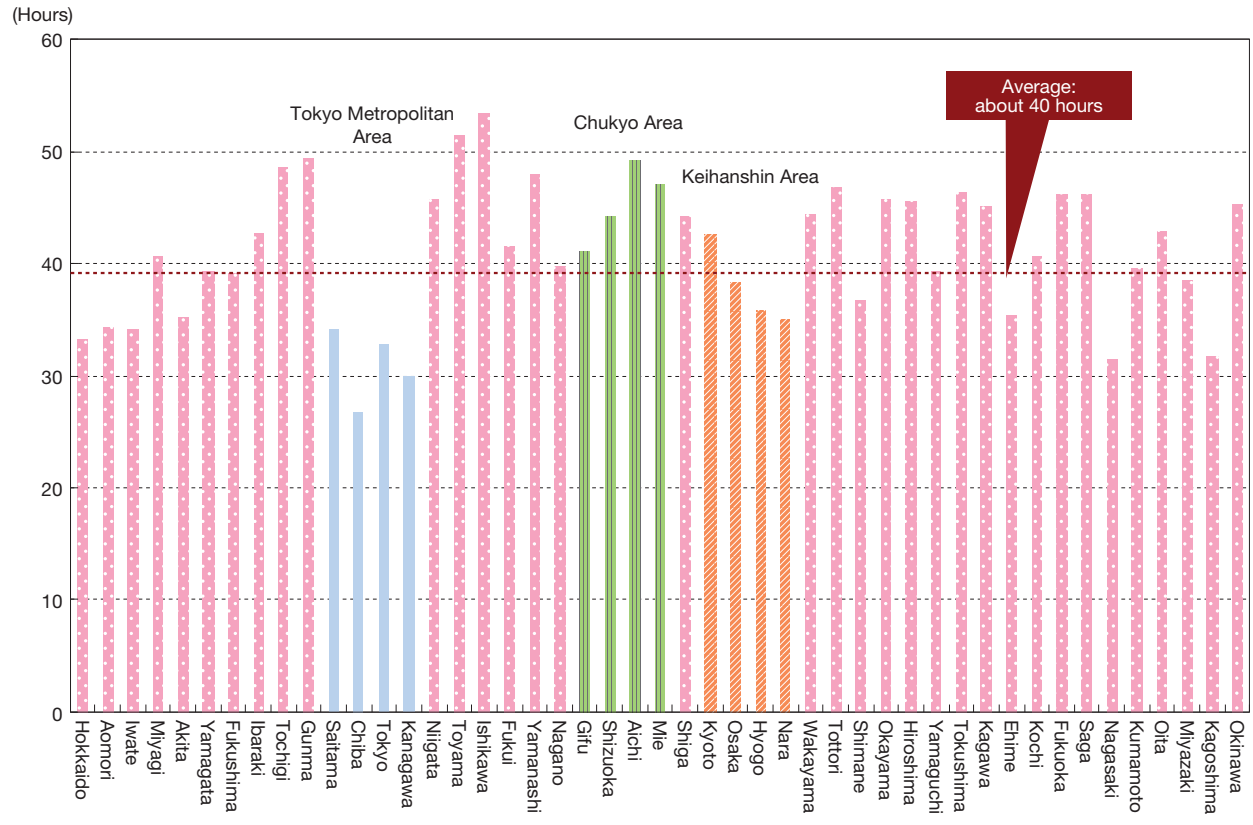
Figure 1-2-49 Scale of Loss from Traffic Jams



Source) MLIT

Since large losses from traffic jams occur also in local regions as well as urban areas, according to the time lost in traffic jams by prefecture per population, it is thought that the resolution of losses from traffic jams will lead to productivity enhancement not only in urban areas, but also across Japan (Figure 1-2-50). Therefore, efforts to enhance society's base productivity, which draw regional potentials to increase productivity of society as a whole, are important.

Figure 1-2-50 Per Capita Time Lost by Traffic Jams by Prefecture



Source) MLIT

Column

Project of productivity revolution 13

Column

The Ministry of Land, Infrastructure, Transport and Tourism (MLIT), in order to promote strongly and collectively its measures for productivity revolution, has established the head office for the revolution within the ministry and is taking measures.

The MLIT has publicized projects that are expected to bring about a certain effect on productivity improvement and are sufficiently matured. As of April 2016, 13 projects have been published.

"Society bases" (i) Pinpoint measures and (ii) wise tolls to solve traffic congestion
(iii) Ports and harbors in the new age of cruises
(iv) "Compact" and "Network"
(v) Optimal utilization of lands and real estates

"By industry" (i) Construction industry, i-Construction
(ii) Housing and lifestyle industry
(iii) Shipbuilding industry, i-Shipping
(iv) Distribution industry
(v) Truck transportation industry
(vi) Tourism industry

"Future oriented" (i) Scientific road traffic safety measures
(ii) Overseas development of high-quality infrastructures considering growth cycles

Some projects are introduced here in some detail (Figure 1-2-51, 1-2-52, and 1-2-53).

