Section 2 Background of imposition of trade restrictive measures

We believe that doubt on free trade, policies and practices that may distort markets, and intensifying competition in the technology field are major factors that exist in the background of the current increase of trade-restrictive measures.

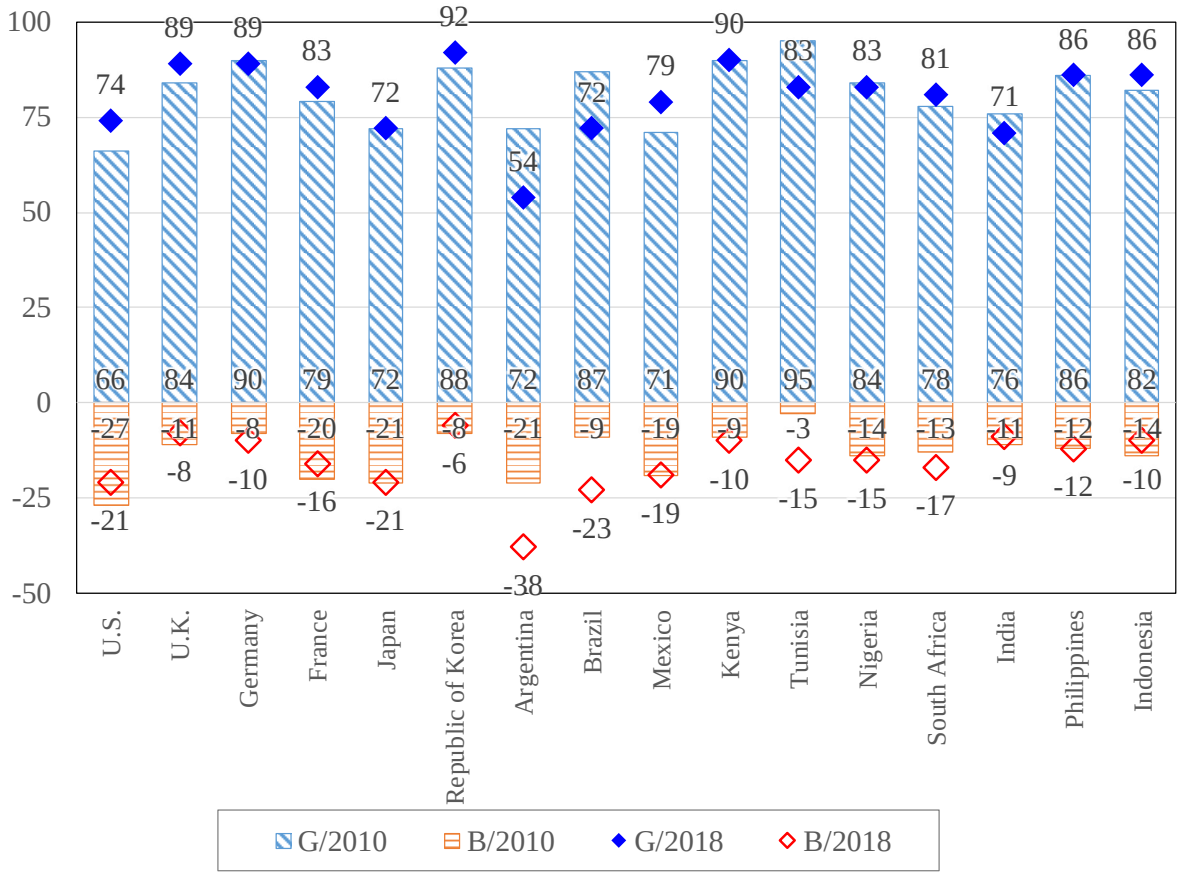
1. Doubt on free trade

Currently, concept and actions toward protectionism have been spreading globally, which are backed by doubt on free trade, especially growing dissatisfaction and concerns that trade would widen an economic gap in the individual countries.

According to a questionnaire survey by a U.S. think tank, more than 80% of the respondents in almost of all the countries answered “Good” to the question “What do you think the growing trade and business ties between (survey country) and other countries is a very good thing, somewhat good, somewhat bad, or a very bad thing for our country?” in 2018. When we compare the above result with a similar survey conducted in 2010, the percentage of the respondent who answered “Good” is at the same level or slightly higher, except for Argentina and Brazil (Figure II-2-2-1-1). Based on the above results, we can conclude that many people in individual country still believe that trade brings benefits to their country’s economy as a whole.

On the other hand, about the question “Does trade with other countries lead to an increase in the wages of (survey country nationality) workers, a decrease in wages, or does it not make a difference?” in the same survey, people in developed countries tend to think that trade leads to a decrease in their wages rather than an increase. On the contrary, when we look at people in emerging/developing countries, more respondents think that trade leads to an increase in their wages. However, when comparing the results in emerging/developing countries in 2014 and those in 2018, the ratio of respondents who think that trade leads to an increase dropped or remained unchanged except for a few countries, which means that expectation that trade could improve their lives is shrinking in emerging/developing countries (Figure II-2-2-1-2).

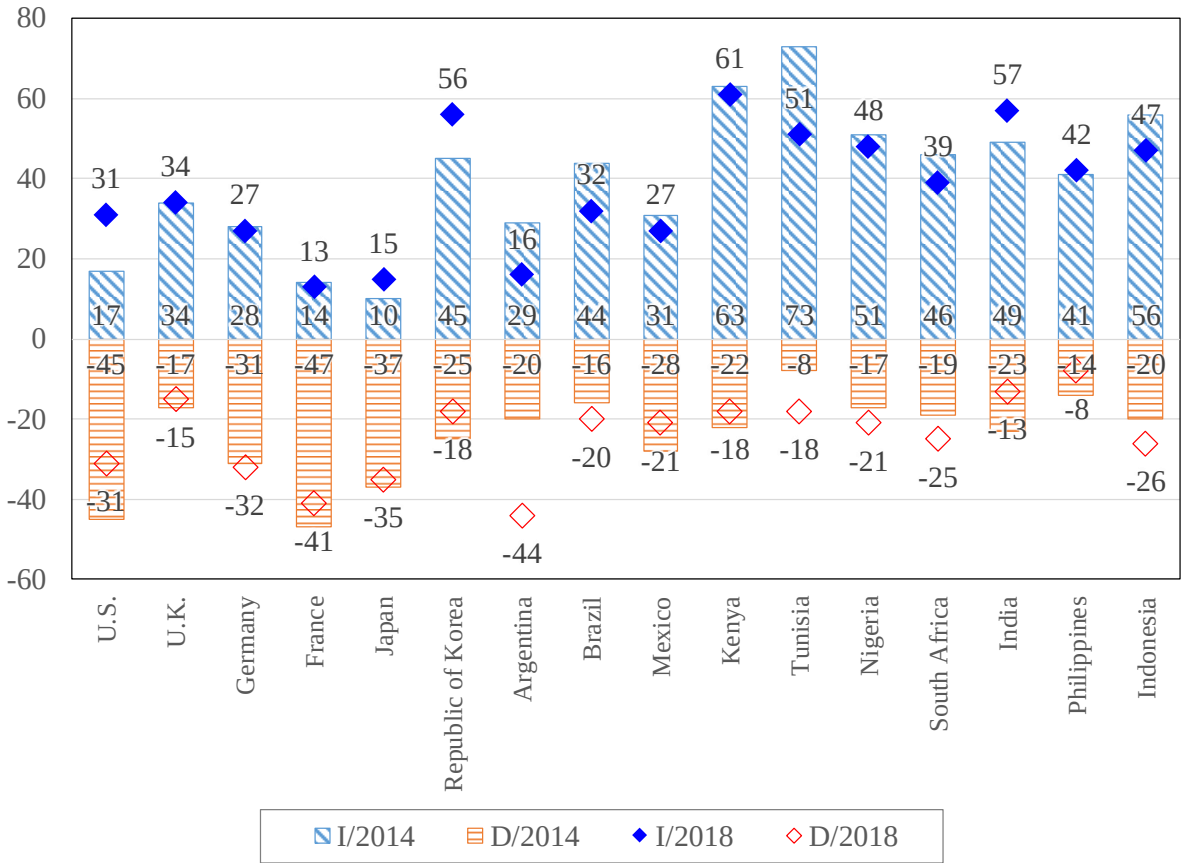
Figure II-2-2-1-1 Whether people think that trade is good or bad for their own country in individual countries



Note: The question is "Q25. What do you think about the growing trade and business ties between (survey country) and other countries - do you think it is a very good thing, somewhat good, somewhat bad, or a very bad thing for our country?"

Source: *Global Attitudes & Trends* (Pew Research Center, 2018).

Figure II-2-2-1-2 Whether people in individual countries think that trade leads to an increase in their wages or not



Note: The question is "Q26. Does trade with other countries lead to an increase in the wages of (survey country nationality) workers, a decrease in wages, or does it not make a difference?."
Source: *Global Attitudes & Trends* (Pew Research Center, 2018).

As explained above, while people in developed countries recognize that trade brings benefits to the economy, many people think that trade does not lead to an increase in their wages, which suggests that there are skeptical views on trade.

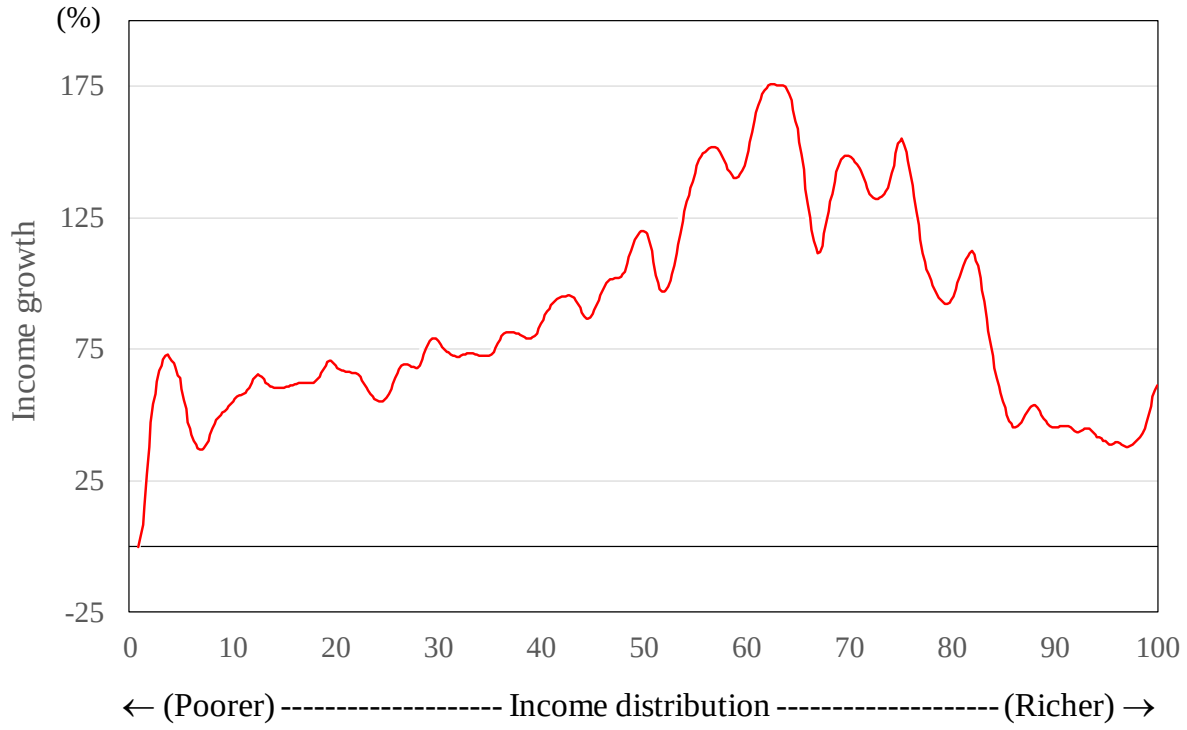
(1) Current global economic gap

"Elephant Curve" is the name given to the chart that shows an increasing ratio of income of people all over the world by income group in the 20 years from 1988when globalization seemed to have been developed the most till 2008 when the global financial crisis occurred. The name of the chart comes from its shape. While it was originally suggested in 2013 by Lakner and Milanovic, both of whom are economists in the World Bank,[79] we use the one produced after modification in response to problems[80]

79 Lakner and Milanovic (2013).
80 Corlett pointed out three problems found in the original elephant curve developed by Lanker and Milanovic: (i) When determining the income percentiles for 1988 and 2008, Lanker and Milanovic extracted samples from different countries; (ii) the population growth rate differs between countries and regions (as the population growth rate of emerging/developing countries is higher than that of developed countries, the entire curve is forced downward); and (iii) special situations in certain countries (such as the "lost decade" in Japan and economic sluggishness in the former Soviet Union

pointed out by Corlett (2016) in the original one developed by Lanker and Milanovic (Figure II-2-2-1-3). The horizontal axis of the chart indicates percentile of global income distribution; the further to the left side a data point is, the lower the income. As income increases, the data point moves to the right. The vertical axis indicates the percent growth in income from 1988 to 2008.

Figure II-2-2-1-3 Elephant curve developed by Corlett



Source: Corlett (2016).

The chart developed by Corlett (2016) shows that while wages increase in all the income percentiles, the growth rate is especially high in (i) the 50% to 70% income percentile which corresponds to the middle class in emerging countries and (ii) the highest percentile that corresponds to the richest class in developed countries. It indicates that the middle class in emerging countries have contributed to narrow the global economic gap. On the other hand, the 80% to 90% percentile that corresponds to the middle class in developed countries show a relatively lower growth rate, indicating that the economic gap between the higher income class and the lower income class may have expanded in some developed countries during this period.

(2) Current condition about gaps among countries

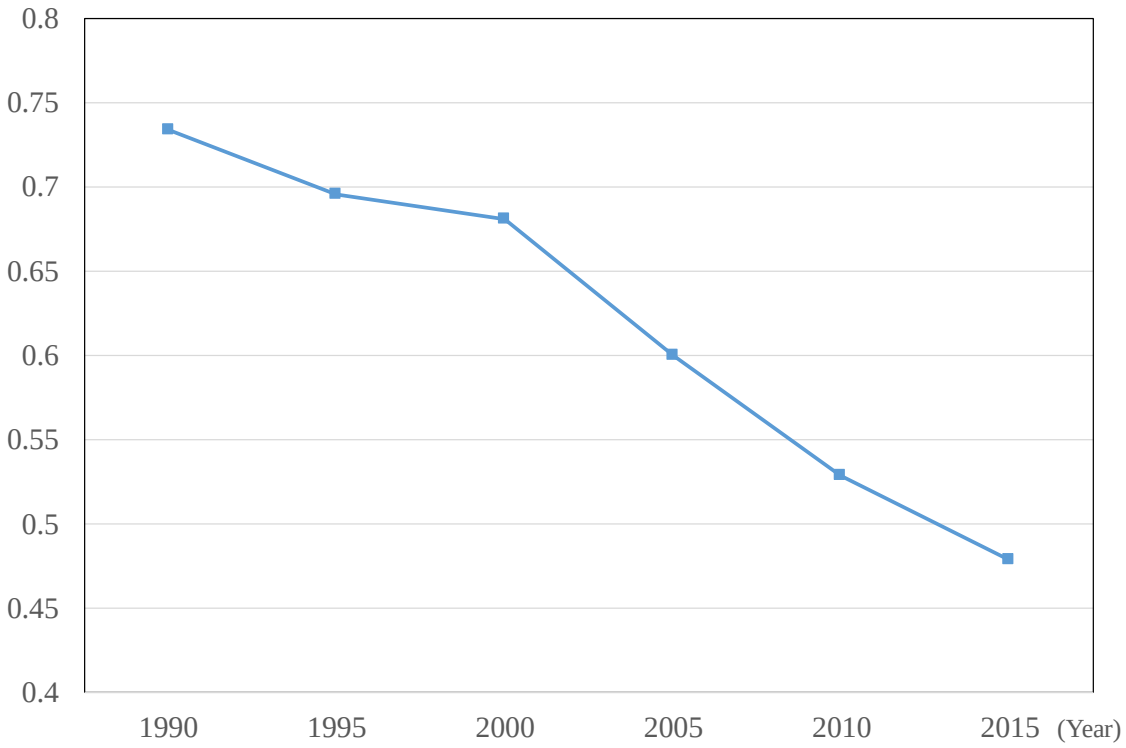
When we look at the economic gap among countries, Gini's coefficient is consistently on a downward trend since 1990, which means that the gap is narrowing (Figure II-2-2-1-4).

When we compare the GDP per capita of each country and the population ratio of each country

countries) pushed down the entire curve. Corlett published a new elephant curve in 2015 that was adjusted in consideration of the bias created by these problems.

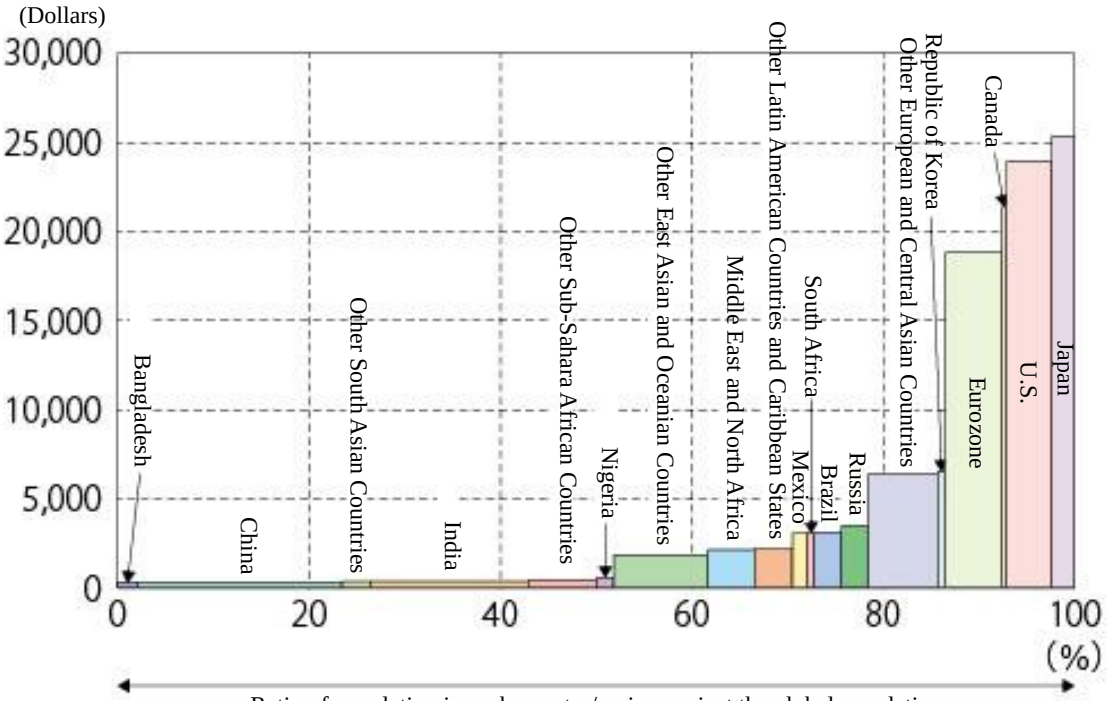
against the global population in 1990 with those in 2017, income has remarkably increased in emerging countries that have large populations such as Asia NIES and China. This is one of the reasons for the above-mentioned peak found in the 50% to 70% income percentile in the elephant curve. While emerging countries have shown remarkable economic growth, countries in Sub-Sahara Africa and South Asia are still left behind (Figure II-2-2-1-5, Figure II-2-2-1-6).