Figure 1-2-51 "Society's Base" (iv) "Compact" and "Networks"

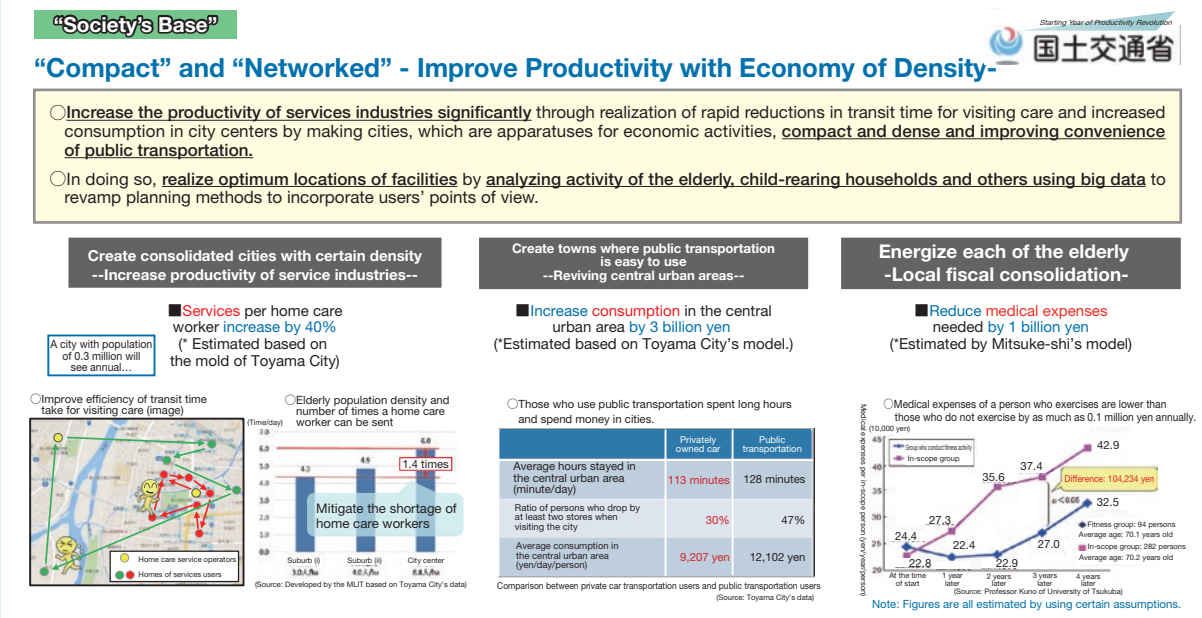


Figure 1-2-52 "By Industry" (iii) Shipbuilding i-Shipping

"By Industry"

Expansion of shipbuilding exports and regional revitalization through i-Shipping

Starting Year of Productivity Revolution 国土交通省

○Promote "i-Shipping" where ICTs are incorporated in all phases from development, building to operation of ships to increase shipbuilding productivity by 50% and aim to realize energy conservation and zero malfunction.

○Increase Japan's share in the world shipbuilding market from 20% to 30%, contributing to GDP expansion, regional economy, and employment.

Current status and issues of shipbuilding

Won the world's No. 1 share in 1956, the largest share won being 50%

→ Fell to third place due to emergence of China and South Korea.

But, Japan still has chances to win.

Japan's share is expanding again amid sluggishness of competitors.

Issue: while Japan leads in productivity, its cost advantage is weak. Energy-saving performance where Japan had advantages was copied and the difference is narrowing.

Inefficiency of the world's ocean trades.

Made-in-Japan products are fuel-efficient with fewer breakdowns.

✓Annual fuel expenses per vessel

About 330 million yen difference between those made by Japan and other countries

(In 25 years of use, the difference amounts to the ship price.)

✓Loss of time due to engine failure: about 200 million yen / time

*In cases of a large tanker

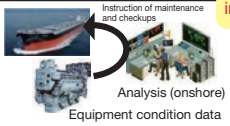
Promote productivity revolution by using advanced information technology in all of design, production, and operation phases.

Expedite new ship model development → Win by performance

Automate production, leverage 3D drawings

Find unreasonableness, inconsistencies, and waste at factories and eliminate them completely by increasing factories' visibility. → Win by cost

Pursue high added value throughout lifetime for customers (shipping operators) → Win by attraction including services



No breakdown with detection made in advance

Figure 1-2-53 "By Industry" (iv) Logistics Industry

"By Industry"

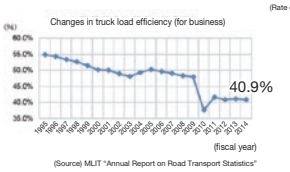
Logistics productivity revolution worked on with all-out efforts of Japan

Starting Year of Productivity Revolution 国土交通省

- Various inefficiencies occurred in Japan's logistics in recent years, such as the truck-loading ratio that declined to 41%. It is necessary to improve productivity to overcome future labor shortages and contribute to economic growth.
- To this end, promote (i) growth accelerating logistics, such as truck business reforms with cooperation of shippers and early realization of automated aligned group run, and (ii) logistics that enhance living through package deliveries that are easy to receive. Targets are being examined with the idea of increasing labor productivity in logistics business by about 20%.