Figure II-2-2-1-4 Trend of Gini's coefficient among countries



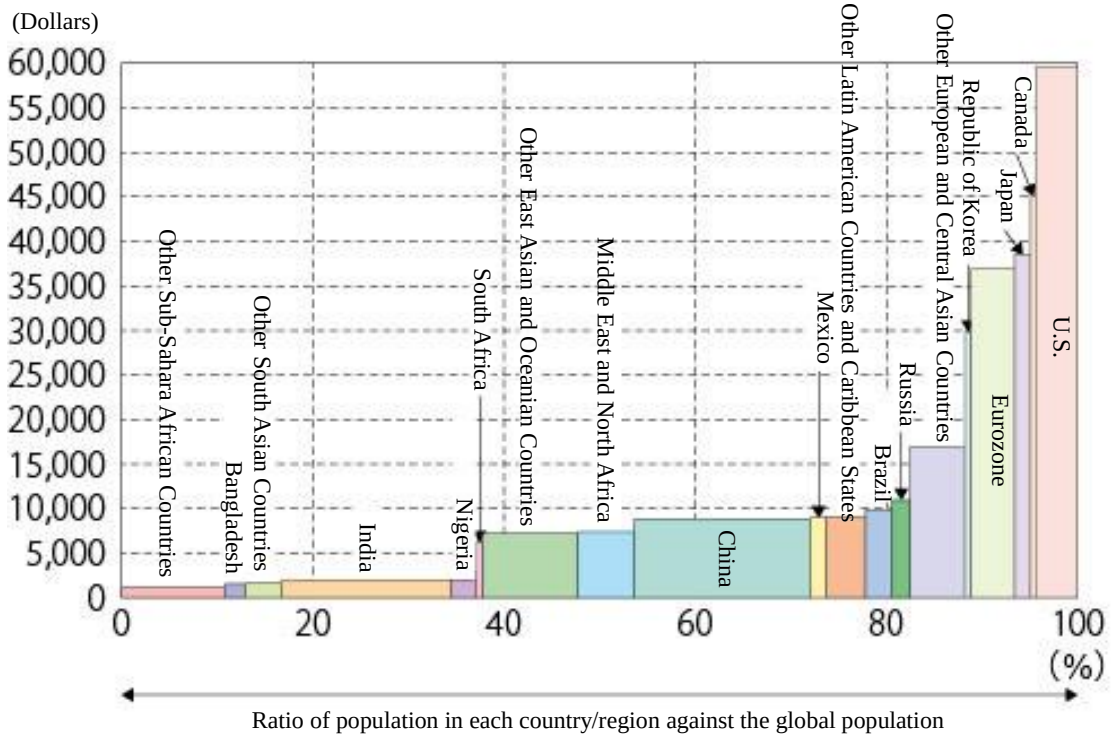
Prepared by the Ministry of Economy, Trade and Industry based on François Bourguignon (2015), p. 42, Table 1.

Figure II-2-2-1-5 Histogram of global GDP (1990)



Source: *World Development Indicators* (World Bank).

Figure II-2-2-1-6 Histogram of global GDP (2017)



Source: *World Development Indicators* (World Bank).

(3) Current condition of domestic gap

For the domestic economic gap in each country, situations are different between developed countries and emerging/developing countries. While the gap is narrowing in emerging/developing countries, the trend switched to expansion in many developed countries since around 2000. For example, Gini's coefficient in the U.S. rose from 0.36 to 0.39 during the period from 2000 to 2016. On the other hand, when we look at the absolute value of Gini's coefficient, while many developed countries have recorded 0.3 to 0.4 recently, emerging/developing countries have shown 0.35 to 0.5. In general, we can figure out there is still a larger domestic gap in emerging/developing countries. Next, we will analyze the factors that lead to a larger gap especially in developed countries by focusing on the effect of globalization and technological innovation.

(i) Impact of trade on labor market

For the impact of trade on the labor market, Stolper-Samuelson theoretically showed in 1941 that wages are equalized by equalizing a relevant price of tradable goods between trading countries (Stolper-Samuelson Theorem). Then, although many analyses have been made using the openness to trade in goods,[81] these only covered the manufacturing industry that produced goods and it was difficult to measure the entire impact on a domestic labor market including the service industry.

Spence and Hlatshwayo (2011) categorized all the domestic industries in the U.S., including the service industry, into the tradable industries and the non-tradable industries, and analyzed impact of trade on the labor market during the period from 1990 through 2008, by using a method of calculating the trade-oriented level of industries developed by Jensen and Kletzer (2005).[82] The result shows that, among the total of 27.3 million of the newly employed in the U.S., 97.7% of workers belong to the non-tradable industries, mainly the medical and government sectors. In the tradable industries, although the number of the newly employed increased in those industries with high wages such as management consulting, financial/insurance, and system design, such increase was offset by a decrease of employment, mainly in the manufacturing industry.

A similar analysis was performed by Philippe and Giraud (2017) in France. The results show that employment dropped by more than one million in the manufacturing and agriculture industries, which are tradable industries, during the period from 1990 through 2015. As a result, employment in the tradable industries was down by 5.8% as a whole.

Although we cannot use the above-mentioned results to derive a cause-and-effect relation that trade directly causes a decrease of employment, we can guess that a decrease in employment in the tradable industries could be a factor expanding a doubt on free trade in developed countries (Figure II-2-2-1-7).

---

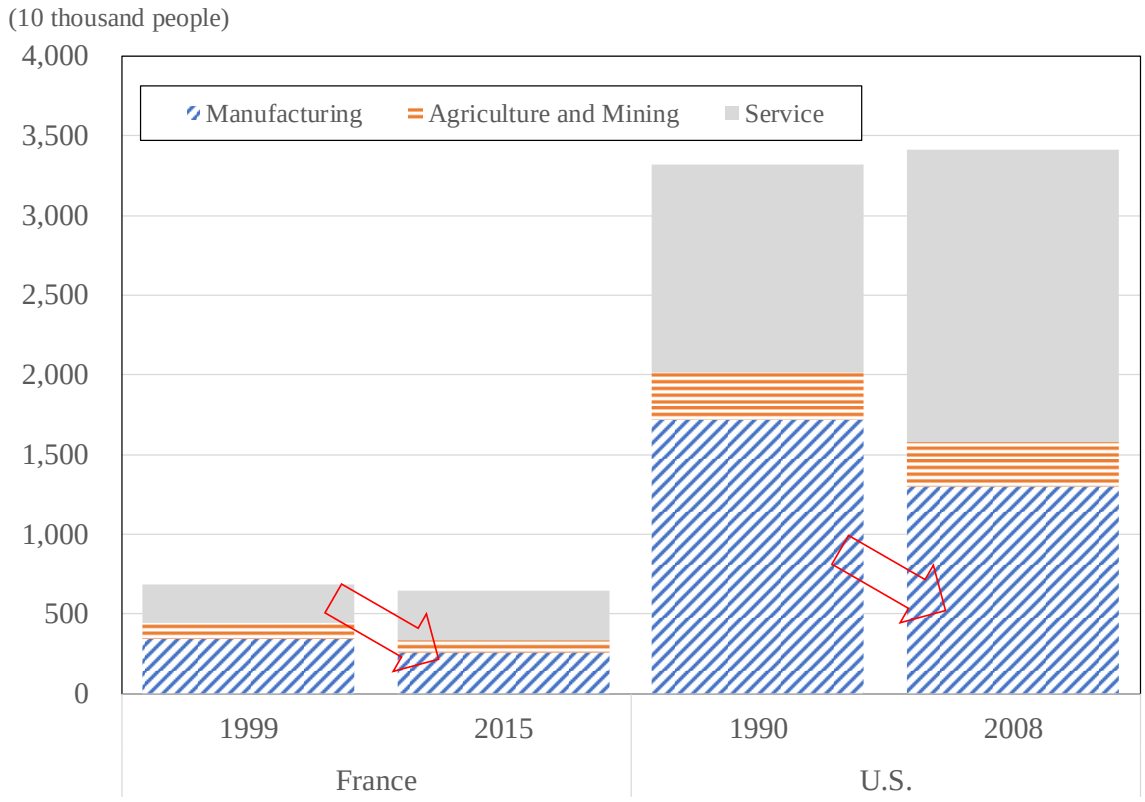
81 The general definition is: Openness to trade = (Export value + Import value) / GDP.

82 As a method to categorize an industry into a tradable industry or a non-tradable industry, Jensen and Kletzer used the geographic concentration of labor in each industry. An industry whose producers concentrate in a specific area could receive the impact of service industries that cannot be checked from trade statistics, rather than the scale of economy due to the concentration or transportation cost of necessary raw materials that could limit consumption activities. Jensen and Kletzer developed a method to analyze such impact.

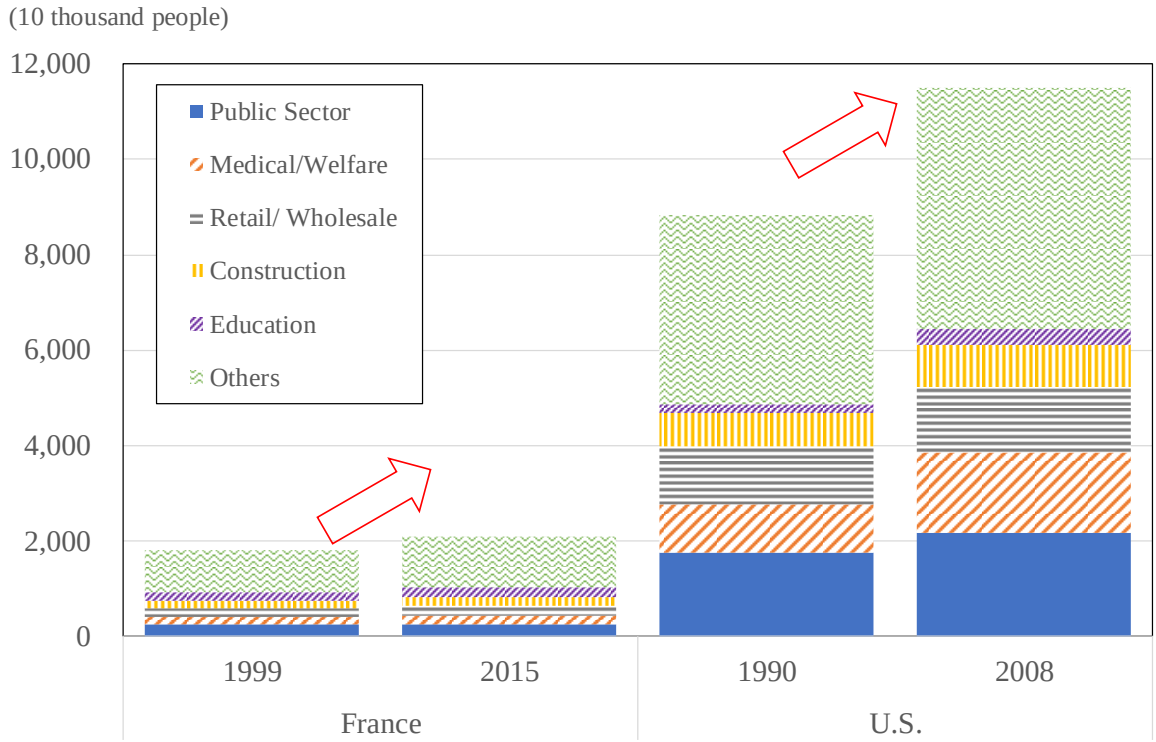
(ii) Impact of technological innovation on the labor market

Analyses of factors expanding economic gap conducted by IMF (2007)[83] and OECD (2011)[84] concluded that technological innovation is a larger factor than globalization in expanding the domestic gap. In the White Paper on International Economy and Trade 2017, we proved that technological innovation is still a major factor to increase the economic gap recently, by using the IMF method (2007)[85] (Table II-2-2-1-8).

Figure II-2-2-1-7 Changes in the number of employees in the tradable industries and the non-tradable industries (France and the U.S.)



83 IMF (2007).
84 OECD (2011).
85 Ministry of Economy, Trade and Industry (2017).



Note: Based on the data for France prepared by Philippe and Giraud (2017) and data for the U.S. prepared by Spence and Hlatshwayo (2011).

Table II-2-2-1-8 Studies on expansion of gap in the past

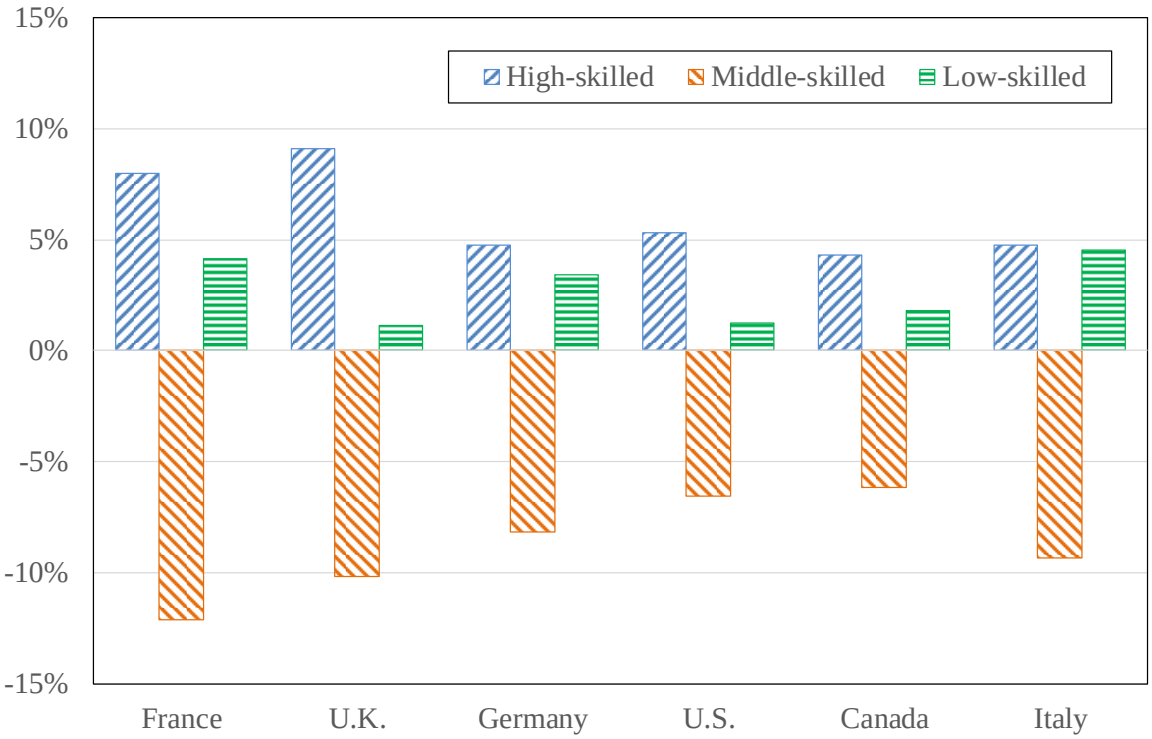
	IMF (2007)	OECD (2011)	METI (2017)
Period	1980 - 2006	Early 1980's - 2008	2001 - 2014
Subject countries	20 developed countries, 31 emerging/developing countries	22 OECD member countries	23 OECD member countries
Dependent variables	Gini's coefficient	The ratio of the highest 10% of labor wages and the remaining 90%	Gini's coefficient
Explanatory variables	Globalization: Foreign direct investment/GDP Technological innovation: ICT/Total capital accumulation	Globalization: Weighted average of import penetration ratio and density Technological innovation: Private R&D expenditures/GDP	Globalization: Foreign direct investment/GDP, trade value Technological innovation: ICT/Total capital accumulation
Conclusion	The most influential factor for expanding the gap is technological innovation. However, when we look only at developed countries, the impact of globalization is larger than that of technological innovation.	Trade does not have a significant effect on a pay differential. On the other hand, technological innovation significantly increases a gap of revenue.	Technological innovation is a factor that expands the gap in developed countries. Trade value is a factor to reduce the gap, like educational policies.

For the impact of technological innovation on the labor market, OECD (2017)[86] explains that a gap expands by replacing middle-skilled workers who mainly work on routine tasks with technologies.

When we look at an employment change rate by skill level of workers in individual countries, while the number of high- and low-skilled workers increases in developed countries, middle-skilled workers decrease, or increase only slightly (Figure II-2-2-1-9).

In emerging/developing countries, except for some countries such as Republic of Korea and Thailand, the number of middle-skilled workers decreases or records a lower growth rate compared to high- and low-skilled workers, which means that the labor replacement by technology can be seen not only in developing countries but also on a global scale (Figure II-2-2-1-10).

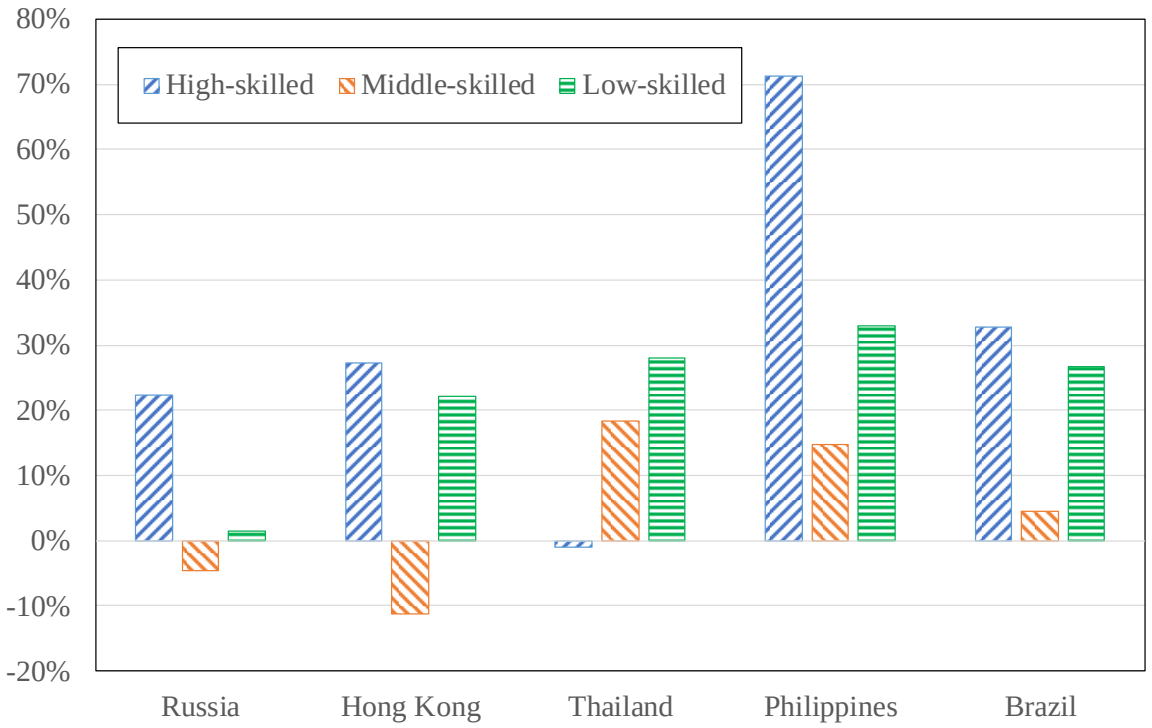
Figure II-2-2-1-9 Employment change rate by skill level in developed countries (from 1995 through 2015)



Source: *Employment Outlook 2017* (OECD), Figure 3. A1.

86 OECD (2017).

Figure II-2-2-1-10 Employment change rate by skill level in emerging/developing countries (from 2005 through 2016)



Source: *Databook of International Labour Statistics* (The Japan Institute for Labour Policy and Training).
Note: Pursuant to the analysis by OECD (2017), high-skilled workers consist of those categorized into ISCO 88 categories 1 to 3, middle-skilled workers are those categorized into ISCO 88 categories 4, 7, and 9, and low-skilled workers ISCO 88 categories 5 and 9.

2. Existence of policies and practices that are suspected to distort the market

Although trade-restrictive measures had been mainly used to protect domestic industry, these are some cases in recent years where they are issued to improve a measure, practice, and/or policy distorting the market that are conducted by a trading partner country. One example is the additional tariff imposed by the U.S. to goods imported from China pursuant to Section 301 of the Trade Act in the context of currently intensifying trade friction between the U.S. and China. Under the multilateral free trade system based on the WTO, if a specific country has conducted a market-distorting measure that breaches the WTO Agreement, such measure should be corrected pursuant to the WTO rules. However, in the current U.S.-China trade friction, backed by an expanding doubt on the function of the WTO, a unilateral measure is conducted to demand correction of policy and practice of the trading partner country.

In this paper, we use the current U.S.-China trade friction as a case study, and check Chinese policies and practices the U.S. regards as problems. The industry support by China that is suspected by the U.S. to distort the market can be broadly categorized into preferential treatment for Chinese companies, and various limitations/restrictions imposed on foreign companies. The former includes

preferential treatment to Chinese companies at the time of government procurement,[87] in addition to financial assistance such as a subsidy, preferential financing, fund supply through sovereign wealth funds, and preferential tax treatment. Measures that are categorized into the latter include technical standards that are unique in China, restricted categories for foreign direct investment in China by type of industry,[88] and restrictions based on the investment scheme,[89] all of which are regarded to prevent foreign companies from participating in the Chinese market. Furthermore, the U.S. alleges that China forces foreign companies to transfer technology,[90] uses human resources who have accumulated experience overseas, and illegally obtains confidential information through corporate spies in developed countries,[91] for the purpose of improving the technical level.[92]

---

87 The United States Trade Representative (USTR) criticizes that the government procurement conditions in China prefers domestic companies. *2018 Report to Congress on China's WTO Compliance* (USTR, 2018), February 2018. (https://ustr.gov/sites/default/files/2018-USTR-Report-to-Congress-on-China%27s-WTO-Compliance.pdf), p. 16, and p. 36.

88 The *Catalogue of Industries for Guiding Foreign Investment* prescribes categories of "Encouraged," "Permitted," "Restricted," and "Prohibited" by industry. For the areas where foreign investment is "Encouraged" listed in the Catalogue, the Chinese government encourages investment by foreign investment companies that have highly advanced technology and investment in advanced manufacturers. It also encourages Chinese corporations to become top-level companies in terms of production capacity, facilities, and technical level on a global basis and investment for the purpose of assisting overseas development by these companies. On the other hand, for matured industries, it is said that the Chinese government restricts investment to protect domestic companies. For example, the automobile sector was categorized as "Encouraged" from 1994 through 2010. However, its category was changed to "Permitted" from 2011 to 2014, and finally in 2015, it was categorized into "Restricted." A similar case was reported in the *2017 Annual Report*," November 15, 2017 (USCC). (https://www.uscc.gov/sites/default/files/Annual_Report/Chapters/Chapter%204%2C%20Section%201%20-%20China%27s%20Pursuit%20of%20Dominance%20in%20Computing%2C%20Robotics%2C%20and%20Biotechnology.pdf)

89 For example, when a foreign company participates in the automobile sector, the Chinese government requires the foreign company to establish a joint venture company with a state-owned company.

90 For example, the USTR and EU criticize forced technology transfer. Although certain problems such as a regulation on a licensing term that was found in the Regulations on Technology Import and Export Administration of the People's Republic of China (publicized in May 1985) were solved in the Regulations of the People's Republic of China on the Administration of the Import and Export of Technologies (effective in January 2002), there still exist problems in the Regulations for the Implementation of the Law on Sino-foreign Equity Joint Ventures. However, regulations prescribed in Article 43 (3) Contract Term and (4) Continuous Use of Technology in the Regulations were deleted by State Council Order No. 709 that was issued and enforced on March 18, 2019.

91 Examples about the use of people who acquired skills overseas and illegal obtainment of confidential information through industrial spies are referred to in the above-mentioned USCC report.

92 In *Finding of the Investigation into China's Acts, Policies, and Practices Related to Technology Transfer, Intellectual Property, and Innovation under Section 301 of the Trade Act of 1974* that was published on March 22, 2018, the USTR pointed out problems found in China. First, the Chinese government reportedly uses a variety of tools, including opaque and discretionary administrative approval processes, foreign equity limitations, and other mechanisms to regulate or intervene in U.S. companies' operations in China. Second, the Chinese government's acts, policies, and practices reportedly deprive U.S. companies of the ability to set market-based terms in licensing and other technology-related negotiations with Chinese companies and undermine U.S. companies' control over their technology in China. Third, the Chinese government reportedly directs and/or unfairly facilitates the systematic investment in, and/or acquisition of, U.S. companies and assets by Chinese companies to obtain cutting-edge technologies and intellectual property and generate large-scale technology transfer in industries deemed important by Chinese government industrial plans. Fourth, the

(1) Overall picture of financial assistance

As explained above, industry assistance takes many forms. Here, we focus on financial assistance given to state-owned or private companies in China.

Notice of the State Council on the Publication of Made in China 2025[93] describes that the Chinese government aims at "accelerating a financial reform, expanding a financing route, and reducing the finance cost for manufacturers. It also makes efforts to actively use features of fiscal finance, development finance, and commercial finance to enhance supports to the focused areas such as the next-generation information technology, high-end facilities, and new materials." More concretely, in addition to supports by the Export-Import Bank of China for manufacturers that intend to participate in a foreign market and more loans provided by the China Development Bank, the Notice states that the Chinese government will seek and use any and all financial support tools such as financing support through issuance of bonds in foreign and domestic markets and supports through venture capital and private equity funds. Although we will discuss details on financial assistance using subsidy, loans, and sovereign wealth funds in a later section, Figure II-2-2-2-1 shows a summarized scale of the assistance.[94] Among 3,703[95] companies listed on the Shanghai Stock Exchange and the Shenzhen Stock Exchange, 3,612 companies were confirmed in their financial statements that how much they received subsidy from the government, of a total amount of 134.6 billion yuan (approximately 2.2 trillion yen) only in the one year of 2017. As some subsidies have not been recorded in a financial statement, we suspect that much larger subsidies are actually provided. Loans provided by the China Development Bank to strategically facilitated industries that are the same as focused areas under Made in China 2025 reached 344.3 billion yuan (approximately 5.6 trillion yen) in 2017,[96] and it is estimated that the target scale of government guidance funds that have increased sharply in recent years as one of the industry fostering measures reaches 5.3 trillion yuan (approximately 87 trillion yen).[97]

Next, we will check individual financial assistance.

---

investigation will consider whether the Chinese government is conducting or supporting unauthorized intrusions into U.S. commercial computer networks or cyber-enabled theft of intellectual property, trade secrets, or confidential business information, and whether this conduct harms U.S. companies or provides competitive advantages to Chinese companies or commercial sectors. *Findings of the Investigation into China's Acts, Policies, and Practices Related to Technology Transfer, Intellectual Property, and Innovation under Section 301 of the Trade Act of 1974*, USTR (2018), March 22, 2018.

93 The full Japanese translation of the State Council Notice on the announcement of Made in China 2025 is available at https://www.jst.go.jp/crds/pdf/2015/FU/CN20150725.pdf.

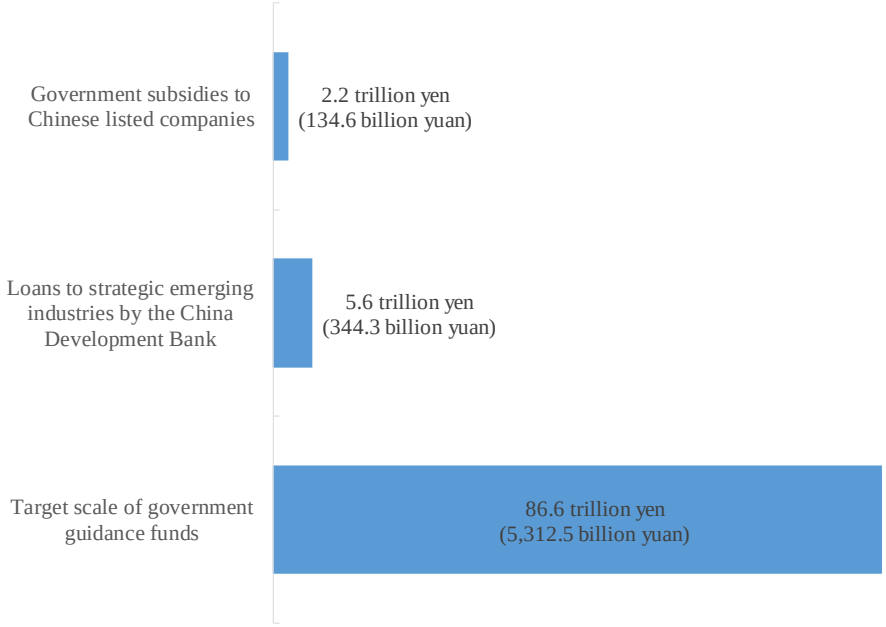
94 Calculated based on 16.3 yen per yuan (the exchange rate as of March 24, 2019).

95 Accumulated A shares that are traded only by domestic investors in China and B shares that can be traded by foreign investors based on Wind database.

96 Please refer to the Annual Report of the China Development Bank.

97 *2018 Special Research Report on Government Guidance Fund* (ChinaVenture Investment Consulting Ltd., 2018).

Figure II-2-2-2-1 Summary of government guidance funds, loans by the China Development Bank, and subsidies by the government



Source: ChinaVenture Investment Consulting Ltd., Annual Report of the China Development Bank, and Wind database.

(2) Subsidy

While the Chinese government alleges that its subsidy is consistent with the WTO rules,[98] several countries, mainly developed ones, have pointed out various issues on the subsidy (broad subsidy including lower interest loans, preferential tax treatment, debt relief, and so on.) provided by the Chinese government. For example, the Trade Policy Review Body (TPRB) at the WTO has discussed that subsidy and other supports could distort the market and cause excessive production capacity. Furthermore, subsidy to individual industry sectors is also discussed at the Steel Global Forum or Government/Authorities Meeting on Semiconductors (GAMS).

Here, we will check subsidy that is prescribed in the WTO Agreement. Under the WTO rules, there are two types of subsidy: The "Red" subsidy is prohibited in any case, and the "Yellow" subsidy is asked to be abolished if it adversely affects a domestic industry of another country. The former Red subsidy includes an export subsidy and a subsidy for preferential use of domestic products. The latter Yellow subsidy is the one whose application is explicitly limited to specific corporations or industries, and, although not explicitly, that are judged to be actually used by specific corporations or industries. Under the WTO rules, if a subsidy is judged to be a Red subsidy, a trading partner country can impose a countervailing duty as a countermeasure. In the case that a subsidy is judged to be a Yellow subsidy, a trading partner country can take appropriate measures to eliminate adverse impact by the subsidy, or the subsidy should be abolished. How to grant a subsidy is also checked. Even if it is not nominally

98 *The Facts and China's Position on China-US Trade Friction*, September 2018 (The State Council Information Office of PRC) (https://www.scio.gov.cn/zfbps/.../201809251638289_336183.doc).

judged as a subsidy, a loan with an extremely low interest rate that deviates from the market rate, direct relief of corporate debt, and provision of profit for restructuring such as debt equity swap[99] are also regarded as a subsidy.

The government subsidy in China (subsidy in narrow definition) can be broadly categorized into a subsidy related to assets and one related to profits. One of the typical examples of the former is those to be granted when a company constructs a plant, etc. and the subsidy is directly depreciated from assets (plant, etc.) on a balance sheet.[100] A subsidy related to profits is granted assuming that the subsidy is used for raw material costs and compensating for a loss.[101] For example, if a government subsidy is granted for a purchase of assets, a company can record a cheaper price on a balance sheet. It results in not only decreasing the monetary burden incurred by the company, but also reducing the depreciation costs used for non-current assets by squeezing the value of recorded non-current assets. As a result, a manufacturing cost of a product can also be down. On the other hand, a subsidy related to profits is used for cutting costs by a company or compensating for a loss enables the company to record greater profit.

Using the Wind database, we prepared Figure II-2-2-2-2 by accumulating government subsidies found in an annual report of companies listed in China[102] by industry, and indicating the breakdown of subsidies in ten focus areas stated in Made in China 2025. This Figure shows that the government subsidies have steadily increased in the recent ten years, and the total as of 2017 is 134.6 billion yuan (approximately 2.2 trillion yen) which is 3.7 times that in 2009. Of the total, the subsidies given to Made in China 2025-related industries account for more than 40% as of 2017. The share is especially high in the next generation information technology industry (share against the total is 12.8%), energy saving/new energy cars (9.1%), and new materials (6.1%).

Additionally, Table II-2-2-2-3 compares average annual growth rates of operating revenue, operating profit, government subsidy, short-term and long-term loans, R&D expenditures, and depreciation cost of companies during the period from 2009 to 2017 in the ten focused areas under Made in China 2025, after categorizing listed companies by industry. The average annual growth rate of the government subsidy is high in these industries, ranging from 13.5% to 43.2%. We can also see the same trend in all ten industries that the growth rate of R&D expenditures and depreciation cost exceeds the growth rate of operating revenue. By industry, next generation information technology,

---

99 In the case that debt equity swap is implemented with the conditions under which private investors are not expected to make an investment or implement debt equity swap.

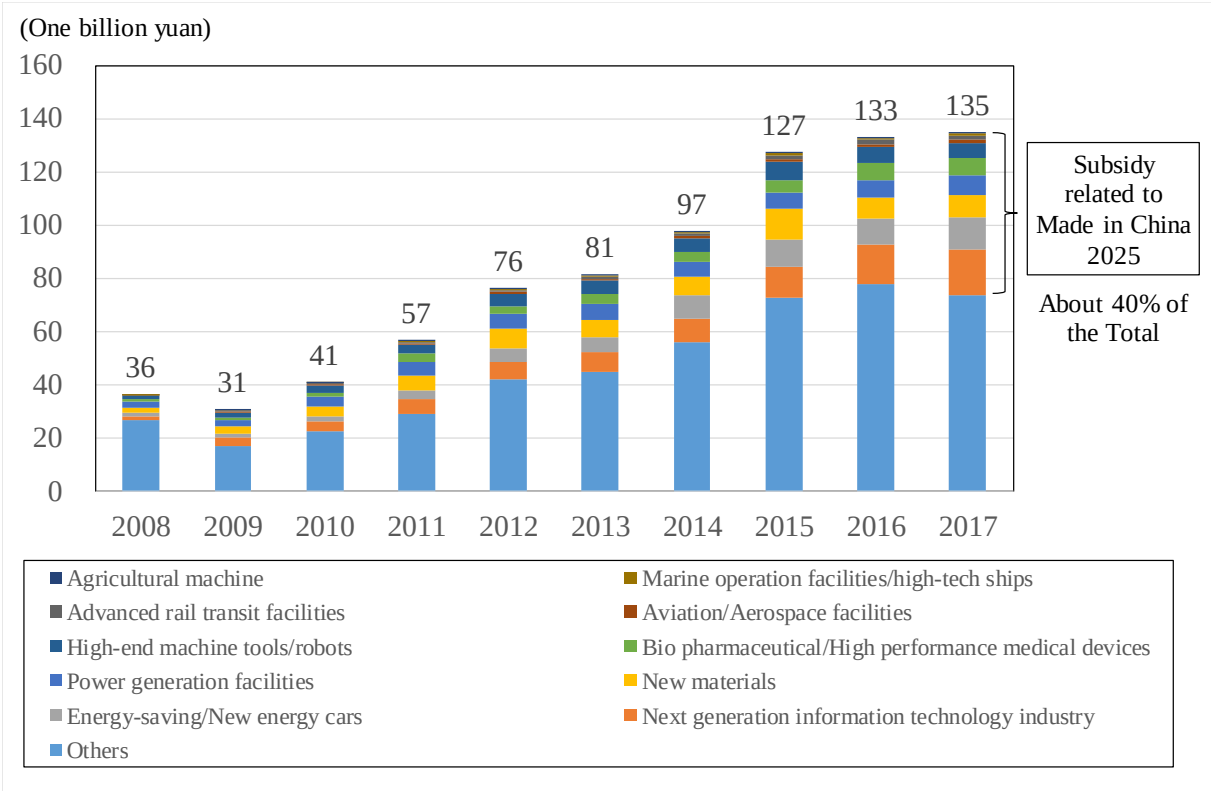
100 A subsidy related to assets offsets the book value of the related assets, or is recognized as deferred income. In the case where a government subsidy is recognized as deferred income, it is recorded in profit/loss in a reasonable and systematic manner during a certain period within the lifetime of the related assets. The government subsidy measured by such amount is directly recorded in the current profit/loss.

101 A subsidy related to profits (i) is recognized as deferred income if it is used for related raw material cost in the following periods or compensating for a loss, and is recorded in profit-loss in a period within the period of such raw material or offset by such related raw material cost, or (ii) is directly recorded in the current profit/loss or offset by the related raw material cost if it is used to cover the related raw material cost or a loss that has already been generated.

102 Accumulated A shares and B shares listed in Shanghai or Shenzhen Stock Exchanges (totally 3,703 companies).

and energy saving/new energy cars are worth noting: the growth rate in all the items such as operating revenue exceeds the growth rate of all the listed companies. On the other hand, although the agriculture machine industry recorded a negative growth in operating revenue (-1.7%) and operating profit (-16.2%), the growth rate of subsidy is 43.2%, which is almost twice as high as the growth rate of all the listed companies (21.4%).

Figure II-2-2-2-2 Total of government subsidies based on corporate financial data and the breakdown of subsidies related to Made in China 2025



Notes: Obtained and accumulated financial data of listed companies in China (A shares and B shares in Shanghai and Shenzhen Stock Exchanges from Wind database). The total number of listed companies is 3,703 as of April 16, 2019 (Shanghai: 1,510, Shenzhen: 2,193) and the financial analysis in Wind covers 3,612 companies.

Source: Wind database.

Table II-2-2-2-3 Average growth rate of financial items of ten focused areas under Made in China 2025 (CAGR: 2009 - 2017)

	Average annual growth rate (2009 - 2017)					
	Operating revenue	Operating profit	Government subsidy	Total of short- and long-term loans	R&D expenditure	Depreciation cost
Next generation information technology industry (493 companies)	23.5%	24.0%	24.5%	25.1%	40.4%	28.7%
High-end machine tools/robots (242 companies)	7.4%	6.2%	13.5%	10.3%	68.6%	18.0%
Aviation/Aerospace facilities (48 companies)	20.2%	19.5%	16.5%	18.5%	84.4%	24.7%
Marine operation facilities/high-tech ships (8 companies)	6.3%	-	20.2%	15.8%	36.4%	16.7%
Advanced rail transit facilities (11 companies)	18.5%	15.4%	18.1%	26.6%	27.1%	14.8%
Energy-saving/New energy cars (150 companies)	18.9%	20.6%	33.2%	22.2%	117.5%	20.0%
Power generation facilities (152 companies)	16.0%	17.1%	17.4%	11.8%	85.6%	20.3%
Agricultural machinery (3 companies)	-1.7%	-16.2%	43.2%	41.7%	5.8%	17.3%
New materials (276 companies)	10.3%	28.9%	15.3%	8.4%	60.8%	10.6%
Bio pharmaceutical/High performance medical devices (255 companies)	17.2%	19.2%	25.0%	14.7%	82.8%	21.8%
Total (3,612 companies)	15.3%	19.7%	21.4%	13.1%	48.7%	17.4%

Note: Data excluded as outlier if operating profit is negative.
Source: Wind database, *ORBIS* (BvD)

When we aggregate the data of government subsidy amount of all listed companies in China[103] as obtained from the Wind database, companies that receive more subsidy include many of the ten focused areas under Made in China 2025 such as automobiles (completed cars), railroad cars, and semiconductors (Table II-2-2-2-4).

Please note that subsidy granted to private companies in China include a purchase subsidy such as a subsidy for new-energy vehicles (NEV) in the automobile sector. In other words, although NEV subsidy is a subsidy system to facilitate NEV consumption, and can be basically categorized as a purchase subsidy for consumers, the subsidy is granted not to consumers but to companies that sell the cars.

103 Aggregated data of A shares (companies whose shares are tradable only by Chinese domestic investors) and B shares (companies whose shares can be traded by foreign investors) listed on Shanghai or Shenzhen Stock Exchange.

Table II-2-2-2-4 Top 20 companies that received government subsidy in 2017

2017

Ranking	Industry	Amount of Subsidy (million yuan)	Operating revenue	Operating profit	Subsidy/ Operating revenue	Subsidy/ Operating profit
1	Oil and natural gas	4,783	2,360,193	86,965	0.2%	5.5%
2	Automobiles (completed cars)	2,659	857,978	54,110	0.3%	4.9%
3	Automobiles (completed cars)	1,613	80,012	7,152	2.0%	22.6%
4	Home appliances	1,332	240,712	21,628	0.6%	6.2%
5	Automobiles (completed cars)	1,276	105,915	5,411	1.2%	23.6%
6	Marine transportation	1,172	90,464	4,957	1.3%	23.6%
7	Home appliances	1,159	111,577	4,113	1.0%	28.2%
8	Apparel	1,155	25,440	99	4.5%	1162.3%
9	Railroad cars	1,118	211,013	14,743	0.5%	7.6%
10	Oil and natural gas	1,099	2,015,890	57,769	0.1%	1.9%
11	Semiconductors	962	93,800	9,674	1.0%	9.9%
12	Semiconductors	906	5,995	44	15.1%	2072.8%
13	Chemical materials	902	53,123	16,959	1.7%	5.3%
14	Consumer goods	880	148,286	26,127	0.6%	3.4%
15	Processed foods	849	67,547	7,116	1.3%	11.9%
16	Semiconductors	799	39,071	2,883	2.0%	27.7%
17	Media	736	12,014	7,244	6.1%	10.2%
18	Investment bank	728	23,804	13,459	3.1%	5.4%
19	Chemical products	717	1,830	-617	39.2%	-116.1%
20	Electric power	713	152,459	4,095	0.5%	17.4%

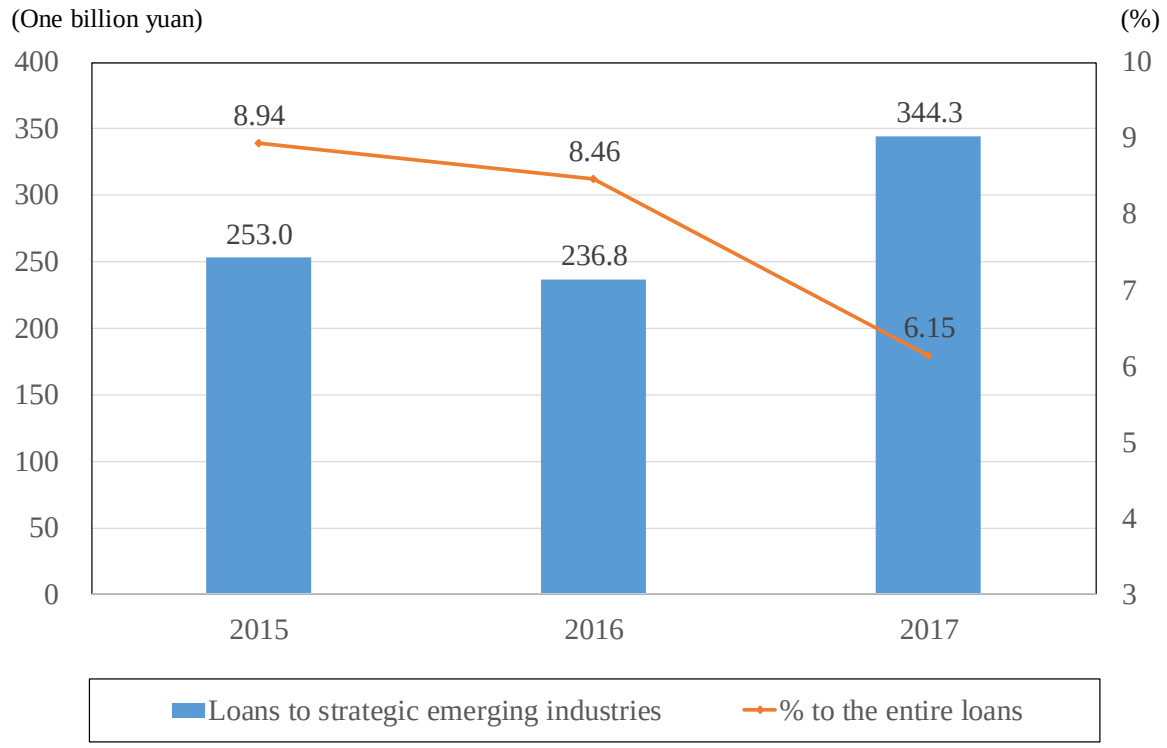
Source: Wind database.