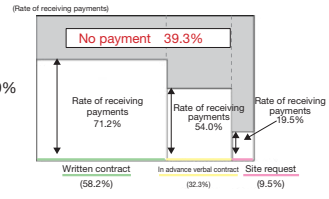
Situations surrounding Japan's logistics

■About 60% of truck transportation capacity are unused

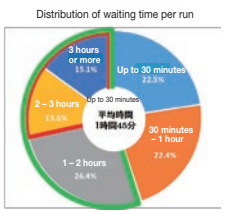


(Source) MLIT "Annual Report on Road Transport Statistics"

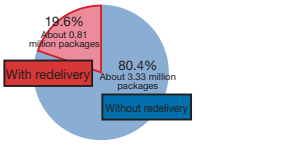
■About 40% of cargo operation are unpaid



■Almost 2 hours of waiting occur per run



■About 20% of deliveries are redelivery



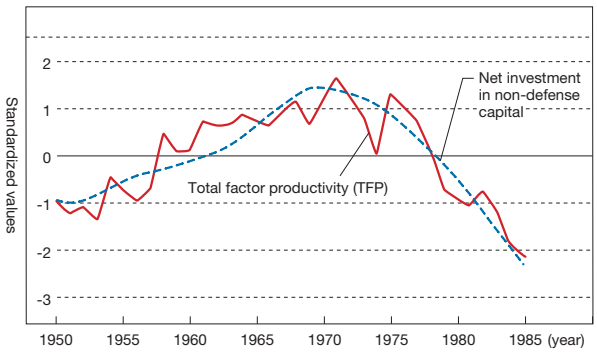
■At least 70% of road trucks cannot enter indoor parking lots of 3 m high ceiling

(Source: 2015 field survey by Japan Tracking Association)

(Correlation between accumulation of social capital and TFP--Answer to the Productivity Puzzle--)

While it is very important to build up productivity increases at project levels, various researches are conducted also on the productivity boosting effect of social capital stock accumulated by public investment (productivity effect), from a macroeconomic perspectives. Research using Japan's data by prefecture has been conducted since the 1970s and such research progressed globally after the 1989 paper by Aschauer "Is Public Expenditure Productive?" Note 34. The U.S. at that time did not know the cause for slowing pace of TFP growth after the 1970s (so-called "productivity puzzle") Note 35 and the research hoped to produce an answer to that.

Figure 1-2-54 Analysis of the Effect of Social Capital Productivity Increase by Aschauer



Source) Developed by the MLIT from D. Aschauer (1989) "Is Public Expenditure Productive?"

The paper by Aschauer carries the stacked bar graph of changes in TFP and net assets of social capital (assets less capital consumption) in the United States after 1950 (Figure 1-2-54). Although we cannot immediately conclude that the growth in social capital stock led to increased TFP based on the research results, it should be noted as indicating the productivity effect of social capital.

(Productivity effect of social capital)

In Japan, there are multiple past researches on the productivity effect of social capital stock, and results of such research often show that development of social capital creates positive contributions (Figure 1-2-55).

Figure 1-2-55 Research Example of Productivity Effect of Social Capital in Japan

Researcher	Estimation period	Productivity Effect of Social Capital (value of elasticity)
Iwamoto (1990)	1955~1984	0.238~0.408
	1955~1970	0.055~0.416
	1971~1984	0.314~0.396
Takenaka, Ishikawa (1991)	1955~1985	0.2
Mitsui, Inoue (1995)	1956~1989	0.248~0.316
Hatano (1998)	1955~1995	0.296~0.328
	1955~1989	0.317~0.324
	1955~1984	0.316~0.318
Yoshino, Nakajima, Nakahigashi (1999)	1955~1970	0.203
	1971~1993	0.079
	1955~1993	0.4623
	1955~1970	0.6487~0.8168 (Marginal productivity)
	1971~1993	0.0842~0.2246 (Marginal productivity)
Mitsui, Takezawa, Kawauchi (1995)	1966~1984	0.142~0.214
Okui (1995)	1965	0.053~0.055
	1970	-0.116~0.018
	1975	-0.13~0.034
	1980	-0.049~-0.259

Researcher	Estimation period	Productivity Effect of Social Capital (value of elasticity)
Asako, Sakamoto (1993)	1975~1985	0.159
	1976~1985	0.065~0.144
	1976~1984	0.116
	1977~1985	0.055
	1977~1984	0.177
Okui (1995)	1965~1980	0.072~0.243
Doi (1998)	1966~1993	-0.082
	1975~1993	0.015
	1985~1993	0.254
	1966~1974	0.131
	1975~1984	0.029
Shioji (2005)	1980~1995	-0.37~0.122

Source) Developed by the MLIT from Li, Hongmei (2010) "Literature study on productivity effect of public capital in Japan"

Note 34 Aschauer, D.A. (1989) "Is Public Expenditure Productive?" *Journal of Economics*, vol. 23, pp. 177-200.

Note 35 As for the cause of the decreased rate of TFP growth since 1970s in the U.S., (i) surging energy prices, (ii) entering into the labor market by baby boomers in large numbers with undeveloped skills, and various other factors are pointed out, but none of them was conclusive.