(3) Loans

Next, we will check loans. Following the announcement of Made in China 2025, the China Development Bank indicates its plans to provide loans of at least 300 billion yuan for the implementation of Made in China 2025 in its five-year plan. According to an annual report of the Bank, the loans to strategic emerging industries have steadily increased in three years from 2015, and reached 344.3 billion yuan (5.6 trillion yen) in 2017, which is equivalent to 6.15% of the total loans by the Bank[104] (Figure II-2-2-2-5, Figure II-2-2-2-6).

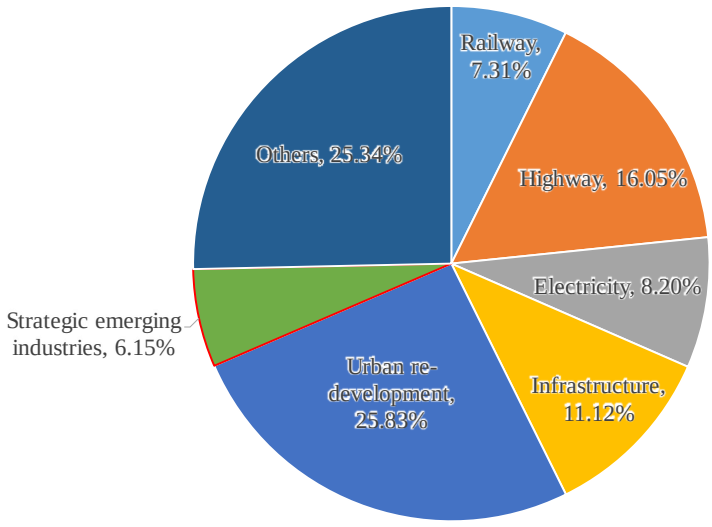
104 Refer to the annual report of the China Development Bank.

Figure II-2-2-2-5 Changes in loans to strategic emerging industries by the China Development Bank (2015 – 2017); Breakdown of loans by sector (2017)



Source: Annual Report of the China Development Bank (2015 - 2017).

Figure II-2-2-2-6 Breakdown by sector for loans provided by the China Development Bank



Source: Annual Report of the China Development Bank (2017).

Chinese companies have received loans not only from the China Development Bank, which is a political bank, but also from various financial institutions such as state-owned commercial banks. Here,

we will also check the possibility that corporate loans in China are made at a rate lower than the market rate. As mentioned previously, loans at a lower rate can be regarded as a subsidy in the broad definition and considered a problem. Some reports and statements, such as a report prepared by the U.S. Department of Commerce[105], pointed out the possibility that loans are made at a rate that is not based on the market mechanism in China. A process by which a modern financial policy affects the real economy is that a central bank adjusts a short-term interest rate through open market operation, which affects the long-term interest rate based on the market mechanism, finally making an impact on the real economy. However, in China, as volatility of short-term interest rates remained high over a long period, although the upper or lower limit of saving and loan rates have already been abolished,[106] commercial banks in China actually refer to the base interest rate announced by the People's Bank of China (PBC) as a benchmark.[107]

Under such circumstances, we cannot deny the possibility that loans at a rate that is lower than the base interest rate announced by the PBC could be provided. In this paper, we estimated the actual interest paid by major listed companies with large sales in six industries that are strategically supported by the Chinese government (secondary batteries, semiconductors, organic ELs, railroad cars, and automobiles (parts and completed cars)).[108] Figure II-2-2-2-7 is a graph showing the ratio of interest amount of interest-bearing debts against the interest-bearing debts recorded in a financial statement of these companies (interest payment ratio). The comparable rate is the base interest rate announced by the PBC plus a fixed margin of 1%. The base interest rate of the PBC as of February 2019 is 4.35% within one year, 4.75% in one to five years, and 4.9% in more than five years. In Figure 7, we extracted the highest and lowest of each base interest rate in the last five years (from February 2014 to February 2019), and, after adding a 1% fixed margin, showed the lowest rate of 5.4% (within one year) and the highest rate of 7.6% (more than five years).[109] When we look at the graph, we found that, although there is some dispersion by industry, many companies subject to the analysis show a rate lower than the comparable base interest rate. For the growth rate of borrowings (short-term and

105 U.S. Department of Commerce (2017), "Review of China's Financial System Memorandum," *Docket C-570-054* (August 1, 2017), p. 8, 12-16 (noting that even though the government nominally removed the last remaining control on lending and deposit rates at the end of 2015, an analysis of interest rate dynamics suggests that interest rates are not yet market-determined) ("DOC Financial System Report") (Exhibit USA-3).

106 The lower limit loan interest was abolished in July 2013, and the upper limit of saving interest was abolished in October 2015.

107 *Atarashikunaru Chugokuno Kinyuseisakuno Wakugumi* (Research Department - Asia, Research Division, Mizuho Research Institute, 2017), March 29, 2017, (https://www.mizuho-ri.co.jp/publication/research/pdf/insight/as170329a.pdf).

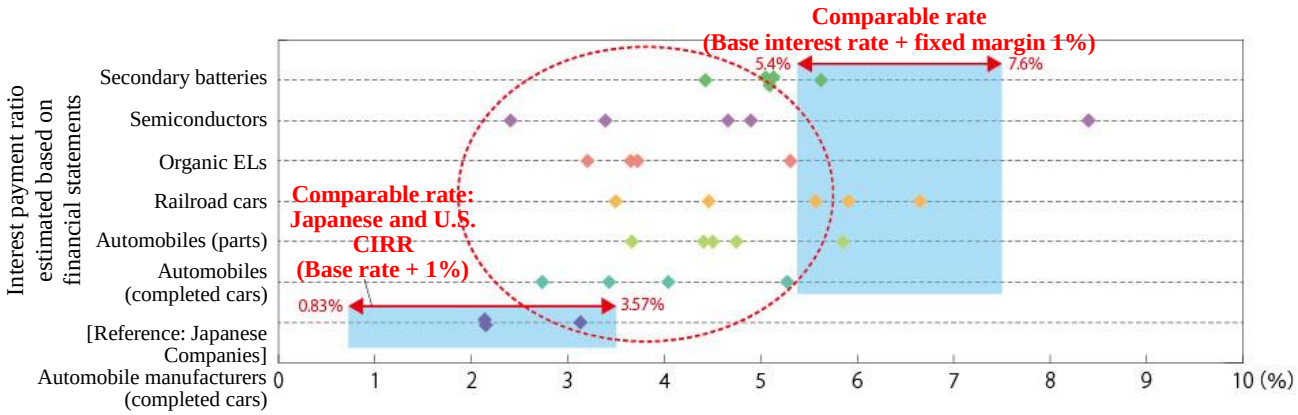
108 When extracting companies subject to the analysis, we firstly chose industries that are covered by Made in China 2025 with reference to sales, growth rate, and the scale of financial assistance such as subsidy, and then selected the top five companies in each industry in terms of sales from the following industries: secondary batteries, semiconductors, organic ELs, railroad cars, automobiles (parts), and automobiles (completed cars).

109 On the other hand, according to a questionnaire survey of entrepreneurs (as of 2017) listed in a monthly magazine *Kanri Sekai* in China, the overall average corporate loan cost is approximately 8.15%, which in general seems an appropriate level if we add a commission and risk premium to the base interest rate. When we check the type of company, the rate is 6.49% for foreign affiliated companies, 6.9% for state-owned and state-controlled companies, and 8.17% for private companies.

long-term) of the companies subject to the analysis in last five years (from 2013 to 2017), the annual average growth rate by industry is between 38% to 96%, although there is some dispersion by company and by industry, which indicates that these companies have sharply increased borrowings (Table II-2-2-2-8).

On the other hand, for reference, we estimated the interest payment ratio of major Japanese completed car manufacturers based on the amount of interest-bearing debts and the interest rate recorded in consolidated detailed statements annexed to the financial report for FY 2017 (from March 2017 to March 2018). The interest rate was weight-averaged depending on a scale of each debt to calculate the interest payment ratio. Considering that more funds are financed on a U.S. dollar basis among Japanese automobile manufacturers, we use the Japanese Commercial Interest Reference Rate (CIRR) (fixed regardless of the loan term), which is 0.83%, as the lowest, and the U.S. CIRR (more than 8.5 years), which is 3.57%, as the highest of the range of comparable rate.[110] The result of the estimate shows that the interest payment ratio of all three completed car manufacturers in Japan is within the range of comparable rate.

Figure II-2-2-2-7 Comparison of interest payment ratio of the subject six industries



Notes: 1. Extracted the average outstanding of A: Interest payment, and B: Interest-bearing debts, etc. (total of short- and long-term borrowings, corporate bonds, and non-current debts whose maturity is within one year, and long-term arrears) in 2017, and use A/B as an estimated interest payment ratio. "A: Interest payment" includes costs caused by any and all the interest-bearing debts such as commercial papers and lease obligations, in addition to interest payment for short- and long-term borrowings and interest of corporate bonds. "B: Interest-bearing debts" is a total of debts that must be repaid, and includes debts that do not bear interest.

2. Among corporations that are subject to the analysis and listed in Mainland China, those whose sales are among top five by industry were analyzed. However, any company that apparently has abnormal data such as non-movement of funds (one company in the automobile industry (completed cars) and one company in the organic EL industry) were excluded.

3. "Base interest rate + fixed margin 1%" is calculated by adding a fixed margin 1% pursuant to the calculation method of the lowest loan interest rate prescribed in the OECD Arrangement on Officially Supported Export Credits to the highest base rate (more than five years of loan term)

110 The lowest loan rate pursuant to Article 20 of the OECD Arrangement on Officially Supported Export Credits. The Japanese CIRR is 0.83% regardless of loan term, EU is from 0.48% (within five years) to 0.88% (more than 8.5 years), the U.S. is from 3.48% (within five years) to 3.57% (more than 8.5 years). Please refer to the web page of Japan Bank for International Cooperation (as of March 15, 2019: https://www.jbic.go.jp/ja/support-menu/cirr.html).

and the lowest rate (within one year of loan term) of the base interest rate that were announced during the period from February 2014 to February 2019 by the PBC. In the case of loans provided by commercial banks, risk premium and profits of bank are added to the above-mentioned base interest rate.

4. [Reference] For three major Japanese completed car manufacturers, we estimated the interest payment ratio based on the data recorded in the detailed statement annexed to the financial report for FY 2017 (March 2017 to March 2018). We use the Japanese CIRR (0.83% regardless of loan term) and the U.S. CIRR (the highest 3.57%, for more than 8.5 years) as the comparable base rates. The base rate is a distribution yield of government bond of each country (as of March 15).

Source: Annual reports of individual companies, the People's Bank of China, CEIC database.

Table II-2-2-2-8 Average annual growth rate of borrowings (short and long) by subject six industries (2013 - 2017)

Secondary batteries	96%
Semiconductors	39%
Organic ELs	38%
Railroad cars	76%
Automobiles (parts)	49%
Automobiles (completed cars)	42%

Note: Estimated about the Chinese companies subject to the calculation of interest payment ratio in Figure II-2-2-2-7.

Source: Prepared by the Ministry of Economy, Trade and Industry based on annual reports of each company.

(4) Sovereign wealth fund

Recently, more attention is given to the financial support through Chinese sovereign wealth funds. There are many types of sovereign wealth funds in China: For example, a "Political fund" such as Silkroad Fund is the fund directly contributed by the Chinese government that specifically instructs the investees under a specific political purpose. "Government guidance fund" is to call corporate investors under the instruction by the government and invest funds to growing areas.[111] "Government guidance funds" can be broadly categorized into those established with leadership of the central government and those with leadership of a local government.[112] Table II-2-2-2-9 is a list of major sovereign wealth funds based on information obtained from various media reporting and reports.

111 "Government Guidance Funds" means funds that aim at venture investment. In this scheme it is said that involvement of the government is limited and indirect, and usually investment by the private sector is called in many cases. However, in the case of some funds such as the Industry Investment Guidance Funds that are explained later, the government makes direct investment for the purpose of facilitating a specific industry.

112 According to a questionnaire survey conducted by ChinaVenture Investment Consulting (ChinaVenture Investment Consulting Research: *2019 Research Report on Government Guidance Fund*), it is said that almost of all the government guidance funds are required to achieve a local investment ratio of 40% or higher.

Table II-2-2-2-9 List of major sovereign wealth funds in China

Category		#	Name	Total amount		Industry	Establishment
				Billion yuan	Billion yen		
Indirect Contribution	Central government	1	The National Fund for Technology Transfer and Commercialization	-	-	Transfer of scientific achievements, etc.	September 2014
		2	Silkroad Fund	265	4,320	The Belt and Road Initiative-related industries and projects	2014
		3	National Made Investment Guidance Fund	150	2,445	High-speed railways, nuclear power, aerospace, clean energy, 3D printing, new-energy cars, robotics, quantum networks	May 2017
		4	National SME Development Fund*	60	978	New industries, unique companies in China	September 2015
		5	State Development & Investment Corp., Ltd. (SDIC) Comprehensive National Emerging Industry VC Guidance Fund	18	285	IT, biotechnology, health, medical, new energy, etc.	May 2017
	Province	6	Xinjiang Uyghur Autonomous Region PPP Government Guidance Fund*	-	-	-	2015
		7	Yangzi jiang Industry Fund	1,000	16,300	IT, advanced manufacturing, new materials, healthcare, clean energy	2015
		8	Jiangxi Province Development Upgrade Guidance Fund	300	4,890	Innovation industries, emerging industries, upgrade of traditional industries, service industry	2017
		9	Shandong Province Private Equity Investment Guidance Fund*	300	4,890	-	2014
		10	Jilin Province Industrial Investment Guidance Fund*	50	815	Strategic emerging industries, modern agriculture, service industry	2015
		11	Hubei Province Economic Belt Industry Fund	40	652	Strategic new industries in Hubei Province	December 2015
	City	12	Shenzhen Futian District Guidance Fund*	Several billion	Several 10 billion	New energy, new materials, aviation, healthcare, IT, upgrade of consumers	2015
		13	Amoy Industry Guidance Fund*	20-30	326-489	Displays, computers & telecommunications, devices, healthcare, new materials, tourism exhibitions, logistics, software, finance, culture	2015
		14	Yangzhong Smart Yangzi jiang Guidance Fund*	-	-	Real estate, sports, culture, agriculture, tourism, advanced manufacturing, innovative industries, transportation, public services	2016
		15	The Hai River Industry Guidance Fund Jiangxi Province Development Upgrade Guidance Fund*	500	8,150	Healthcare, new energy, culture, advanced manufacturing, TMTs, mobile	2015
		16	Shenzhen Guidance Fund*	249	4,059	IT, healthcare, smart devices, environment protection	2010
		17	Chengdu Qianhai Industry Guidance Fund*	200	3,260	Infrastructure, strategic emerging industries, advanced manufacturing, innovation industries, public services	2016
		18	Xuzhou Industry Development Guidance Fund*	100	1,630	-	2016
		19	Tianjin Industry Innovation Guidance Fund*	80	1,304	Healthcare, new energy, culture, advanced manufacturing, TMTs, mobile internet	2015
		20	Chongqing City Industry Guidance Equity Investment Fund	3	41	Agriculture, modern services, culture, science & technology, tourism	May 2014

Category		#	Name	Total amount		Industry	Establishment
				Billion yuan	Billion yen		
Direct investment	Central government	21	National Emerging Industry Venture Investment Guidance Fund*	200	3,260	Industry innovation, innovation, etc.	August 2015
		22	State Enterprise Restructuring Fund	350 (131 for 1st phase)	5,705 (2,135)	Development and sector unification of state-owned companies controlled by the national government, restructuring for specialization, adjustment of production capacity, etc.	September 2016
		23	China State-Owned Assets Venture Capital Fund	200	3,260	Innovative technology, industry upgrade	2016
		24	Guoxin Guotong Investment Fund	150	2,445	Providing yuan funds and professional assistance for Chinese companies to participate in the Belt and Road Initiative, facilitating cooperation to realize international production capacity and machinery & equipment manufacturing as well as to conduct international investment and acquisition.	November 2016
		25	China Integrated Circuit Industry Investment Fund	139 (1st phase)	2,266	Semiconductor manufacturing, chip designing, chip materials, chip testing, assembling	September 2014
		26	China Internet Investment Fund	100	1,630	Internet	January 2017
		27	National Military-Private Amalgamation Industry Development Fund	30	492	System reform of defense industry enterprises and business units, defense equipment, securitization of military assets, military-private amalgamation technology, reform of state-owned defense industry enterprises	September 2016
		28	China Culture and Industry Investment Fund	20	326	Culture, media, entertainment, performance art, data	July 2011
		29	Advanced Manufacturing Investment Fund	20 (1st phase)	326	The focused areas under Made in China 2025: Railway transportation, high-end ships, and ocean engineering machinery and equipment, industrial robots, new-energy cars, modern agriculture machinery and equipment, advanced medical devices, new materials	June 2016
		30	China Development Fund	50	815	Major sectors such as advanced manufacturing, next generation vehicles, robotics, IT	August 2015
	Province	31	Henan Industrial Agglomeration Area Development Investment Fund*	-	-	Advanced manufacturing, services	2017
		32	Guangdong Integrated Circuit Industry Investment Fund*	-	-	Integrated circuits, advanced manufacturing, materials and devices	2016
		33	Zhejiang Province Government Industry Fund	20	326	IT, environment protection, health, tourism, finance, advanced manufacturing, fashion, agriculture	May 2014
	City	34	China Big Data Industry Development Fund	20-30	326-489	Big data industry in Guiyang City	2016
		35	Shanghai Integrated Circuit Industry Investment Fund	50	815	Semiconductor manufacturing, chip designing, chip materials, chip testing, assembling	2017
Not Available	Province	36	Zhengyuan Silkroad Fund*	-	-	Construction of airports, airport industry, logistics, international trade and finance, culture and tourism	2017
	City	37	Shenzhen State-owned Assets Reform and Development Fund*	-	-	Environment protection, advanced manufacturing	2016
		38	Beijing Science & Technology Innovation Fund	1,000	16,300	Optoelectronics technology, big data, new materials, clean energy, AI, advanced manufacturing, healthcare, IT, quantum computing	2017
		39	Beijing Big Data Industry Investment Fund	10 (1st phase)	163	Big data transaction platforms, sensors, chips, data resources, data technology	2016
		40	Guangzhou IoT Industry Fund	1.2	20	IoT	August 2017

Notes: When categorizing funds into indirect investment or direct investment, we obtained confirmed information from a web site of each fund, if possible. On the other hand, when we could not obtain confirmed information from a web page, we integrated opinions from well-informed persons and

estimated that a fund was indirect investment if its name includes the word "Guidance," and if not, direct investment.
Converted at the rate of one yuan = 16.3 yen (as of March 24, 2019). Funds with "*" mark mean the funds that are said to receive investment by a fund of funds (FoFs).
Source: Prepared by the Ministry of Economy, Trade and Industry using information from ChinaVenture Investment Consulting Ltd., Bloomberg, and web pages of each fund.

Among the industry facilitation measures for Chinese industries, government guidance funds attract the most attention, and have sharply increased in recent years. As of 2017, there are 1,166 funds and the target scale is 5.3 trillion yuan (approximately 87 trillion yen) (Figure II-2-2-2-10). The Government Guidance Funds have six investment areas that are prescribed in the Interim Administrative Measures for the Startup Investment Enterprises;[113] namely, (i) Non-basic public services, (ii) infrastructure, (ii) housing warranty, (iii) biological environment, (iv) regional development, (v) strategic emerging industry and advanced manufacturing, and (vi) venture innovation. One of the important roles of the government guidance funds is to fulfill the capital needs in such areas. Particularly, some people pointed out that the Chinese government intends to facilitate R&D investment in advanced technology by expanding the scale of emerging high-tech companies in each region, and acquire technologies from foreign companies through M&A.[114]

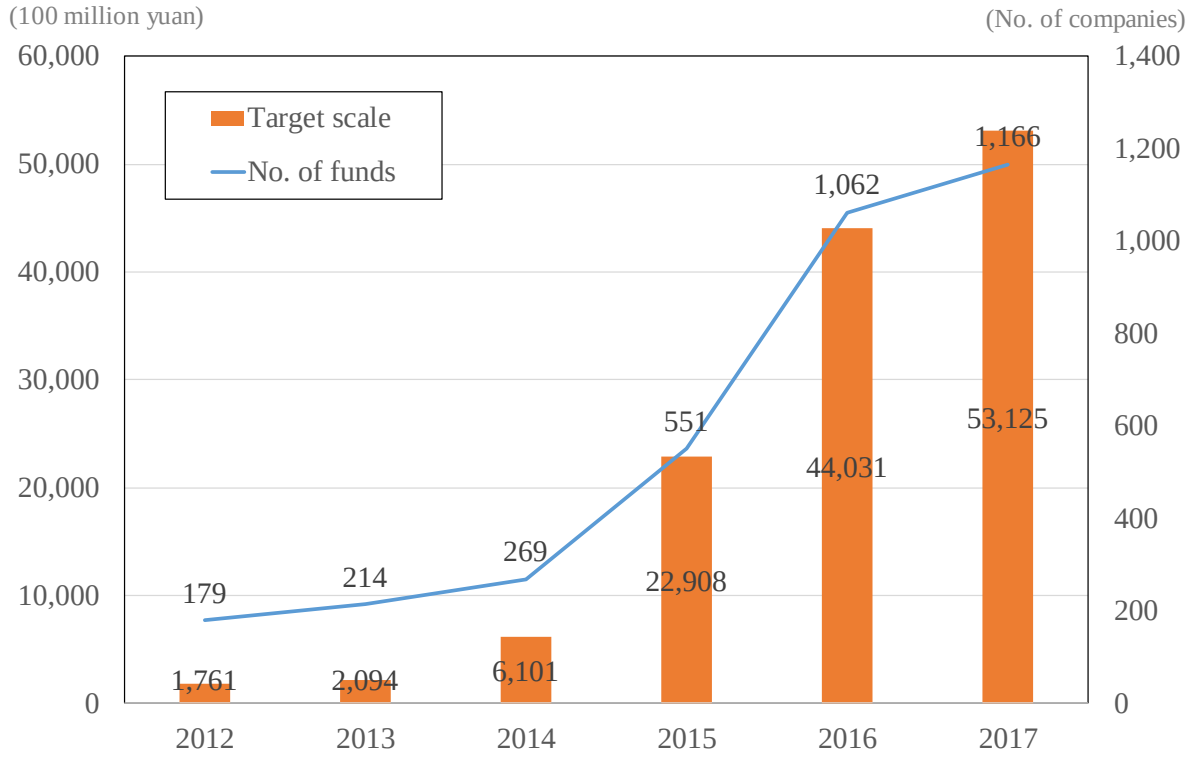
Figure II-2-2-2-11 shows a basic system of a government guidance fund. In the general case, the central or a local government firstly instructs a state-owned assets management division or a fund administration company that is backed by state-owned assets to establish a parent fund. Then, a state-owned company, etc. establishes an administration company in cooperation with a financial institution and other investors. The administration company plays a role to give investment management instructions such as investment decisions and political guidance to the parent fund. The parent fund collects and manages funds from investors pursuant to the investment management instruction given by the administration company and makes investments in investees or conducts asset management as a limited partner (LP). The investees of the parent fund are sometimes individual companies, but mainly child funds that invest in a specific area. Near 90% of the government guidance funds make 15% to 30% of investment in a child fund.[115]

In a questionnaire survey conducted by ChinaVenture Investment Consulting,[116] government guidance funds are categorized into five types (Figure II-2-2-2-12). Based on this category, the largest share (allowed multiple answers) is dominated by the venture investment guidance funds (73.3%). If we add the share of angel investment guidance funds, which rank third (36.7%), funds to aim at supporting companies at the time of establishment or recently established companies dominate the

113 Interim Administrative Measures for the Startup Investment Enterprises (http://big5.gov.cn/gate/big5/www.gov.cn/ziliao/flfg/2005-11/15/content_99008.htm)
114 Malkin, A. (2018), "Made in China 2025 as a Challenge in Global Trade Governance," August 15, 2018, (https://www.cigionline.org/publications/made-china-2025-challenge-global-trade-governance-analysis-and-recommendations)
115 China Investment Research (2019): *Special Research Report on Government Guidance Fund* (ChinaVenture Investment Consulting (2019)).
116 Ditto.

largest share. The second largest share is industry investment guidance funds (58.7%)[117] that aim at fostering the next generation industries, including the China Integrated Circuit Industry Investment Fund (aka the "Big Fund") that is famous for supporting semiconductor companies, the National Emerging Industry Venture Investment Guidance Fund that aims at supporting industrial innovation, and the Advanced Manufacturing Investment Fund that is related to Made in China 2025 and invests in strategic emerging industries such as new-energy and energy-saving cars.

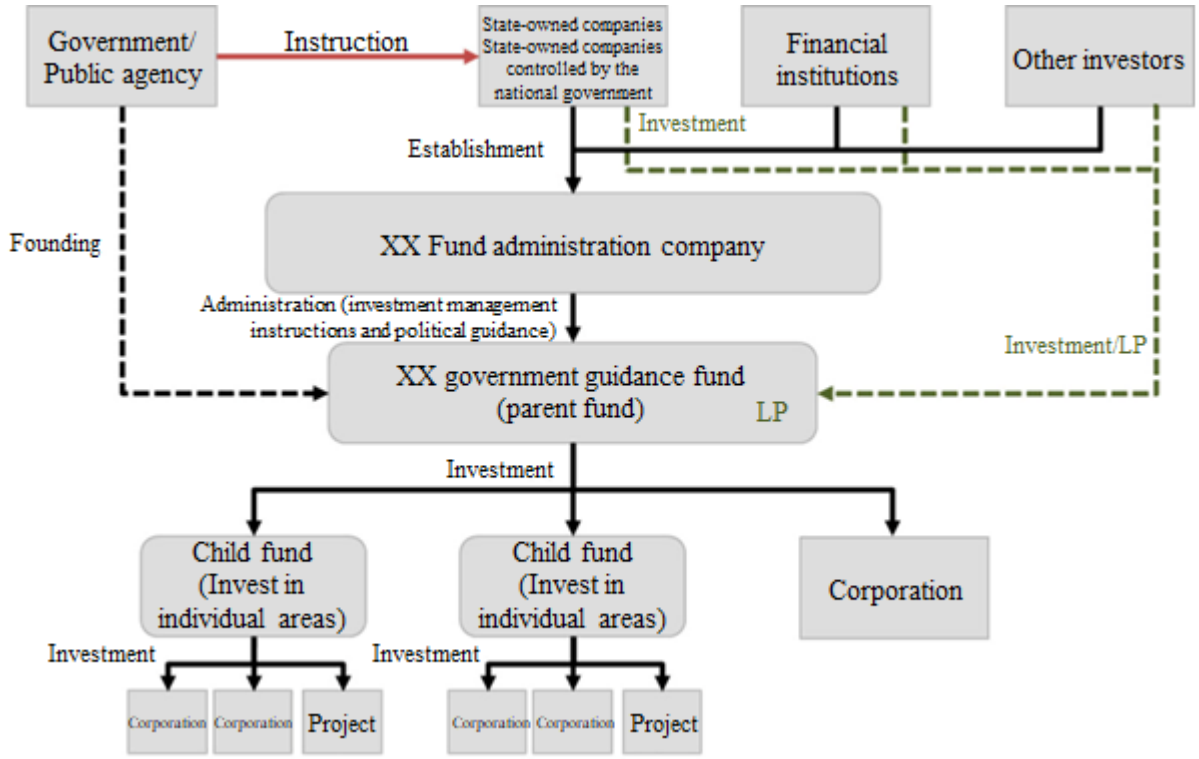
Figure II-2-2-2-10 Changes in target scale of government guidance funds



Source: *2018 Special Research Report on Government Guidance Fund* (ChinaVenture Investment Consulting).

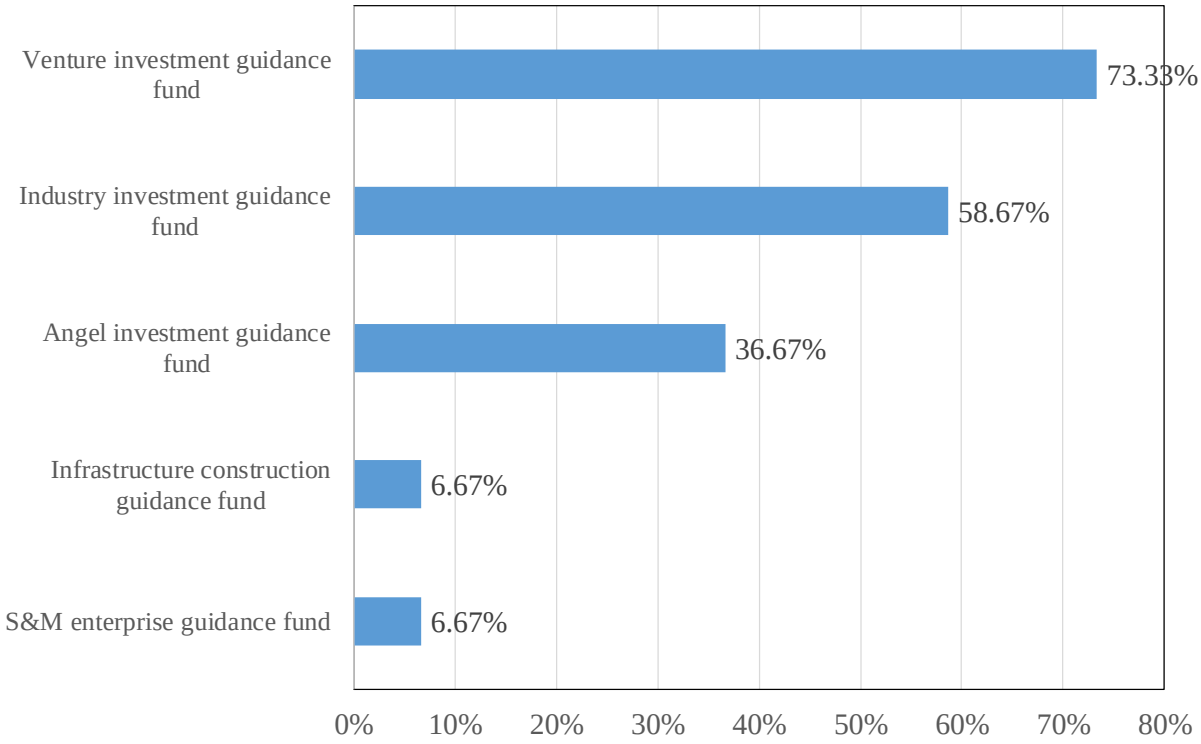
117 According to the *Industry Depth Analysis of Industry Investment Fund Industry in China and Development Plan Consultation Proposal Report from 2016 to 2020* that was publicized by the Industry Research Center for Chinese Investment in 2016, as an "Industry investment fund (*we understand that it is the same as an "industry investment guidance fund") is based on industrial policies of the government, it basically provides direct capital assistance. Therefore, compared to general venture capital and private equity, it is said that the fund requires less profitability and the loan term is longer. Furthermore, features of the "industry investment fund" are that (i) it mainly invests in non-listed companies (or non-listed shares of a listed company); (ii) the investment term is longer in general and typically three to seven years (or longer in some cases); (iii) it is engaged in the management of the investee (it has a right to determine important matters of the company depending on the investment scale, provides financial management and business management resources to increase the corporate value, and supports corporate governance, etc.); and (iv) the purpose of the investment is to facilitate corporate development based on the potential of the company through investment, as well as exit from the investment with various methods in a timely manner to ensure the capital gain of the investment. The exit methods include IPO, M&A, transfer based on the consultation, and buyback.

Figure II-2-2-2-11 System of government guidance fund



Note: This is a conceptual system chart of a general government guidance fund, and involvement of each party may be different from an actual case.
Source: Web sites of individual funds, various reports, hearing from well-informed persons.

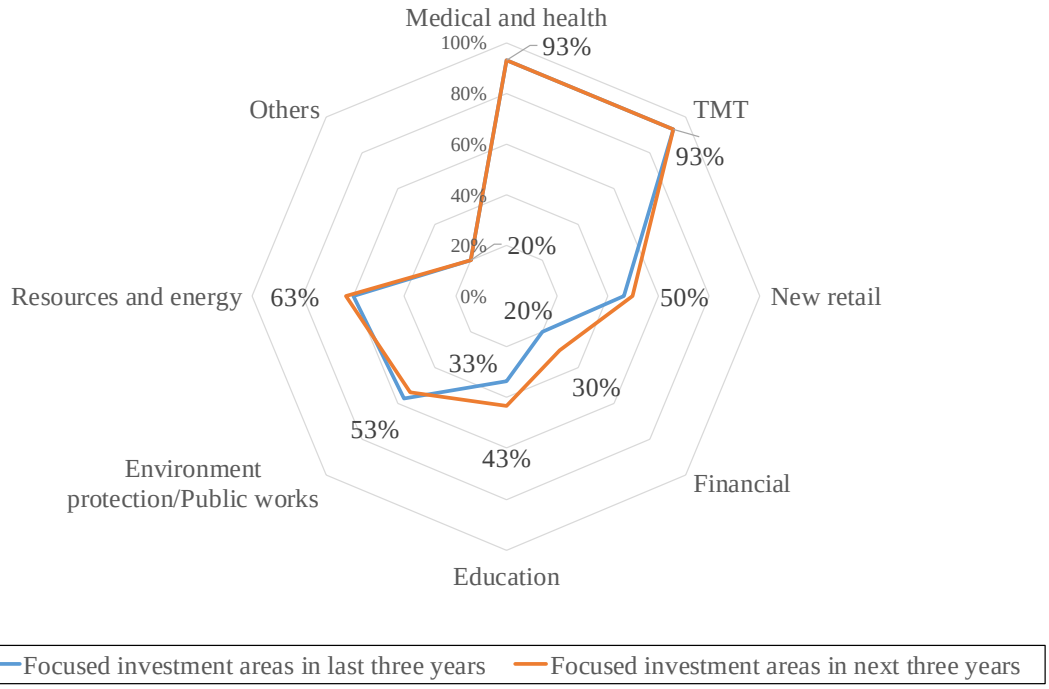
Chart II-2-2-2-12 Share of individual types of government guidance funds (multiple answers allowed)



Note: As a government guidance fund has multiple features, we allowed multiple answers.
Source: *2019 Questionnaire Survey on Government Guidance Fund* (ChinaVenture Investment Consulting).

The above-mentioned questionnaire survey also asked what fields were investees of the government guidance funds in the last three years and potential investees in the next three years (Figure II-2-2-2-13). According to the result of the survey, the top answers are medical and health (93%), technology/media/telecom (TMT, 93%), resources and energy (63%), and new retail (50%). From an aspect of financial assistance by the government, investments are mainly made in areas that have a high public nature and focus on the next generation industries such as TMT and new retail.

Figure II-2-2-2-13 Investees of government guidance funds (multiple answers allowed)



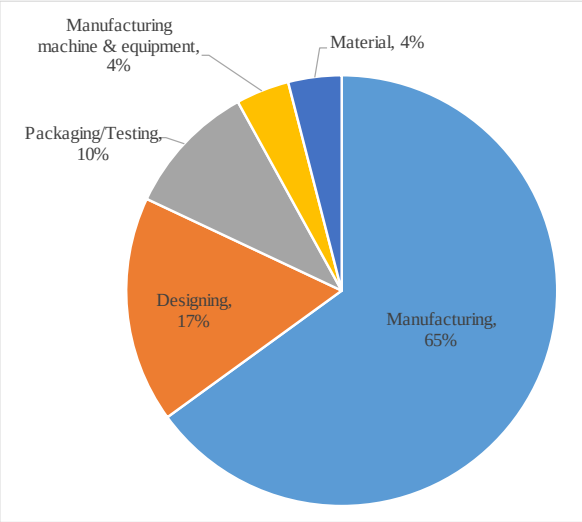
Note: Questionnaire survey on government guidance funds. TMT means technology/media/telecom, and new retail is a concept coined by Jack Ma to mean the unity of on-line and off-line commerce.
Source: *2019 Questionnaire Survey on Government Guidance Fund* (ChinaVenture Investment Consulting).

Here, for the purpose of outlining a specific assistance process conducted by a government guidance fund, we will use the above-mentioned China Integrated Circuit Industry Investment Fund (aka the "Big Fund") as an example to make an explanation. In September 2014, the Chinese government determined to establish a national fund to enhance the semiconductor industry, which is one of the strategic industries in China, pursuant to the government document entitled the *China National IC Industry Development Guidelines* that was announced in 2014, and the Big Fund was established in September 2014 to support the integrated circuit (IC) industry chain. The IC industry have received the largest funds from government guidance funds. It is said that the Big Fund has invested in two to three companies that lead each segment of designing, manufacturing, packaging, testing, machinery & equipment, material, and application of IC, for the purpose of providing capital to IC companies as well as supporting the ecosystem for investing in the IC industry. The Big Fund especially focuses on the chip manufacturing sector, which is apparently shown in the breakdown of investees in the first phase: manufacturing (65%), designing (17%), packaging/testing (10%), manufacturing industry (4%), and materials (4%) (Figure II-2-2-2-14). The Big Fund also aims at increasing its involvement in corporate governance of investees,[118] and some suggest that the

118 In an interview of Ding Wenwu, president of the National Integrated Circuit Industry Investment Fund by China Times (October 2017), he stated that "The Fund basically invests in the top three companies in each category," "Among the categories of designing, manufacturing, and machinery & equipment,

government would increase its influencing power to major IC companies that are in the advanced industry through the Big Fund. It is said that companies that are supported by the Big Fund also receive financial assistance from sovereign financial institutions and state-owned banks such as the China Development Bank for conducting large-scale M&A and investing in a plant. For example, Tsinghua Unigroup, a large semiconductor group, participated in the IC industry in 2013 through a corporate merger. After only five years, it grew to make a 10 trillion yen-scale investment in the IC sector. It has received a large amount of investment from the Big Fund from since 1st investment phase, and also received support from the China Development Bank that enabled it to repeatedly merge with other companies and construct large plants. As a result, it grew to a comprehensive semiconductor group that covers the range from designing to manufacturing (upstream and downstream) within a short period (Figure II-2-2-2-15). Semiconductor Manufacturing International Corporation (SMIC), which is the largest IC foundry in China with state-of-art technology,[119] has also received support from the Big Fund and other funds based on a core city such as Shanghai, and repeatedly invested near one trillion yen in affiliated companies, plants, and machinery & equipment, sharply expanding its production capacity (Figure II-2-2-2-16).

Figure II-2-2-2-14 Investment share by process at the "First Phase" by the Integrated Circuit Industry Investment Fund



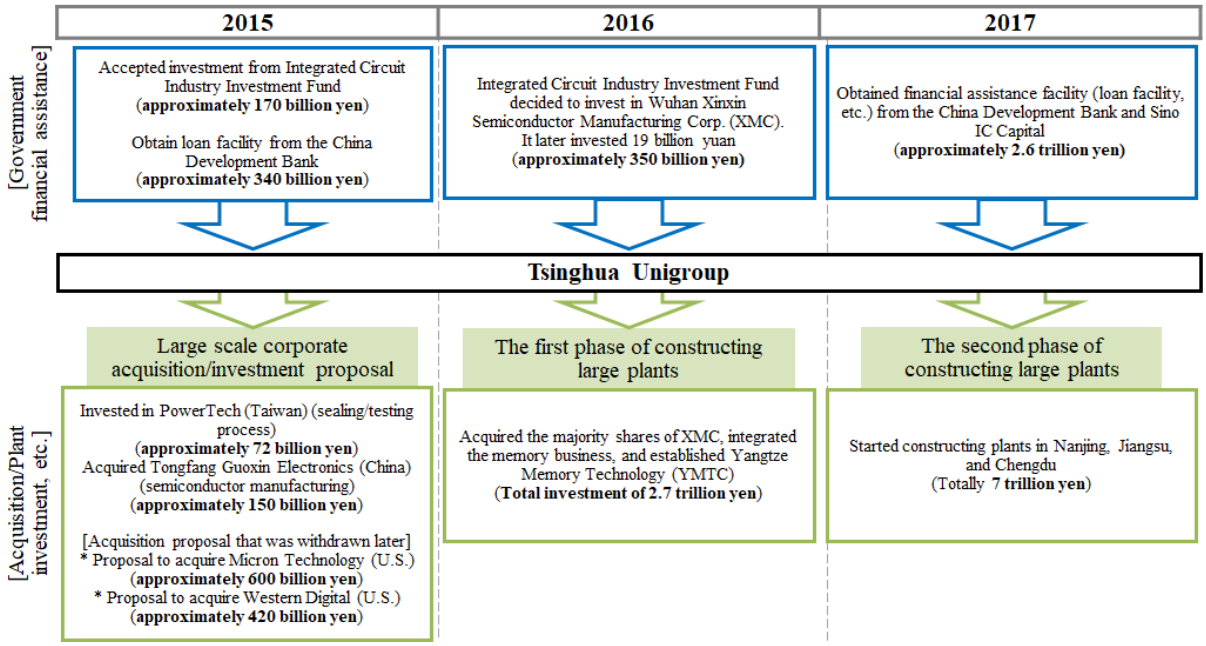
Source: Extracted from *FY2017 Seizo Kiban Gijutsu Jittaitou Chosa (Chugoku Seizogyou no Jittaiwo Fumaeta Wagakuni Seizogyono Sangyo Kyousouryoku Chousa)* (Ministry of Economy, Trade and Industry).

---

the Fund especially focuses on chip manufacturing, which has received at least 60% of the total investment." He added that, after making an investment, "The Fund sends a director and an auditor to an investee to improve the governance of the investee company," "The Fund also facilitates integration, restructuring, and structural reform conducted by the investee," "The Fund increases its engagement in important projects and is fully involved in the areas of strategy determination, capital use, and corporate governance," and "The fund asks the government to implement measures that provide benefit to the investee company."

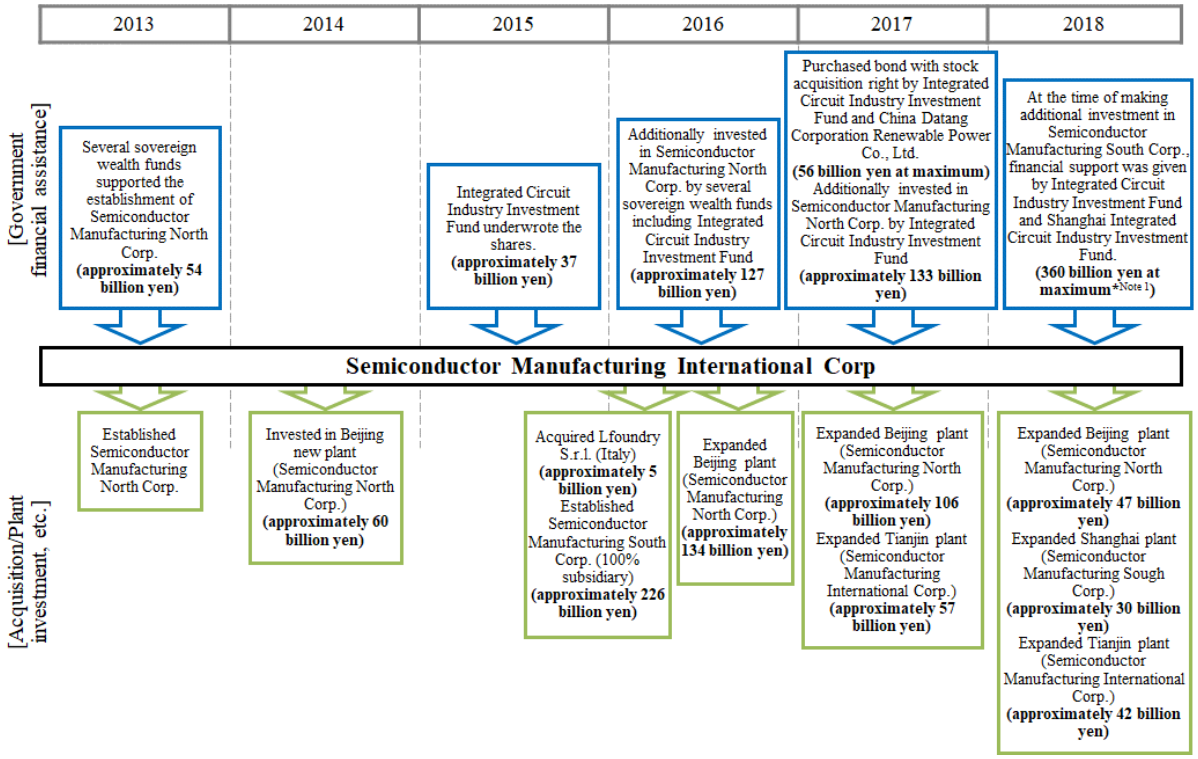
119 Ranked fifth in the world among IC foundries.

Figure II-2-2-2-15 Government financial support to semiconductor-related companies (example in Tsinghua Unigroup)



Source: Prepared by the Ministry of Economy, Trade and Industry based on *FY2017 Seizo Kiban Gijutsu Jittai Chosa (Chugoku Seizougyou no Jittaiwo Fumaeta Wagakuni Seizogyono Sangyo Kyousouryoku Chousa)* (Ministry of Economy, Trade and Industry), *Zephyr* (BvD), and various media reports.

Figure II-2-2-2-16 Government financial support to a semiconductor-related company (example in Semiconductor Manufacturing International Corporation)



Note 1: 360 billion yen of additional support includes contribution from SMIC.

Source: Prepared by the Ministry of Economy, Trade and Industry based on press release of SMIC, *FY2017 Seizo Kiban Gijutsu Jittai Chosa (Chugoku Seizougyou no Jittaiwo Fumaeta Wagakuni Seizogyono Sangyo Kyousouryoku Chousa)* (Ministry of Economy, Trade and Industry), and *Zephyr* (BvD).

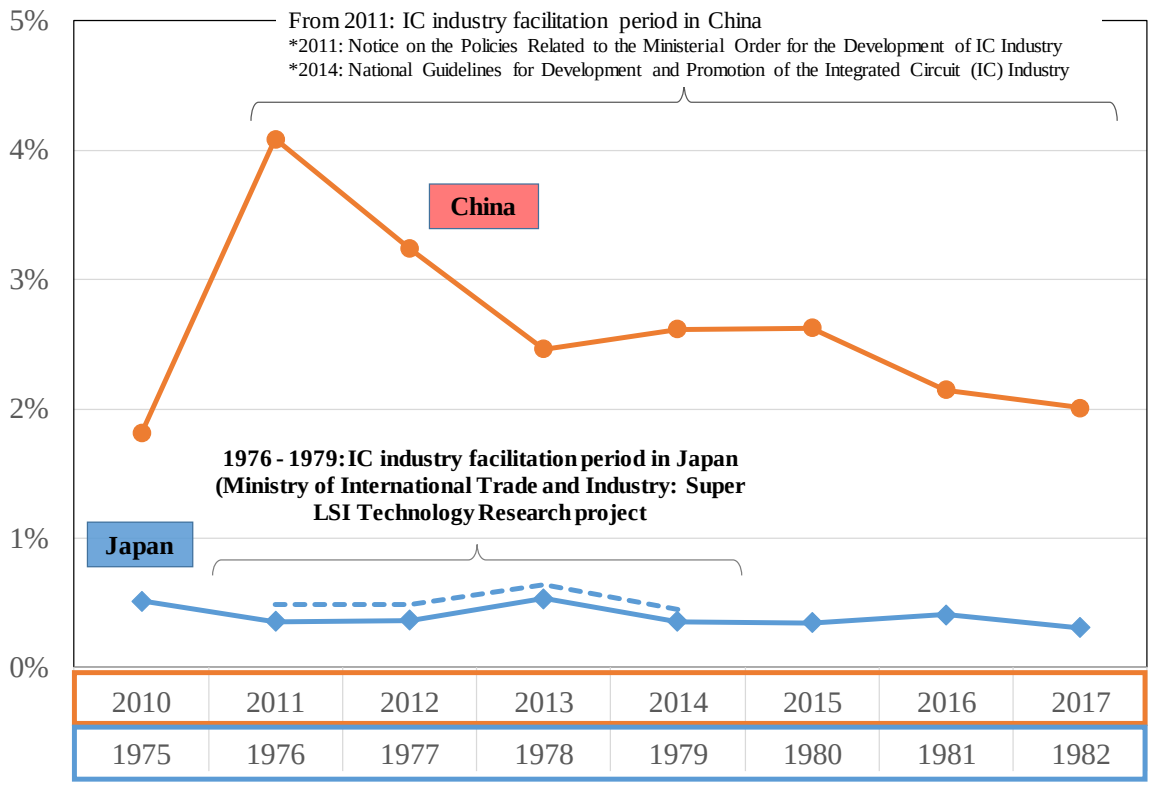
When we compare the scale of government support to the IC industry in Japan during the IC industry facilitation period (the late 1970's) and the current support provided by the Chinese government, it should be noted that the support by the Chinese government is larger. In the 1970's in Japan, the then Ministry of International Trade and Industry used the Large-Scale Technology Research Development System that was applied to the development of large computers to launch the Super LSI Technology Research Association (a four-year national project from 1976 through 1979). The Japanese government contributed 29 billion yen to the Association in the above four years.[120] On the other hand, when we look at a support by the Chinese government, the scale of funds provided by the Big Fund reached 138.7 billion yuan (approximately 2.3 trillion yen) only in the first phase. As mentioned above, when including government subsidies and other forms of financial assistance, the scale is huge. We again list a graph included in *2018 White Paper on International Economy and Trade* that compares the government subsidy to IC industry-related companies by Japan and China (Figure II-2-2-2-17). While the current government subsidy to IC industry-related companies by the Chinese government is two to four percent against sales,[121] the ratio of subsidy to IC industries by the Japanese government during the IC industry facilitation period[122] is estimated at less than 0.7% at maximum. This fact proves that the Chinese government subsidy to the IC industry is large compared to that by the Japanese government in the past.

120 Please refer to Y. Okuyama (2001), "*HANDOTAINO REKISHI - SONO 20: 20 SEIKI-KOHAN CHO-LSI ENO MICHI - Super LSI Technology Research Association (1),*" SEAJ Journal September 2011, No. 134.

121 Prepared based on annual reports of top 19 Chinese listed companies related to IC in terms of market capitalization and *Securities Research Report* by Zhongtai Securities Co., Ltd. Please refer to page 179 of *2018 White Paper on International Economy and Trade*.

122 The survey was conducted in relation to five companies participating in the Super LSI Technology Research Association (excluding joint ventures). Estimated based on the financial reports of the subject companies. Under the Japanese accounting standard, there are no basis laws that require to record a government subsidy in a financial statement; a subsidy is customarily recorded in other income (others) of non-operating income. Therefore, we use other income (others)/sales ratio as a ratio of government subsidy against sales. Other income (others) is recorded as a non-operating income item in a balance sheet. For the four-year period during which the project by the Super LSI Technology Research Association Business was conducted (1976 - 1979), the ratio of government subsidy against sales is calculated by dividing the government subsidy of 29 billion yen during that four-year period by the number of years and by total sales of five member companies. Then, we calculate the ratio of other income (others) against sales of each company and add the result to obtain the government subsidy in the highest case.

Figure II-2-2-2-17 Comparison of financial support to IC industry facilitation period by Japanese and Chinese governments (government subsidies/sales ratio)



Notes: 1. The data of China are calculated by dividing government subsidy in each year of Chinese listed top 19 IC-related companies in terms of market capitalization by total sales of these 19 companies.

2. The data of Japan indicated by the blue line are calculated by dividing the total of other income (others) of five member companies of the Super LSI Technology Research Association (excluding joint ventures) (Toshiba, NEC, Hitachi, Fujitsu, and Mitsubishi Electric) in each year (subsidy was customarily recorded in other income (others) of non-operating income under the then-current Japanese accounting standard) by total sales. For the data indicated by the blue broken line, the government investment to the Super LSI Technology Research Association (29 billion yen) equally divided by the Association business implementation period of four years is included in addition to other income (others) as a numerator, and total sales is used as a denominator. Then we calculated the ratio using such numerator and denominator.

Source: Prepared by the Ministry of Economy, Trade and Industry based on annual reports of the subject 19 companies and *Securities Research Report* by Zhongtai Securities Co., Ltd. for the data of China, and financial reports of the subject five companies for the data of Japan.

(5) Impact of various financial assistance

As explained above, China gives certain industries financial support using various tools such as subsidy, loan, and fund, and we confirm that such form of support is on an upward trend historically. We also confirm that the possibility of existence of non-apparent subsidies and loans with a potentially lower interest rate as well as companies that use a huge amount of sovereign wealth funds and loans exist.

Here, we would like to point out the following three impacts that are caused by the increase of

subsidy and other financial assistance. First, as indicated in the example in the Big Fund, there is the possibility that the government has increased its influential power to major companies (especially private companies) engaged in an advanced industry such as semiconductor and telecommunication through the government's financial assistance. Second, the government support could work as priming water to attract private money and a huge amount of capital would flow into a certain industry. As a result, excessive production would possibly occur. Third, a company that receives such a huge amount of money could use it for acquiring a foreign company that has an advanced technology.

3. Competing for dominance in the high-tech area

(1) Increasing importance of high-tech technological development

One of the factors intensifying the protectionism is technology competition for dominance in the high-tech area where many countries are competing fiercely for technology development.

The advanced technology such as AI, robots, and semiconductors is the area whose growth is expected to continue, and thus, many countries have made efforts to develop new technology and promote the industry in a strategic manner. Among them, the world has paid a great deal of attention to the next generation telecommunication standard (the fifth-generation mobile telecommunication standard/5G) in the telecommunication area that is one of the most advanced technologies, as 5G is expected to make a large innovative change in various areas such as social infrastructure, industry, daily life, and education, as well as bring a huge economic benefit.

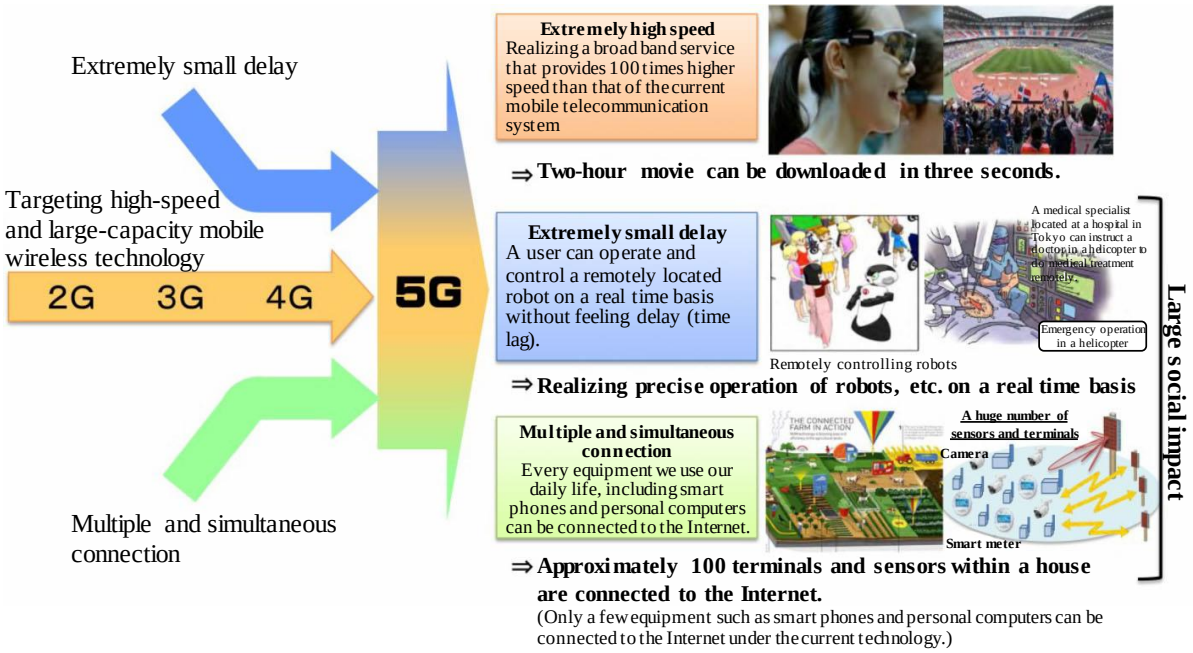
The major targeted performance of 5G telecommunication compared to the fourth generation is as follows: Extremely high speed with 100 times higher maximum telecommunication speed than that of the fourth-generation, super huge capacity, an extremely small delay with 1/10 delay time, and multiple and simultaneous connection with 100 times the pieces of equipment to be connected per base station.[123] In addition, it is aimed at realizing low cost and lower electricity consumption. Although 5G is a great technical achievement, it not only means improving the wireless access technology that is an important function of the existing telecommunication standard, but also is expected to play a core role as a telecommunication infrastructure that can support various application areas in an environment where new application areas using ICT (Information and Communication Technology) are expanding with the keywords of IoT (Internet of things) and M2M (Machine to machine).[124] The current number of devices that are connected to the Internet reaches several ten billion and that is expected to double by 2020.[125] Thanks to dissemination of 5G, commercialization of various services will be accelerated, such as artificial intelligence (AI), autonomous driving, robot technology, and remote medical treatment, and will also bring innovation in the existing industries. According to an estimate by IHS Markit, the impact of 5G technology to the world economy will be extremely large and continuous, and expand to every possible areas, reaching 12.3 trillion dollars by

123 *Survey of technology trends from patent application information in FY 2016 - Mobile Wireless Telecommunication System toward LET Advanced and 5G* (Patent Office, 2017), page 5.
124 *Survey of technology trends from patent application information in FY 2016 - Mobile Wireless Telecommunication System toward LET Advanced and 5G* (Patent Office, 2017), page 4.
125 *Survey of technology trends from patent application information in FY 2016 - Mobile Wireless Telecommunication System toward LET Advanced and 5G* (Patent Office, 2017), page 5.

2035.[126]

On the other hand, on the economic side, if a specific country overwhelms the competition on 5G technology, due to its diversified application areas, the country would have influence over various new growing industries that will emerge in the future. Furthermore, some countries pointed out that the 5G network could be misused by acquiring confidential information or spying activities, or attacking important social infrastructures such as autonomous driving, all of which could be threats to the national security. In this regard, the technology competition surrounding 5G is important not only from the economic viewpoint but also the national security viewpoint, which causes competition led by governments and intensifying competition.

Figure II-2-2-3-1 Technical changes featuring 5G



Source: *IoT JIDAINI MUKETA IDOUTAI TSUSHIN SEISAKUNO DOKO* (Ministry of Internal Affairs and Communications, November 2016).

(2) Technology development competition in the high-tech area

When we look at the current trend of the technology development competition in the high-tech area, we should focus on the emergence of China. In China, in 2015 the State Council announced Made in China 2025 that prescribes accelerating the meaningful growth of domestic industries in China in 10 strategic high-tech areas such as the next generation information technology including 5G, new materials, and bio-pharmaceuticals (Table II-2-2-3-2). This trends can be clearly seen from the increase of technology development expenditures. When we look at changes in R&D expenditures in each country, we find that China has remarkably increased the expenditures to catch up with the U.S., which ranks first (Figure II-2-2-3-3).

Next, we will review the technology acquisition condition of each country by the major high-tech

126 HIS Economics/HIS Technology (2017), "The 5G economy: How 5G technology will contribute to the global economy."

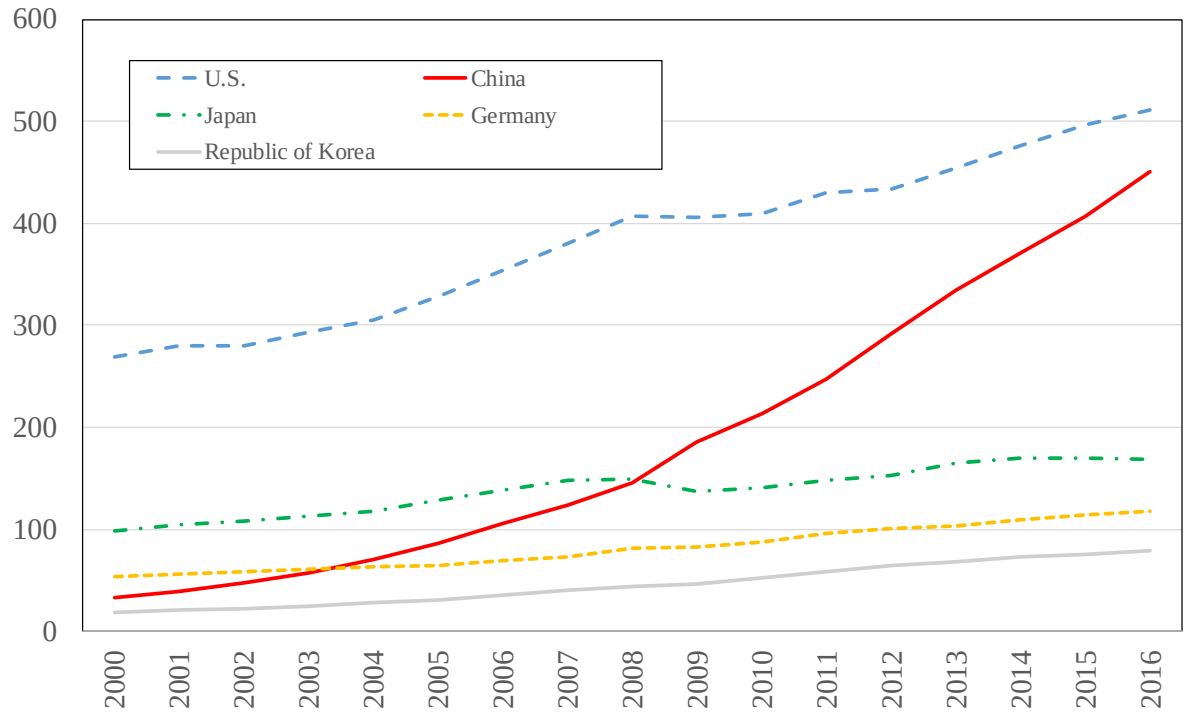
technology.

Table II-2-2-3-2 Focused ten areas under Made in China 2025

1	Next generation information technology
2	Advanced digital control machine tools/robots
3	Aviation and aerospace-related equipment
4	Marine construction machinery/high-tech ships
5	Advanced rail transit systems
6	Energy-saving/new energy cars
7	Power generation equipment
8	New materials
9	Bio-pharmaceutical/high performance medical devices
10	Agriculture machinery and equipment

Figure II-2-2-3-3 Changes in R&D expenditures by individual countries

(Billion dollars)



Source: Stat database (OECD).

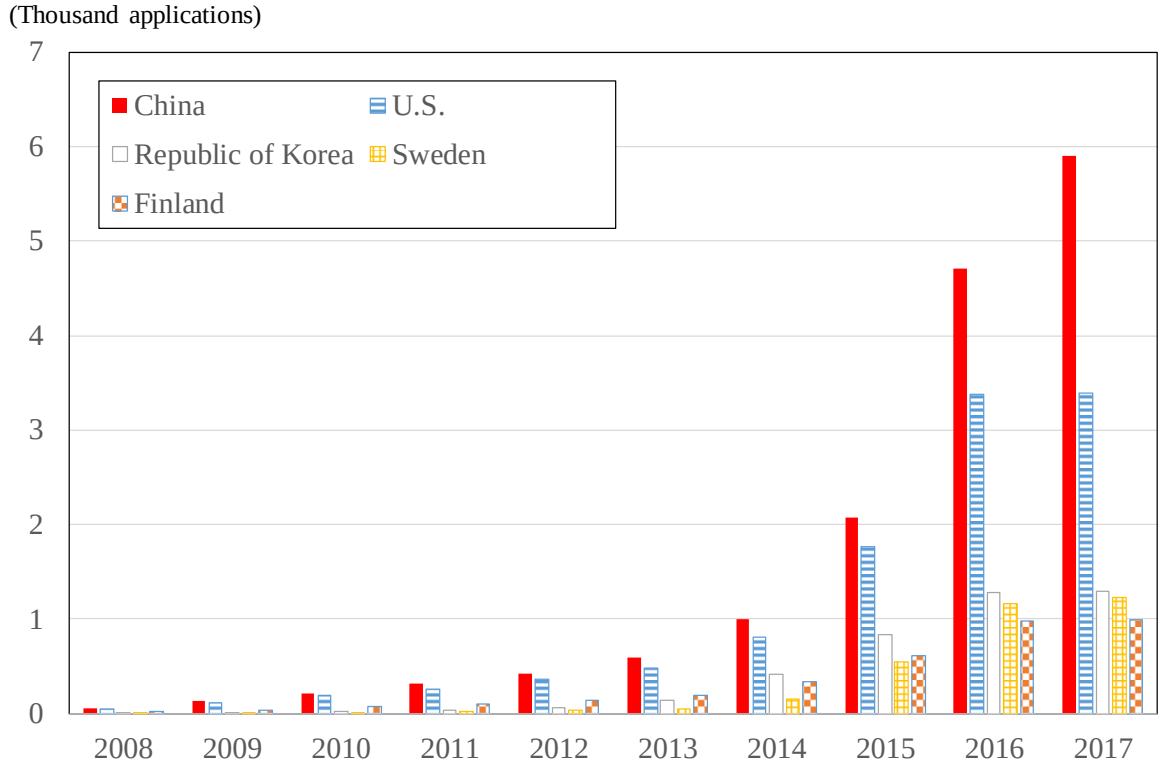
(i) 5G-related patents

When we look at the number of applications of patents related to 5G[127] by country using Orbis

127 To understand the current situation, it includes the number of applications before approval. It also includes patents that are held by a patent sale or through M&A, etc. (Extracted the patents that fall into all the following (i) to (iv) conditions from Orbis IP [as of February 4, 2019]: (i) The application year or the priority year is 2008 or later; (ii) it has already been approved or under application; (iii) IPC category is H04; and (iv) The description "5G" exists in an official bulletin.

Intellectual Property database provided by Bureau van Dijk (in 10 years from 2008 to 2017) (Figure II-2-2-3-4), the number of patent applications whose patentee (i.e. final parent company; the same shall apply hereinafter) are Chinese companies has shown a sharp increase to remarkably exceed the number of patent applications by U.S. companies. On the other hand, in terms of patent appraisal value[128] (Figure II-2-2-3-5), the appraisal value of patents whose patentees are Chinese companies has not increased in compared with the increase in the number of patent applications, and the appraisal value of patent whose patentees are U.S. companies is significantly high and remarkably exceeds that of Japanese companies, which rank second.

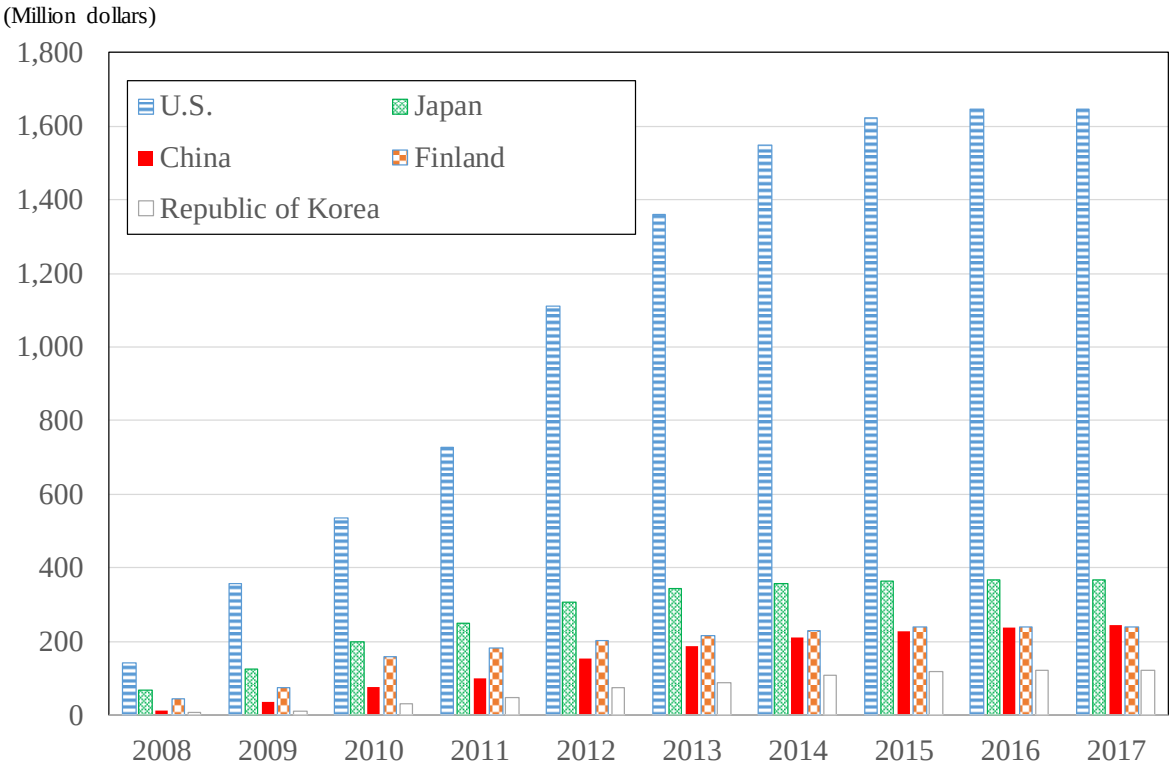
Figure II-2-2-3-4 The accumulated number of patent applications related to 5G by country (top five countries)



Note: Country means the country to which the patentee (final parent company) belongs. In the case of a patent group that forms a family, one patent family is counted as one patent (as of February 4, 2019). Includes patents under application. Due to delay of registering the data in the database and a different timing of switching to PCT application by each country in and after 2016, the graph may not show all the application data.
Source: *Orbis-IP* (BvD).

128 Aggregated the estimate (the estimate of patent appraisal value calculated by IP Business Information using the market approach) provided by BvD for each patent or patent family.

Figure II-2-2-3-5 Accumulated patent appraisal value related to 5G by country (top five countries)



Note: Country means the country to which the patentee (final parent company) belongs. The patent appraisal value is calculated by aggregating the estimate provided by BvD for each patent or patent family (as of February 4, 2019). Includes patents under application. Due to delay of registering the data in the database and a different timing of switching to PCT application by each country in and after 2016, the graph may not show all the application data.
Source: *Orbis-IP* (BvD).

When we examine the number of patent applications and appraisal value of patents related to 5G by company (final parent company; the same shall apply hereinafter) (as of February 4, 2019) (Table II-2-2-3-6), the top ten companies in the number of patent applications include four Chinese companies and two U.S. companies. On the other hand, in terms of appraisal value, the top three are dominated by the U.S. companies, and only one company (Huawei) ranks fifth among the top ten companies. For Japan, one company ranks 10th in terms of the number of applications and two companies rank 9th and 10th in terms of appraisal value.

Then, when we look at the R&D expenditures by company, Huawei, which ranks first in the number of patent applications related to 5G, has spent 394 billion yuan (approximately 6,812.3 billion yen) in the last ten years, and publicly announced that it plans to make R&D investment at the level of 15 to 20 billion-dollar per year (approximately 1,665 billion to 2,220 billion yen) in the future.[129] It is estimated that Intel, which ranks second, and Ericsson, which ranks third, have spent about 13 billion

129 Huawei Japan website.
(https://www.huawei.com/jp/about-huawei/publications/huawave/31/hw31_exploration_lights)

dollars and about 500 million dollars in FY 2017, respectively.[130] These facts prove that top companies in terms of the number of patent applications have spent a huge amount of R&D expenditures. This also suggests that increasing R&D expenditures by Chinese companies as mentioned above could lead to expanding presence of China in the high-tech area.

On the other hand, comparison of the number of applications and appraisal value of patent shows that, in the 5G area, although China has remarkably increased the number of related patent applications, it is still largely left behind the U.S. in patent appraisal value. However, given a large increase of R&D expenditures in China, we cannot deny that China has the potential to show a larger presence in terms of patent quality. It should be noted that as the patent appraisal value significantly varies depending on timing and purpose of appraisal, as well as appraisal parties, and you should use the appraisal value indicated here as one set of reference data.

As competition surrounding 5G has a different aspect from the patent viewpoint, we will describe the power map of the telecommunication infrastructure market. When 5G is commercialized, it is dispensable to establish telecommunication infrastructure including a core facility such as a portable base station and wireless connection network. Therefore, another important factor is to acquire the mobile telecommunication infrastructure market. According to a survey by IHS Markit, China dominates about 40% of the mobile telecommunication infrastructure market in 2017 (including 2G, 3G, LTE, and 5G), the largest share by country in the world (Figure II-2-2-3-7).

130 Extracted from BvD Orbis Database.

Table II-2-2-3-6 Top companies with the number of applications and appraisal value of 5G-related patents

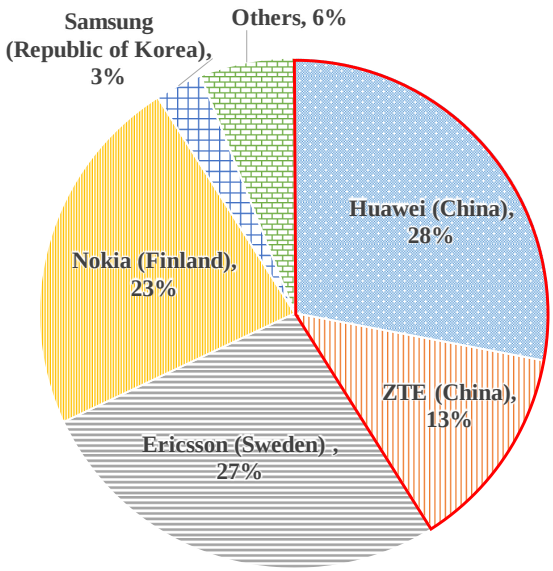
Top 10 companies in terms of number of patent applications		
	Company name	Nationality
1	Huawei	China
2	Intel	U.S.
3	Ericsson	Sweden
4	Samsung Electronics	Republic of Korea
5	Nokia	Finland
6	Qualcomm	U.S.
7	ZTE	China
8	Chinese state-owned companies, etc.	China
9	Oppo	China
10	Sony	Japan

Top 10 companies in terms of total patent appraisal value		
	Company name	Nationality
1	Intel	U.S.
2	Qualcomm	U.S.
3	Nokia	Finland
4	Apple	U.S.
5	Huawei	China
6	Flextronics	Singapore
7	Samsung Electronics	Republic of Korea
8	Ericsson	Sweden
9	Panasonic	Japan
10	Sony	Japan

Note: Nationality is determined based on the country to which the patentee (final parent company) belongs. In the case of a patent group that forms a family, one patent family is counted as one patent. The total appraisal value is aggregated for each patent or patent family using the estimate provided by BvD. Includes patent under application (As of February 4, 2019).

Source: *Orbis-IP* (BvD).

Figure II-2-2-3-7　Market share of mobile telecommunication infrastructure (2017)



Source: IHS Markit.

(ii) Lithium-ion batteries

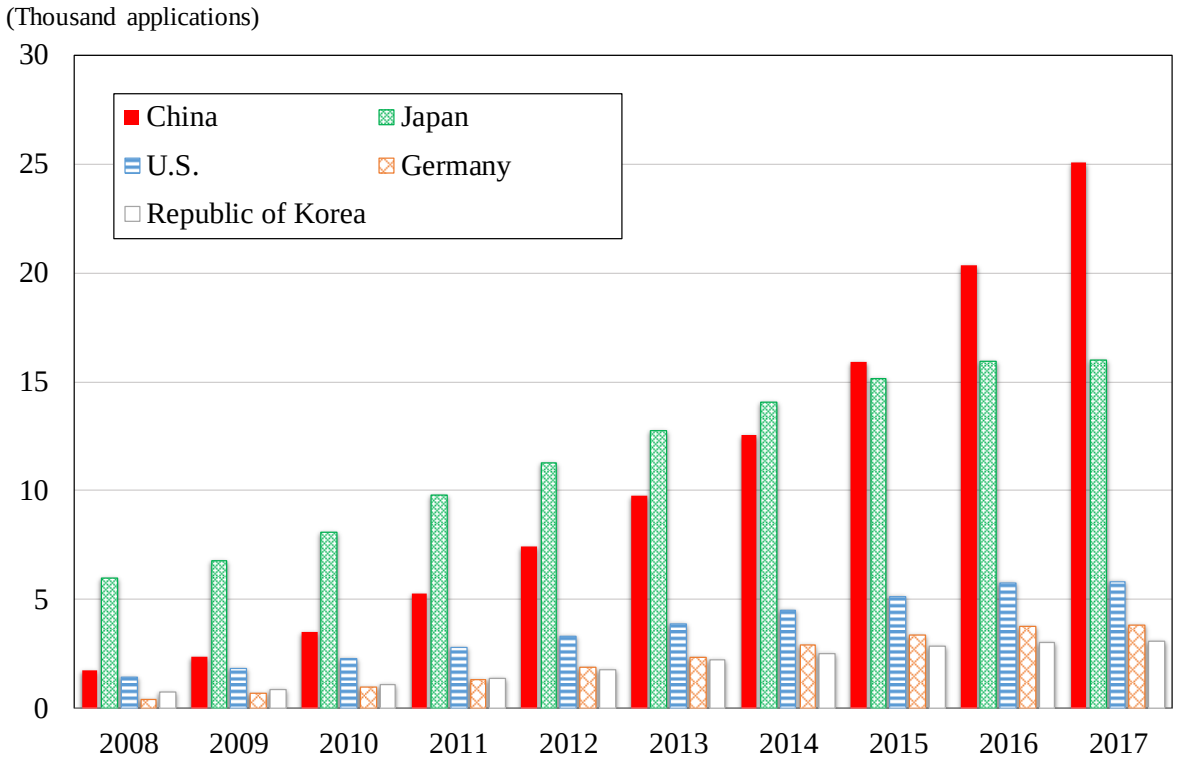
Similar to 5G, another advanced technology for which many countries have competed for technology development is lithium-ion batteries. We will examine the number of patent applications and patent appraisal value by country, and corporate ranking in this field. In the lithium-ion battery-related field,[131] Japan ranked first by 2014 for the number of patent applications. However, after that, Japan lost the lead and China has ranked first and significantly increased the number of applications (Figure II-2-2-3-8). On the other hand, when we look at the patent appraisal value, China has not increased the appraisal value compared with the number of applications in this field, and Japan keeps the lead and ranks first in the world (Figure II-2-2-3-9). In the corporate ranking, while four Chinese companies are included in the top ten companies in number of applications, no Chinese company places in the top ten companies in patent appraisal value. On the other hand, while four Japanese companies are included in the top ten in the number of applications, seven companies are listed in the top ten in patent appraisal value (Table II-2-2-3-10).

As explained above, when we look at lithium-ion battery-related patents, although the number of patent applications by Chinese companies has significantly increased, the patent appraisal value has not shown high growth, which suggests that China is still struggling in terms of quality. On the other hand, when we look at the market share in the in-vehicle lithium-ion battery that dominates (constitutes a majority of) market share and shows a significant increase, the share of supply volume

131 To understand the current situation, it includes the number of applications before approval. It also includes patents that are held by a patent sale or through M&A, etc. (Extracted the patents that fall into all the following (i) to (iv) conditions from Orbis IP [as of January 30, 2019]: (i) The application year or the priority year is 2000 or later; (ii) it has already been approved or under application; (iii) IPC category is H01, H02, C01, C08, or B60; (iv) The description “lithium ion battery” or “li ion battery” exists in an official bulletin.)

by Chinese companies is larger compared to that of patent appraisal value of entire lithium-ion battery (Figure II-2-2-3-11).

Figure II-2-2-3-8 The accumulated numbers of lithium-ion battery-related patent applications by country (top five countries)

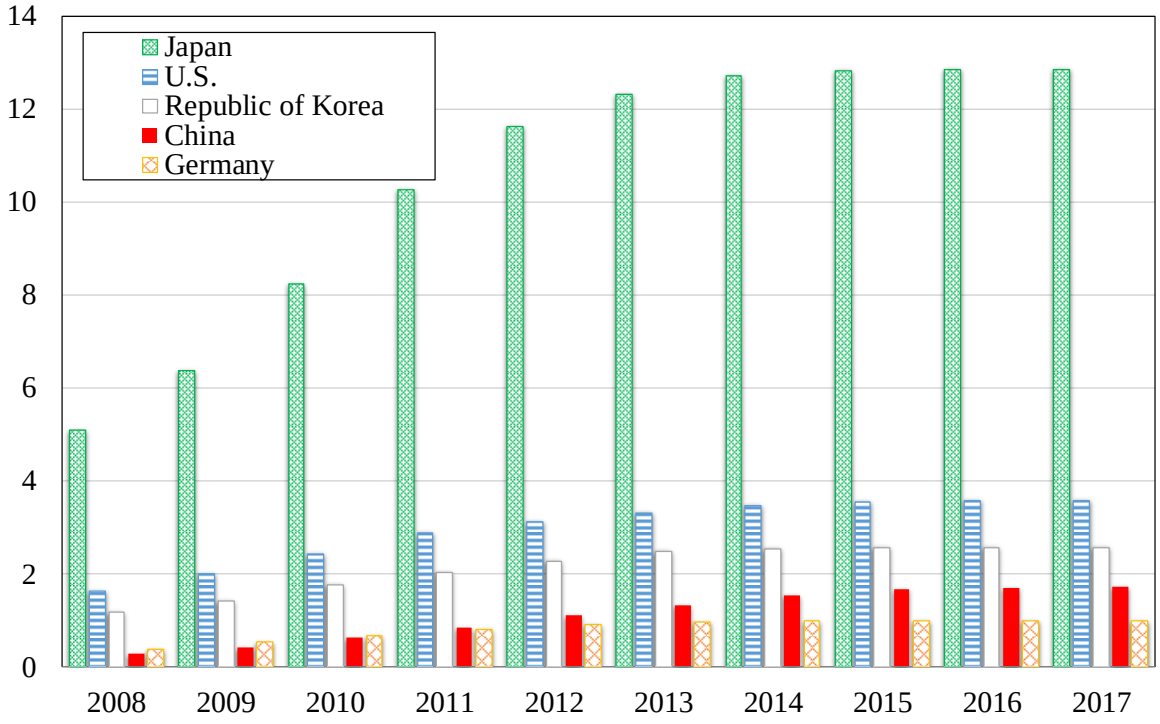


Note: Country means the country to which the patentee (final parent company) belongs. In the case of a patent group that forms a family, one patent family is counted as one patent (as of January 30, 2019). Includes patent under application. Due to delay of registering the data in the database and a different timing of switching to PCT application by each country in and after 2016, the graph may not show all the application data.

Source: *Orbis-IP* (BvD).

Figure II-2-2-3-9 The accumulated appraisal value of lithium-ion battery-related patents by country (top five countries)

(Billion dollars)



Note: Country means the country to which the patentee (final parent company) belongs. The patent appraisal value is calculated by aggregating the estimate provided by BvD for each patent or patent family (as of January 30, 2019). Includes patents under application. Due to delay of registering the data in the database and a different timing of switching to PCT application by each country in and after 2016, the graph may not show all the application data.

Source: *Orbis-IP* (BvD).

Table II-2-2-3-10 Top 10 companies in the number of applications and appraisal value of patents related to lithium-ion batteries

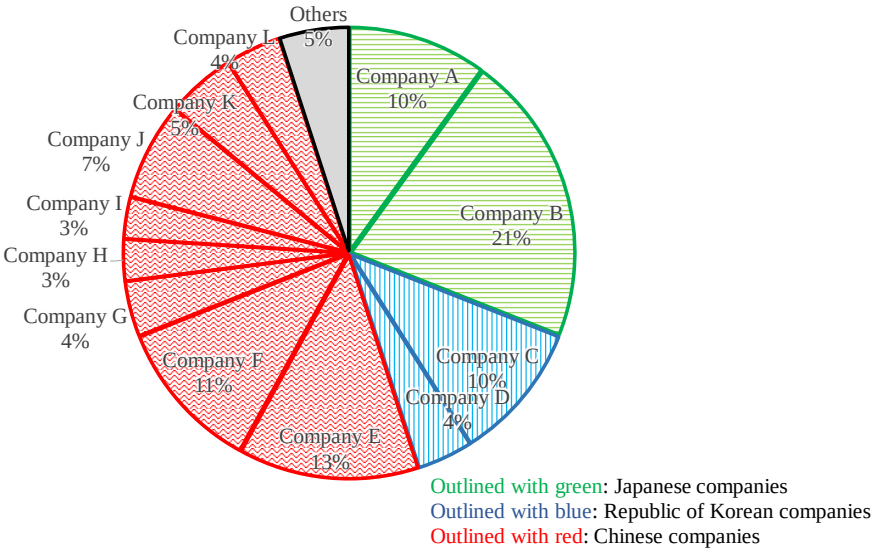
Top companies in terms of the number of applications		
	Company name	Nationality
1	Toyota	Japan
2	Bosch	Germany
3	China state-owned companies, etc.	China
4	Panasonic	Japan
5	Samsung SDI	Republic of Korea
6	TDK	Japan
7	BYD	China
8	Lishen Battery	China
9	Guoxuan High-tech	China
10	Nissan Motor	Japan

Top companies in terms of the total patent appraisal value		
	Company name	Nationality
1	Toyota	Japan
2	LG Chemical	Republic of Korea
3	Samsung SDI	Republic of Korea
4	Panasonic	Japan
5	Semiconductor Energy Laboratory	Japan
6	Nissan Motor	Japan
7	Sony	Japan
8	Toray	Japan
9	GM	U.S.
10	Hitachi	Japan

Note: Nationality is determined based on the country to which the patentee (final parent company) belongs. In the case of a patent group that forms a family, one patent family is counted as one patent. The total appraisal value is aggregated for each patent or patent family using the estimate provided by BvD. Includes patents under application (As of January 30, 2019).

Source: *Orbis-IP* (BvD).

Figure II-2-2-3-11 Market share of in-vehicle lithium batteries (2016)



Source: Extracted from *JIDOSHA SHINJIDAI SENRYAKU KAIGI* (1st meeting) material (Ministry of Economy, Trade and Industry, 2018).

(iii) Artificial Intelligence (AI)

In 2017, the State Council of the PRC announced that it aims at leading the world in the AI theory, technology, and application fields by 2030 under the Next Generation AI Development Plan, and establishing the AI industry with funding on the scale of one trillion-yuan (approximately 16.5 trillion yen).[132] According to the Plan, the market scale is expected to exceed 150 billion yuan (approximately 2.5 trillion yen) in 2020,[133] and the AI industry is expected to more than double to 400 billion yuan in 2025 in collaboration with universities, research institutes, private companies, and military agencies, fostering AI professionals and scientists, and promoting cross-disciplinary studies in existing academic fields and AI.

According to an AI report[134] prepared by the World Intellectual Property Organization (WIPO), in the ranking of the number of AI-related patent applications, the top two are U.S. companies, and six among the top 10 are Japanese companies (Table II-2-3-3-12). No Chinese company appears among the top 20 companies.

On the other hand, when we look at the number of patent applications related to AI that are submitted by universities and public research institutes, eight institutes among the top 10 institutes are Chinese ones, and the remaining two are from Republic of Korea (Table II-2-3-3-13). Furthermore, when we look at the top 500 applicants of AI-related patent applications, while universities and public research institutes in the U.S. and Republic of Korea are approximately 20, respectively, Chinese universities and public research institutes are more than 100, overwhelming numbers. This indicates that AI-related patent applications by research institutes are dominated by China (Figure II-2-3-3-14).

132 Calculated at the exchange rate of 1 yuan = 16.5 yen.
133 Calculated at the exchange rate of 1 yuan = 16.5 yen.
134 *Technology Trends 2019* "Artificial intelligence" (WIPO).

Table II-2-2-3-12 Top companies in the number of patent applications related to AI

	Company name	Country	No. of applications
1	IBM	U.S.	8,290
2	Microsoft	U.S.	5,930
3	Toshiba	Japan	5,223
4	Samsung	Republic of Korea	5,102
5	NEC	Japan	4,406
6	Fujitsu	Japan	4,303
7	Hitachi	Japan	4,233
8	Panasonic	Japan	4,228
9	Canon	Japan	3,959
10	Alphabet	U.S.	3,814

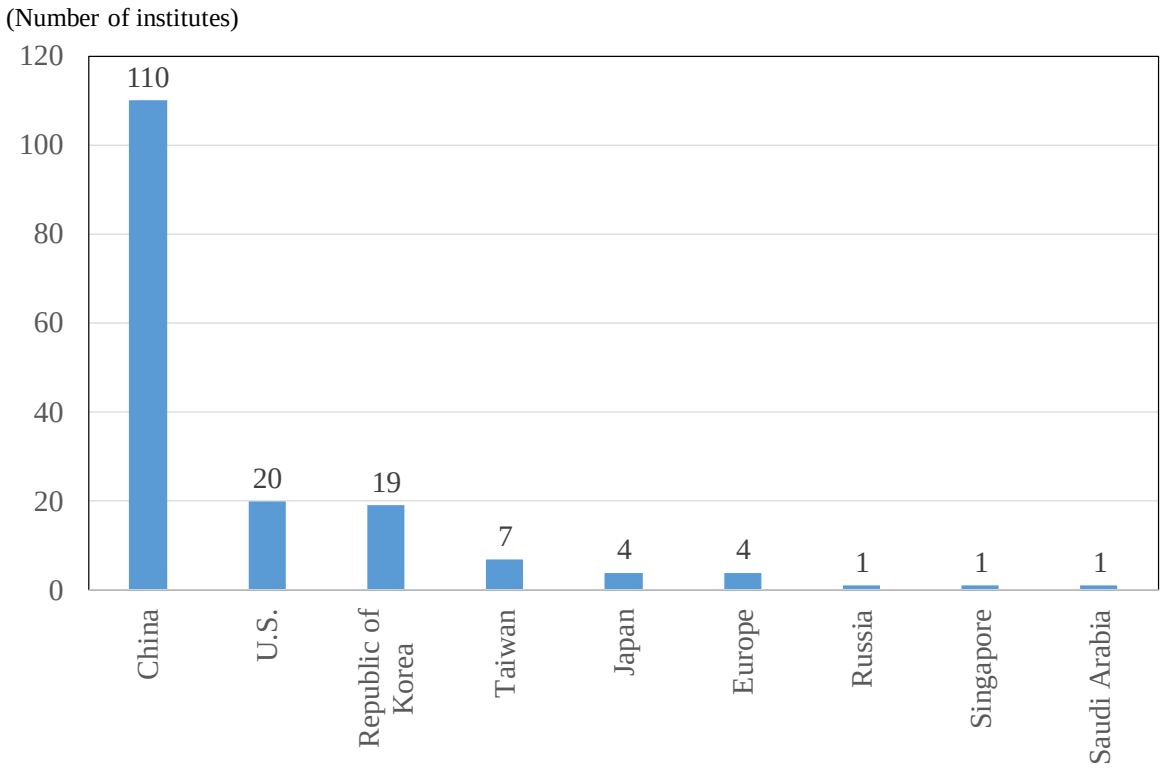
Source: *Technology Trends 2019* (WIPO).

Table II-2-3-3-13 Top universities and public research institutes in the number of patent applications related to AI

	Institute name	Country	No. of applications
1	Chinese Academy of Sciences	China	2,652
2	Electronics and Telecommunications Research Institute	Republic of Korea	1,936
3	Xidian University	China	1,423
4	Zhejiang University	China	1,394
5	IACF	Republic of Korea	1,281
6	Beijing University of Technology	China	1,190
7	Tsinghua University	China	1,172
8	Beihang University	China	1,026
9	Chongqing University	China	996
10	Tianjin University	China	922

Source: *Technology Trends 2019* (WIPO).

Figure II-2-2-3-14 The number of universities and research institutes among top 500 applicants of AI-related patent applications by country/region



Source: *Technology Trends 2019* (WIPO).

(3) High-tech technology of Japan, US, and China

As explained above, China has increased its presence in patent applications and the market share in the high-tech field. The background of this trend is that the Chinese government announced Made in China 2025, a national strategy for fostering the high-tech industry to tackle technology acquisition and industry development in the high-tech field as a country as a whole. The U.S. has positioned China's national strategy as an effort to threaten its advantageous position in the advanced technology area not only from an economic viewpoint but also from a national security viewpoint, and has heightened the sense of crisis. The U.S. Department of Defense pointed out in a report issued in September 2018 [135] that China focuses on establishing a leading position in the areas of semiconductors, chip materials, and satellites that can be dual use between the private and military sectors, and invested in the advanced basic technology such as artificial intelligence, robots, and autonomous driving that can be widely used in both the private and military sectors. In November 2018, the U.S.-China Economic and Security Review Commission (USCC) issued its annual report, warning that a series of policies executed by the Chinese government for innovation and technology intend to establish a core position in the subject field on a global basis, and may significantly impact the competitive power and the national security of the U.S.

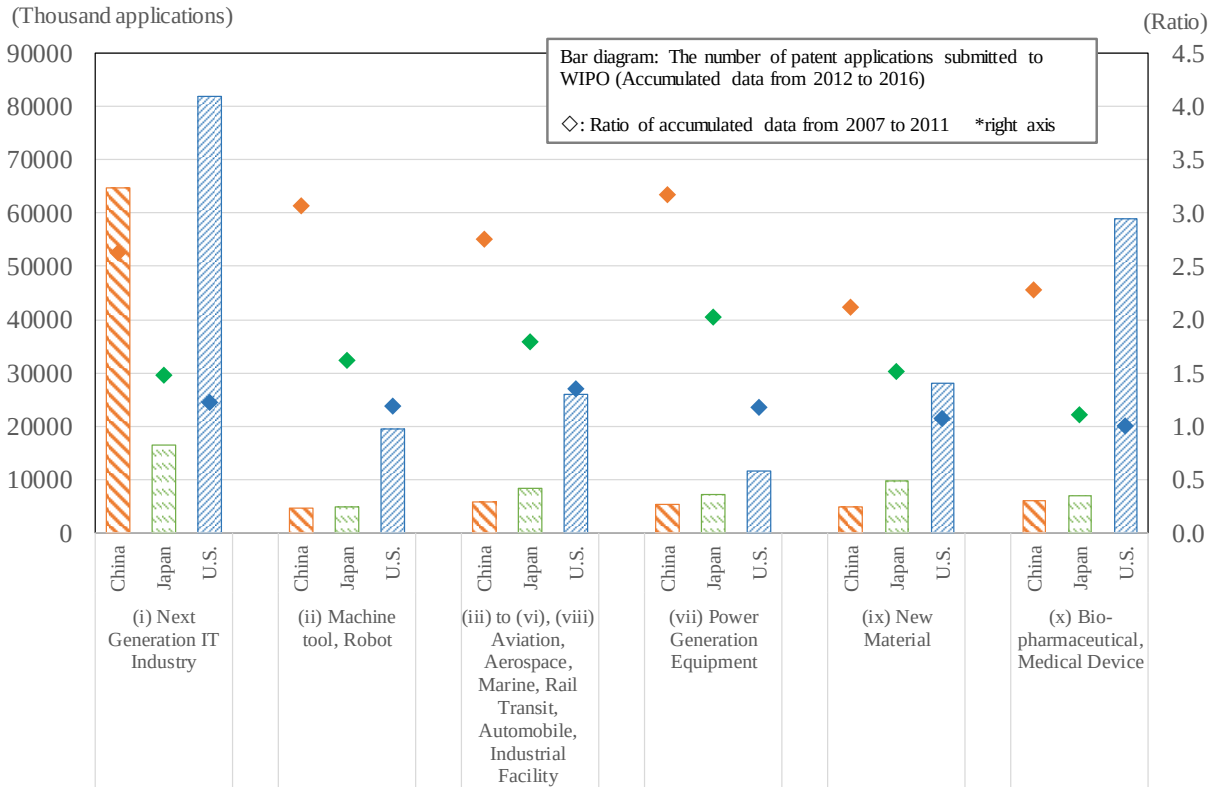
In the above (2), we examined the patent applications in individual high-tech fields such as 5G,

135 *Assessing and strengthening the manufacturing and defense industrial base and supply chain resiliency of the United States* (U.S. Department of Defense, August 2018).

lithium-ion batteries, and AI. Next, we will compare the number of patent applications and the patent appraisal value of Japan, the U.S., and China along in line with priority areas under Made in China 2025. Comparison is made on the number of patent applications submitted to WIPO and the patent appraisal value by companies in Japan, U.S., and China (final parent) in the five years from 2012 to 2016, using the database provided by Bureau van Dijkof[136] (Figure II-2-2-3-15, Figure II-2-2-3-16). These charts indicate that although China has generally increased its presence in terms of the number of applications in the focused areas under Made in China 2025, its patent appraisal value is still significantly lower compared to that of Japan and the U.S. It is also apparent that China specifically focuses on the next IT industry field, as proven by the number of patent applications and the patent appraisal value also being concentrated on the next IT industry fields. On the other hand, the patent appraisal value of Japan is unproportionally higher than its number of applications compared to the U.S. and China. For checking the growth rate of the number of applications and the appraisal value of each country, Figure II-2-2-3-15 and Figure II-2-2-3-16 also show how the number of patent applications and the patent appraisal value grew by comparing the data in the five years from 2007 to 2011 with that in the next five years from 2012 to 2016. In all the fields, the growth rate of China is higher than that of Japan and the U.S., in both the number of applications and the appraisal value, suggesting that China may catch up with Japan and the U.S. not only in the number of applications but also the appraisal value in the future. Additionally, as it is expected that digital technology and the real industries will become more unified, the emerging presence of China that has strength in the next generation IT industry may quickly extend to other fields.

136 We aggregated the data of patents from Orbis IP that fulfill the following conditions (i) and (ii) by WIPO technology category [as of February 4, 2019]: (i) The priority year is from 2008 to 2017; and (ii) the patent is approved or under application.

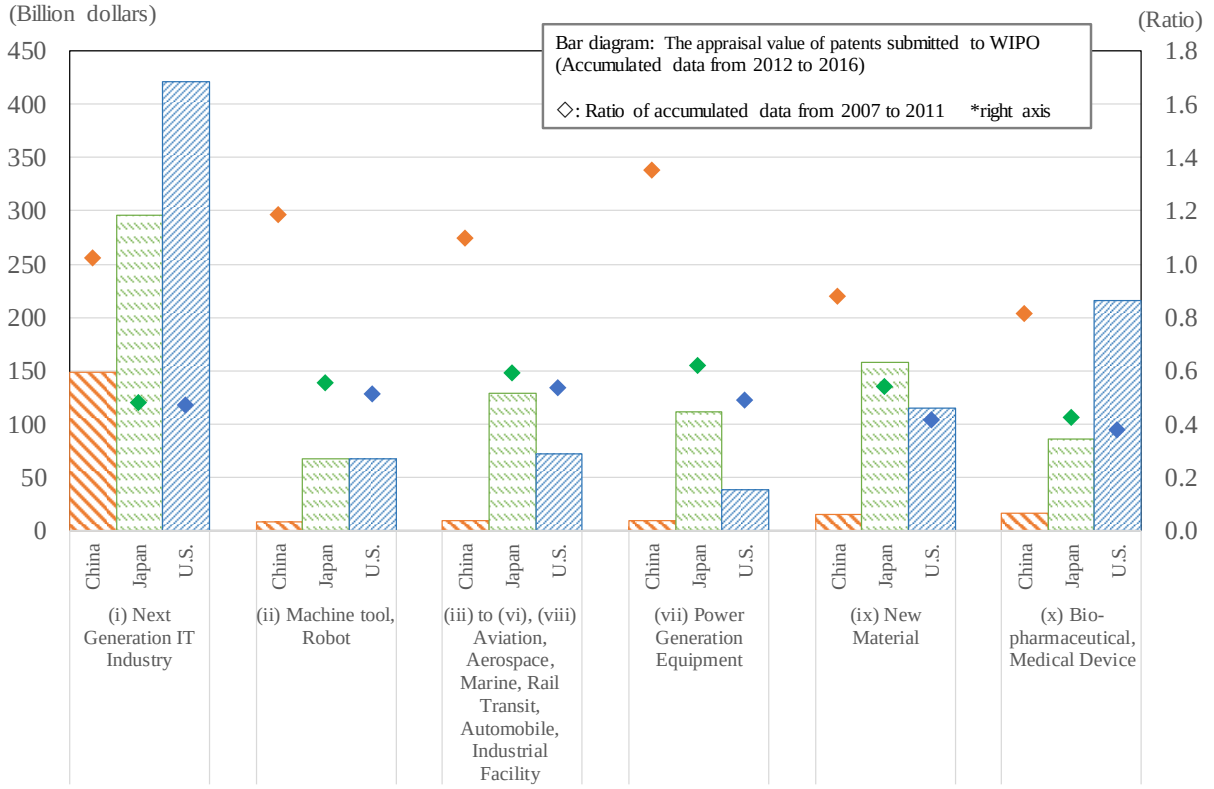
Figure II-2-2-3-15 Comparison of the number of patent applications to WIPO by companies in Japan, the U.S., and China (accumulated from 2012 to 2016)



Note: Country means the country to which the patentee (final parent company) belongs. The number of patent applications is calculated by aggregating the estimate provided by BvD for each patent (as of March 15, 2019). Includes patents under application.

Source: *Orbis-IP* (BvD).

Figure II-2-2-3-16 Comparison of the appraisal value of patents submitted to WIPO by companies in Japan, the U.S., and China (aggregated in a parent company from 2012 to 2016)



Note: Country means the country to which the patentee (final parent company) belongs. The patent appraisal value is calculated by aggregating the estimate provided by BvD for each patent (as of March 15, 2019). Includes patents under application.

Source: *Orbis-IP* (BvD).